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# BMJ Open

## Developing an evidence framework and assessing the evidence on migrant health research in Malaysia: a scoping review

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1 TITLE

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5 1 **Developing an evidence framework and assessing the**  
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9 2 **evidence on migrant health research in Malaysia: a**  
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12 3 **scoping review**  
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## ABSTRACT

## Abstract

**Background:** A large number of international migrants in Malaysia face challenges in procuring proper health, the extent of which is still relatively unknown. This study aims to explore the current status and composition of migrant health research in Malaysia, and to establish a framework to assess the quality of the academic literature.

**Methods:** A scoping review was conducted, whereby six databases – each database's inception date to 17 September 2019 – were searched. Studies were eligible for inclusion if they were conducted in Malaysia, peer-reviewed, fitted in the Bay Area Regional Health Inequities Initiative (BARHII) framework, and targeted the vulnerable international migrant population. Data was extracted by using the BARHII framework and a self-developed decision tree to identify the type of study design and corresponding level of evidence. The Joanna Briggs Institute (JBI) critical appraisal tools were modified and used to assess study quality, and a multiple-correspondence analysis (MCA) was conducted to identify associations between type of migrant, health dimension, research design, and study quality.

**Results:** 67 publications met the selection criteria and were included in the study. The majority (n=41) of studies included foreign workers. Over two-thirds (n=46) focused on disease and injury, and a similar number (n=46) had descriptive designs. The average quality of the papers was low, yet, differed significantly between research designs and health dimensions. The MCA showed that high quality studies were mostly qualitative designs that included refugees and focused on living conditions, while prevalence and analytical cross-sectional studies were mostly low quality.

## ABSTRACT

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43 **Conclusion:** This study makes methodological contributions to the field of migrant health  
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6 44 research and shows research gaps in different health dimensions among migrants in Malaysia.  
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8 45 Researchers should address these gaps to improve the evidence base on migrant health in  
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10 46 Malaysia to support policymakers with high quality evidence for decision-making.  
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14 47 **Key Words:** Malaysia, migrant, health, refugee, foreign worker, disease, research design,  
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16 48 evidence level, methodological research  
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## 22 50 **Article summary**

### 23 24 25 51 **Strengths and limitations of this study**

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28 52 • This study provides a comprehensive overview of the migrant health evidence base in  
29  
30 53 Malaysia, including a summary table, critical assessment tables, and a multiple-  
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32 54 correspondence analysis (MCA).  
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35 55 • Methodological contributions by creating an evidence assessment framework,  
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37 56 including modified Joanna Briggs Institute (JBI) checklists and a decision tree that  
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39 57 identifies the type of study design and corresponding level of evidence.  
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42 58 • Exclusive focus on vulnerable migrant populations within the non-citizen community  
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44 59 in Malaysia.  
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47 60 • Only English peer-reviewed academic articles were included in this study, and,  
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49 61 therefore, much relevant information that could potentially be used to inform both  
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51 62 policies and practice could have been excluded from this review  
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## 63 Introduction

64 Worldwide, the international migrant population accounts for 258 million people, with almost  
65 one-third within Asia.<sup>1</sup> Due to its strategic geographic location and high labour demand,  
66 Malaysia is among the top destination countries for international migrants in the Asian  
67 region.<sup>2</sup> According to the Department of Statistics Malaysia (DOSM), the documented non-  
68 citizen population represents 3.2 million people in 2019, 10% of Malaysia's total population.<sup>3</sup>  
69 DOSM defines a non-citizen as a person that resides in Malaysia for six months or more in  
70 the reference year.<sup>4</sup> However, no subcategories are included in this definition. According to  
71 the Office of the United Nations High Commissioner for Human Rights (OHCHR), a non-  
72 citizen is an individual that does not have an effective connection with the location where the  
73 person is situated according to the host nation, and includes various types of migrants, such  
74 as foreigners with permanent residency, refugees, asylum seekers, foreign labour,  
75 international students, stateless individuals, and victims of human trafficking.<sup>5</sup>  
76  
77• The vast majority of non-citizens in Malaysia are migrant workers, where foreign labour can  
78 be divided according to their visa status into regular migrant workers and irregular migrant  
79 workers. Regular migrant workers – also known as documented or legal migrant workers –  
80 can be defined as *“a migrant worker or members of his or her family authorised to enter, to*  
81 *stay and to engage in a remunerated activity in the State of employment pursuant to the law*  
82 *of that State and to international agreements to which that State is a party.”*<sup>6(p. 29)</sup> Irregular  
83 migrant workers – referred to as undocumented or illegal workers – can be defined as  
84 *“migrant workers or members of their families, who are not authorised to enter, to stay or to*  
85 *engage in employment in a state.”*<sup>6(p. 102)</sup> According to the Ministry of Home Affairs  
86 (MOHA), Malaysia issued 2 million work permits to documented migrant workers in 2019.<sup>7</sup>

## Materials and Methods

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3 87 However, the total number of migrant workers, both documented and undocumented, is  
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5 88 estimated to fall between 4 and 6 million people.<sup>8</sup> Another group that contribute significantly  
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8 89 to the non-citizen population in Malaysia are refugees and asylum seekers. Refugees and  
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10 90 asylum seekers are often used interchangeably, yet, these populations differ by their legal  
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12 91 status in destination countries. Refugees can be defined as *“people who, owing to a well-*  
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14 92 *founded fear of persecution for reasons of race, religion, nationality, membership of a*  
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16 93 *particular social group or political opinions, is outside the country of his nationality and is*  
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18 94 *unable or, owing to such fear, is unwilling avail himself of the protection of that country.”*<sup>6(p.</sup>  
19  
20 95 <sup>79)</sup> Asylum seekers can be defined as *“people who seek safety from persecutions or serious*  
21  
22 96 *harm in a country other than his or her own and awaits a decision on the application for*  
23  
24 97 *refugee status under relevant international and national instruments. In case of a negative*  
25  
26 98 *decision, the person must leave the country and may be expelled, as may any non-national in*  
27  
28 99 *an irregular or unlawful situation, unless permission to stay is provided on humanitarian or*  
29  
30 100 *other related grounds.”*<sup>6(p. 12)</sup> In 2019, an approximate 178,580 refugees and asylum seekers  
31  
32 101 have registered with UNHCR in Malaysia, with a large majority from Myanmar (153,770),  
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34 102 and some other countries in the region, such as Pakistan, Yemen, Somalia, Syria,  
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36 103 Afghanistan, Iraq, Palestine, and Sri Lanka.<sup>9</sup>  
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45 105 Foreign workers (documented and undocumented), refugees, and asylum seekers can be  
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47 106 classified as vulnerable migrants in Malaysia, as this population may face significant  
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49 107 hardships in their new country of residence.<sup>10 11</sup> Vulnerable migrants are more prone to being  
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51 108 exploited and abused, have an increased need to be protected by duty-bearers, and are not  
52  
53 109 able to fully benefit from their human rights.<sup>12</sup> Health is among these affected human rights,  
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55 110 as migrant workers and refugees could encounter various challenges to maintain proper  
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57 111 health and prevent poor health outcomes, including difficulties in accessing healthcare and  
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## Materials and Methods

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3 112 obtaining quality health services.<sup>12-14</sup> According to Sweileh et al,<sup>15</sup> assessing the current  
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5 113 status of scientific output and identifying research gaps could positively contribute towards  
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8 114 improving the evidence base for advocating for migrant health needs. Despite the burgeoning  
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10 115 academic literature on migrant health in Malaysia, health information on migrant-related  
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12 116 issues is still limited, and public data remains difficult to access. Aggravating the matter,  
13  
14 117 there is no overall picture of the evidence base on migrant health in Malaysia currently  
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16 118 available, including critical appraisal of the quality of the evidence base. Therefore, the aim  
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18 119 of this scoping review is to explore the current status and composition of migrant health  
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20 120 research in Malaysia, and to establish a framework to assess the quality of this academic  
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22 121 literature.  
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## 134 **Method**

### 135 **General methods**

136 A scoping review was conducted, following the Preferred Reporting Items for Systematic  
137 reviews and Meta-Analyses – Extension for Scoping Reviews (PRISMA-ScR) guidelines<sup>16</sup>  
138 (Supplementary file 1). A pre-review protocol was developed to guide decisions for literature  
139 selection and structure of the review, and included the review question, aim, search strategy,  
140 selection criteria, and risk of bias assessment. However, the protocol was not formally  
141 registered and changed to some extent over the course of this review. Data was extracted and  
142 organised using the Bay Area Regional Health Inequities Initiative (BARHII) framework. In  
143 addition, a decision tree was developed to classify the type of study design and level of  
144 evidence of each journal article. Subsequently, quality assessment of the included literature  
145 was conducted by using the Joanna Briggs Institute (JBI) critical appraisal toolkit. Lastly, the  
146 data was analysed and a multiple-correspondence analysis (MCA) was applied to explore  
147 existing relationships between variables.

### 148 **Patient and public involvement**

149 There were no patients involved in this study.

### 150 **Conceptual framework**

151 The Bay Area Regional Health Inequities Initiative (BARHII) framework was utilised to  
152 organise the identified literature in this scoping review into specific factors that shape  
153 equitable health outcomes (Figure 1). The BARHII framework was selected due to its  
154 comprehensive nature and inclusion of various health dimensions, whereas most other models  
155 focused on specific public health elements or lacked clear explanation regarding the included  
156 health-related components of the model. Although the framework was developed to address

## Materials and Methods

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2  
3 157 health inequities, its coherent structure lends itself to this project as it allows the researchers  
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5 158 to approach health from different perspectives.  
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11 160 [INSERT FIGURE 1]  
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17 162 The BARHII framework consists of six dimensions: 1) social inequities; 2) institutional  
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19 163 inequities; 3) living conditions; 4) risk behaviours; 5) disease and injury; and 6) mortality.  
20  
21 164 Except for 'social inequities,' the other five categories were used to describe which health  
22  
23 165 dimension the particular articles focused on. The social inequities element was incorporated  
24  
25 166 by describing the population of interest, which were divided into three categories; foreign  
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27 167 workers, asylum seekers and refugees, and unclassified migrants.  
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31 168 Institutional inequities include the practices of corporations, businesses, government  
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33 169 agencies, schools, not-for-profit organisations as well as laws, regulations, and policies that  
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35 170 could influence health outcomes (e.g. a regulation that obligates companies to financially  
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37 171 compensate an individual in case of a work incident).  
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41 172 Living conditions consist of the physical environment (e.g. indoor air pollution), economic  
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43 173 and work environment (e.g. unemployment), social environment (e.g. discrimination in the  
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45 174 neighbourhood), and service environment (e.g. healthcare) that people live in, and that play a  
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47 175 role in determining their health outcomes (e.g. denied healthcare access due to visa status).  
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51 176 Risk behaviour includes smoking, poor nutrition, low physical activity, violence, alcohol and  
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53 177 other drugs, and sexual behaviour. This dimension reflects the way someone acts and how  
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55 178 that increases or decreases the risk of obtaining a particular health outcome (e.g. the attitude  
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## Materials and Methods

179 and its related behaviour towards smoking could influence the individual's level of risk of  
180 developing lung cancer).

181 Disease and injury consist of communicable diseases (also known as infectious diseases; e.g.  
182 chlamydia), chronic diseases (also known as non-communicable diseases; e.g. cancer), and  
183 injuries (e.g. fractured bone). This dimension describes the number of people or individual  
184 cases with a particular health outcome (e.g. ten out of the 100 people suffered from cancer).

185 Mortality was changed to 'mortality and morbidity' and focused on death and disease rates of  
186 the study population (e.g. ten out of 1,000 live births of children under the age of one pass  
187 away) to distinguish epidemiological studies with larger samples from descriptive studies  
188 with smaller samples, where the latter were categorised as 'disease and injury' studies.

### 189 **Search strategy**

190 Six databases were carefully selected for this study as they cover a wide scope of disciplines,  
191 which may not be typically brought together in systematic literature searches. Econlit,  
192 Embase, Global Health, Medline, PsycInfo, and Social Policy and Practice were searched,  
193 and included all articles of each database's inception date to 17 September 2019. The search  
194 process included a two-stage procedure that was conducted by AS. The first stage focused on  
195 identifying English-language key words and Medical Subject Headings (MeSH) items for  
196 migrants (e.g. immigrants, foreign workers, refugees), health (e.g. disease, infection,  
197 disorder), and Malaysia (e.g. Sabah, Kuala Lumpur). Subsequently, these items were  
198 combined by using Boolean operators (e.g. migrant AND health AND Malaysia) in the  
199 search platform of each database (Supplementary file 2).

### 200 **Selection criteria**

201 Studies were eligible for inclusion if they have met the following inclusion criteria: 1)  
202 Conducted in Malaysia; 2) published in peer-reviewed academic journals; 3) primary

## Materials and Methods

203 outcomes of the study included a health-related variable from at least one of the six  
204 dimensions of the BARHII framework; 4) employment of one of the following study designs:  
205 literature synthesis (systematic review, meta-analysis, other scientific review designs),  
206 qualitative (interviews, focus group discussions), and/or quantitative (randomised controlled  
207 trial, cohort, case-control, cross-sectional, case series, case report) study design; 5) written in  
208 English; 6) inclusion of (im)migrants, foreign workers, asylum seekers, and refugees, as these  
209 groups were all considered as the vulnerable migrant population in Malaysia.

210 Studies were excluded if they were: 1) conducted or included data from 1965 or earlier, as  
211 Singapore was one of the Malaya states until 1965, and this study is careful to only include  
212 Malaysia studies; 2) grey literature; 3) opinion papers, editorials, fieldnotes of symposia,  
213 conferences and workshop abstracts; 4) focused on non-citizens and foreigners, where it was  
214 unclear whether a vulnerable migrant population was included (such as permanent residents,  
215 naturalised persons, expatriates, temporary visitors, tourists, Malaysian returnees, and  
216 international students); 5) only presented migrants as a control variable and no other  
217 information regarding migrants was available.

**218 Data extraction**

219 Three reviewers (AS, DC, and NP) were involved in the screening process, where all had  
220 experience in the domain of public health and AS and NP had practical knowledge with  
221 respect to conducting systematic reviews due to previous research work. Titles and abstracts  
222 were exported by AS and subsequently moved into Rayyan, an open-source software  
223 designed to support systematic reviews. AS and DC were the main reviewers, where AS  
224 conducted an entire screening of titles and abstracts and DC assessed a randomly selected  
225 20% sample. Independent screening was carried out by using the 'blind' function of Rayyan,  
226 with both researchers working separately. The first stage involved screening titles and

## Materials and Methods

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3 227 abstracts according to the selection criteria. Subsequently, AS and DC conducted an  
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5 228 independent full-text screening of all potential articles, and attached comments to each article  
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8 229 on why the paper was included or excluded. After each screening stage, AS and DC  
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10 230 compared their findings and discussed the discrepancies. Conflicts were examined and  
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12 231 resolved by NP.

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15 232 Following the full-text screening stage, the data were extracted by one reviewer (AS) and  
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17 233 disaggregated by the different dimensions of the BARHII framework, including the type of  
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19 234 migrant (social inequities), main health dimension (institutional inequities, living conditions,  
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21 235 risk behaviours, disease & injury, and morality & morbidity rates), and health subdimensions.

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25 236 For the next stage, a decision tree was developed to ensure that the correct quality appraisal  
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27 237 tool by study design was selected and to identify the level of evidence of included literature  
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29 238 (Figure 2).

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35 240 [INSERT FIGURE 2]

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41 242 This tree built on study design tree from the Centre for Evidence-Based Medicine (CEBM)<sup>18</sup>  
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43 243 and essentially allowed research of varying designs to be consistently, reliably classified into  
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45 244 one of several design families. First, a definitions table of included research designs was  
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47 245 developed to adapt specific characteristics of each definition into the decision tree to identify  
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49 246 the paper's study design (Table 1).

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55 248 [INSERT TABLE 1]

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## Materials and Methods

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3 250 Second, Tomlin & Borgetto's<sup>23</sup> evidence model was utilised to identify the paper's level of  
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5 251 evidence, as the study designs that were included in their model were in line with the  
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7 252 included research designs in this study. In addition, it was one of the few models that  
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9 253 deconstructed the single-hierarchy framework and assigned study designs to different  
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11 254 categories depending on the study objective (e.g. if the study design did not aim to provide a  
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13 255 causal-relationship, but simply describe a particular outcome, the study design would be  
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15 256 classified as descriptive research), and, therefore, valued studies with different objectives  
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17 257 equally. The model consists of four dimensions, including descriptive research, experimental  
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19 258 research, outcome research, and qualitative research. Each of these dimensions contains four  
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21 259 subclasses to show the level of evidence – level 1 is the highest level of evidence and level 4  
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23 260 the lowest – for each subclass. The assignment of these levels to the different study designs  
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25 261 are based on the degree of internal validity/authenticity and external validity/transferability,  
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27 262 where level 1 is regarded with the highest level of these two measures and level 4 ranks the  
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29 263 lowest. Table 2 shows the different research dimensions that correspond with the included  
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31 264 study designs and level of evidence.  
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41 266 [INSERT TABLE 2]  
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47 268 After incorporating feedback and multiple testing rounds, where the total set of articles were  
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49 269 used each time, the final version of the decision tree – as seen in Figure 2 – was used to  
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51 270 extract the data.  
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### 271 **Quality appraisal and level of evidence assessment**

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57 272 Quality assessments of the included studies were conducted by one reviewer (AS) based on  
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59 273 the Joanna Briggs Institute (JBI) critical appraisal tools,<sup>24</sup> as this toolkit includes checklists  
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## Materials and Methods

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3 274 for a wide variety of study designs that are most in line with the previous established research  
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5 275 designs included in this study. Additional objective criteria specific to migrant health studies  
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7 276 were developed for each JBI checklist to increase their reliability in the specific topical area.  
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9 277 After discussing the additional criteria and piloting the tools, slight modifications were made  
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11 278 for the JBI tools, and these final versions were used to assess the quality of the papers  
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14 279 (Supplementary file 3-9).

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17 280 Questions were answered with 'Yes (V)' if the study met the criteria according to  
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19 281 descriptions provided in the final version of the JBI toolkit. 'No/Unclear (X)' was selected if  
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21 282 the study did not address the question or if information to assess the given criteria was  
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23 283 lacking. The score concerning the quality of the study was determined by summing up all  
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25 284 'Yes' answers and dividing this number by the total number of answered questions, which  
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27 285 differ by study design in the JBI tools. Questions that were answered with 'Not applicable  
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29 286 (N/A)' were excluded from the calculation. A three-band scoring index – low quality = 0% to  
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31 287 50%; moderate quality = above 50% and below 75%; and high quality = 75% or higher – was  
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33 288 developed to simplify the interpretation of the quality of the study and allow comparison of  
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35 289 quality between study types.

### 290 **Data analysis**

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38 291 Data concerning the type of migrant, health dimension, health subdimension, research design,  
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40 292 level of evidence, and quality assessment score were imported into Microsoft Excel for Mac  
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42 293 (version 16.28). The mean quality score was calculated for the different variables, including  
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44 294 the type of migrant, health dimension, health subdimension, research design, and level of  
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46 295 evidence. RStudio (version 1.0.136; Macintosh; Intel Mac OS X 10\_15) was utilised to  
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48 296 conduct chi-square tests and a multiple-correspondence analysis (MCA). An MCA is a  
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50 297 descriptive technique that can be utilised to visually demonstrate patterns among categorical  
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3 298 variables. It represents associations between categories of several variables – here, these  
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5 299 include the type of migrant, main health dimension, quality of the study, and research design  
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8 300 – in a two-dimensional space, where the distance between categories is meaningful to show  
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10 301 existing relationships. The MCA allows categories with similar profiles to be grouped  
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12 302 together, where a closer distance of categories within the same quadrant demonstrates a  
13  
14 303 stronger relationship, whereas categories that are further apart and in opposite quadrants  
15  
16 304 present weaker associations.<sup>25</sup> In support of the MCA, a Chi-square test was conducted to  
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18 305 assess if there was an actual association among categories or if the established relationship  
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20 306 was by chance. It should be noted that a few studies included two BARHII dimensions, yet,  
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22 307 the analysis only allowed one dimension to be included. Therefore, only the most prominent  
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24 308 dimension was selected and used for the analysis.  
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## Results

**Results**

The study selection process is presented in Figure 3. After removing the duplicates, 1,282 original records were identified. A total of 1,136 papers were excluded after the title and abstract screening stage due to the paper focusing on another population of interest, lacking focus on a BARHII health dimension, no peer-reviewed research paper, and data before 1965, resulting in 146 articles eligible for the full-text screening stage. Subsequently, full-text articles were retrieved from these 146 records, and eventually, 67 papers met the inclusion criteria and were included in the scoping review.

[INSERT FIGURE 3]

**Characteristics of included papers**

This section first demonstrates the findings of each BARHII dimension, followed by the results on the quality and level of evidence of the included studies. Lastly, existing relationships between the type of study design, quality of the study, type of migrant, and main health dimension are shown. Table 3 presents a descriptive summary of all included articles, including the study design and its related level of evidence, study period, type of migrant, sample population, main health dimension, health subdimension, quality assessment score and a short description of the study.

[INSERT TABLE 3]

## Results

**331 Health dimension and type of migrant**

332 The literature was first assessed to understand the topical coverage of research against the six  
333 dimensions of the BARHII public health framework. The first dimension, social inequities,  
334 was used to describe our population of interest and refers to the type of migrants (e.g. foreign  
335 workers, asylum seekers and refugees, or unclassified migrants). The other five dimensions  
336 focussed on elements that influence the health status of the population of interest, including  
337 institutional inequities, living conditions, risk behaviour, disease and injury, and mortality  
338 and morbidity. These latter five categories are outlined below and include results on the types  
339 of migrants that were researched within these dimensions.

**340 *Institutional inequities***

341 One paper addressed the institutional inequities dimension<sup>65</sup> by exploring the inclusion of  
342 migrant workers into national universal health coverage (UHC) policies in five Association of  
343 Southeast Asian Nations (ASEAN) countries: Indonesia, Philippines, Malaysia, Thailand and  
344 Singapore. It stated that Malaysia has implemented a medical insurance policy for foreign  
345 labour by obligating documented migrant workers to be enrolled in private insurance  
346 schemes, as non-citizens have no access to UHC at public facilities.

**347 *Living conditions***

348 Eleven papers were classified under the living conditions dimension, where most articles  
349 (n=9/11) addressed the service environment subdimension.<sup>10 29 56 57 69 73 87 88 91</sup> All of these  
350 papers studied the asylum seeker and refugee population, except for one article that focused  
351 on migrant workers.<sup>87</sup> Half the studies used qualitative methods to explore barriers to  
352 healthcare utilisation and showed that language difficulties, discrimination, insufficient health  
353 literacy, and cultural differences were common issues. One study focused on the social

## Results

1  
2  
3 354 environment subdimension and showed that refugee children experience discrimination by  
4  
5 355 locals, such as stereotyping them as criminals and also by other refugees of different  
6  
7 356 ethnicities and national origins.<sup>89</sup> Santos et al<sup>62</sup> assessed elements related to the work  
8  
9 357 environment subdimension by investigating perceived environmental hazards among foreign  
10  
11 358 workers, demonstrating that noise and dust were perceived as the greatest occupational health  
12  
13 359 threats.  
14  
15

360 ***Risk behaviours***

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21 361 Ten studies researched the risk behaviour dimension, with most articles (n=8/10) conducted  
22  
23 362 on general migrant populations without clear identification of which migrant categories were  
24  
25 363 included in their study.<sup>28 31 34 54 55 60 81 83</sup> Three of these articles focused on the sexual  
26  
27 364 behaviour subdimension, exploring risk behaviour related to human papillomavirus (HPV).  
28  
29 365 The studies showed that a significant number of migrant women have high HPV risk  
30  
31 366 behaviour due to lack of understanding with respect to cervical cancer, the screening process,  
32  
33 367 and poor knowledge concerning HPV vaccination.<sup>54 55 83</sup> Two papers, classified within the  
34  
35 368 'poor nutrition' subdimension, showed poor health outcomes among detained migrants due to  
36  
37 369 nutrition deficiencies.<sup>31 81</sup> The other articles among unclassified migrants included two  
38  
39 370 studies on the 'violence and abuse' subdimensions, exploring maternal filicide<sup>60</sup> and  
40  
41 371 neglecting children<sup>28</sup>; and one other study on the 'alcohol and other drugs' subdimension,  
42  
43 372 pertaining to the usage of inhalants<sup>34</sup>. All of these studies simply showed that migrants  
44  
45 373 represent a certain proportion of the identified cases. Only the study on the use of inhalants  
46  
47 374 presented more cases among migrants than among locals. Two final studies included foreign  
48  
49 375 workers and explored the 'hygiene and sanitation' and 'hazard and safety awareness'  
50  
51 376 subdimensions.<sup>70 75</sup> Kamaludin & How<sup>70</sup> stated that migrant workers had significantly less  
52  
53 377 knowledge regarding environmental health, such as air quality, natural hazards, sanitation,  
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## Results

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3 378 and industrial hazards, compared to local workers. Woh et al<sup>75</sup> investigated the level of  
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5 379 hygiene among migrant food handlers and argued that personal hygiene and sanitation  
6  
7  
8 380 measures should be improved among migrant food handlers.  
9

10  
11 381 ***Disease and injuries***  
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13  
14  
15 382 With a total of 46 studies, the disease & injury dimension presented the largest study field of  
16  
17 383 interest related to the BARHII framework. Foreign workers were with 36 articles the most  
18  
19 384 studied group of migrants,<sup>30 33 36 37 39-49 51-53 59 62 66-68 71 72 74 76-79 82 84-86 88 90</sup> while only six and  
20  
21 385 four articles included unclassified migrants<sup>32 38 50 58 61 63</sup> and refugee populations,<sup>26 27 64 80</sup>  
22  
23 386 respectively. The majority (n=27/46) of the articles studied communicable diseases, where 18  
24  
25 387 of these studies focused on parasites,<sup>27 30 32 36 37 41-45 52 67 68 77 78 82 84 90</sup> eight on bacteria,<sup>38 40 53 58</sup>  
26  
27 388 <sup>61 63 72 74</sup> and two on viruses.<sup>48 63</sup> Most of the studies were merely descriptive and presented  
28  
29 389 that migrants, irrespective of the defined type, represented a significant share among the  
30  
31 390 study populations. Non-communicable diseases were studied far less compared to  
32  
33 391 communicable diseases and were only specifically addressed in three articles.<sup>26 46 66</sup> Scheutz  
34  
35 392 et al<sup>26</sup> found high numbers of different non-communicable oral complications among  
36  
37 393 Vietnamese refugees, such as tooth decay and missing teeth. Vijian et al<sup>66</sup> compared the  
38  
39 394 difference in characteristics between foreign workers and Malaysian patients with perforated  
40  
41 395 peptic ulcers, showing that the treated foreign labour population were younger, experienced  
42  
43 396 fewer post-operative complications, and had smaller-sized ulcers compared to locals. Murty<sup>46</sup>  
44  
45 397 reported a case study, presenting a deceased migrant worker due to a cystic tumour in the  
46  
47 398 heart region.  
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54  
55 399 In addition to the studies that focused on single disease outcomes, two studies were  
56  
57 400 conducted that presented distributions of various diseases among foreign workers, including  
58  
59 401 communicable and non-communicable disorders.<sup>39 88</sup> Five studies focused on the 'mental  
60

## Results

1  
2  
3 402 health' subdimension, where these studies concentrated on describing psychiatric disorders,<sup>33</sup>  
4  
5 403 determining quality of life-related risk factors,<sup>50 64</sup> and testing the effect of different coping  
6  
7 404 mechanisms and therapy sessions on the level of stress.<sup>76 80</sup> Nine studies explored the 'injury'  
8  
9 405 subdimension, where nearly all (n=8/9) studies focused on work-related injuries. Most of  
10  
11 406 these studies examined the prevalence of particular injury and traumas, including fatal  
12  
13 407 lightning strikes,<sup>47</sup> ocular trauma,<sup>71</sup> and other musculoskeletal pain.<sup>59 62 79</sup> Ratnasingam et al<sup>51</sup>  
14  
15 408 compared the number of occupational incidents between local workers and migrant workers,  
16  
17 409 where foreign workers had less accidents. In addition, two papers described the risk factors  
18  
19 410 for work-related injuries, such as high machine-related vibration exposure<sup>49</sup> and low levels of  
20  
21 411 the company's safety commitment (as assessed by the foreign workers themselves).<sup>85</sup>  
22  
23 412 Ya'acob et al<sup>86</sup> conducted an RCT to evaluate the impact of a specific workplace intervention  
24  
25 413 on musculoskeletal symptoms (MMS) among foreign labour and showed that the intervention  
26  
27 414 reduced musculoskeletal symptoms in the foot and ankle regions significantly compared to  
28  
29 415 the control group.

**416 Mortality and morbidity**

30  
31 417 Two papers addressed the mortality and morbidity dimension by showing incidence rates  
32  
33 418 among general cohorts of migrants. Zulkifli et al<sup>29</sup> conducted a study on maternal and child  
34  
35 419 health in Sabah and identified that infant mortality rates were significantly higher for  
36  
37 420 migrants compared to locals. Dony et al<sup>35</sup> also conducted a study in Sabah and showed that at  
38  
39 421 least 24% of new tuberculosis cases detected since 1990 were among migrants and that  
40  
41 422 leprosy incidence rates among migrants were on average 3.7 times higher than the incidence  
42  
43 423 rate among Malaysians.

**424 Level of evidence and quality of the study**

## Results

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2  
3 425 After data extraction using the BARHII framework, the studies were assessed on the level of  
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5 426 evidence and quality. The decision tree was used to identify the research design and its  
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7 427 related level of evidence for each paper, and, subsequently, the JBI tool of the specific  
8  
9 428 research design was applied to conduct the quality assessment. In total, 65 articles were  
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11 429 assessed on the quality of the study disaggregated by BARHII dimension (Table 4) and  
12  
13 430 quality of the study disaggregated by level of evidence (Table 5). Two articles were excluded  
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15 431 from this assessment as their study designs – a scoping review<sup>65</sup> and mixed-method<sup>73</sup> design  
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17 432 – as the JBI tools do not accommodate these study designs. The quality assessment scores can  
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19 433 be found in Supplementary file 10.  
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435 [INSERT TABLE 4]

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437 [INSERT TABLE 5]

438

439 In general, the quality of the evidence base on migrant health in Malaysia is low (49.2%) and  
440 consists mostly of level 3 evidence papers (n=27/65). Level 2 evidence represented 38.5% of  
441 the evidence base (n=25/65), followed by level 4 evidence papers (n=13/65). No level 1  
442 evidence studies (systematic reviews or meta-analyses) were identified.

#### 443 ***Study quality by migrant type***

444 Studies including asylum seekers and refugees have the highest mean quality (58.4%) and  
445 were represented mostly (n=6/9) by level 2 evidence papers. Yet, asylum seekers and

## Results

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3 446 refugees are the least researched category among the three migrant groups (n=10, including a  
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5 447 non-appraised article). The majority of the papers (n=41) focused on foreign workers, where  
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7 448 the different levels of evidence were relatively equally divided (level 2=35%; level 3=37.5%;  
8  
9 449 level 4=27.5%). However, the overall quality of these papers was low (45.7%), presenting the  
10  
11 450 lowest score among the three migrant groups. Articles including unclassified migrants scored  
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13 451 an average quality of 52.7%, which is mainly (62.5%) derived from level 3 evidence papers.  
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**452 *Study quality by health dimension***

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21 453 Four out of the five BARHII health dimensions were included in the quality assessment. The  
22  
23 454 institutional inequities dimension was excluded from the critical appraisal, as only one study  
24  
25 455 addressed this dimension and was based on a research design that was not covered by JBI  
26  
27 456 toolkit. The 'living conditions' dimension has the highest average score (59.7%) and included  
28  
29 457 mostly (60%) level 2 evidence studies. The average quality score for the 'risk behaviour'  
30  
31 458 dimension was low (48.7%), and the majority of the studies were within the descriptive  
32  
33 459 research design (level 2 = four papers; level 3 = three papers). The 'disease & injury'  
34  
35 460 dimension represented the largest (n=46/65) share of the evidence base and had the lowest  
36  
37 461 average quality (46.3%) of all four dimensions. Prevalence studies with (level 2 evidence)  
38  
39 462 and without an analytical element (level 3 evidence) were the most common research designs  
40  
41 463 (n=19/67 and n=13/67, respectively). Lastly, the mortality and morbidity dimension had a  
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43 464 low (47.9%) average quality and included one level 3 evidence study and one level 4  
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45 465 evidence study.  
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**53 466 *Study quality by study design***

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56 467 Out of the four research dimensions, the descriptive research dimension represents the  
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58 468 majority (70.8%) of the evidence base with a mean quality of 47.7%. Within this category,  
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## Results

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3 469 case reports (level 4 evidence) have the highest mean quality (81.5%), whereas prevalence  
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5 470 studies with an analytical component (level 2 evidence) have the lowest mean quality  
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7  
8 471 (39.7%). Only two papers were classified as experimental designs, where both studies were  
9  
10 472 randomised controlled trials (level 2 evidence) and had quality scores of 30.8% and 38.5%,  
11  
12 473 the lowest quality of all research designs. Observational research papers had a mean quality  
13  
14 474 score of 46.1%, ranging from 42.6% among analytical cross-sectional studies (level 4  
15  
16 475 evidence) to 56.7% for case-controls (level 3 evidence). The qualitative research dimension  
17  
18 476 had the highest mean quality and was the only research dimension with a high-quality score  
19  
20 477 (76%). Almost all of these papers (n=4/5) included qualitative studies with more rigor (level  
21  
22 478 2 evidence) and had a mean score of 82.5%. Nevertheless, there was one qualitative study  
23  
24 479 with less rigor (level 3 evidence) scored 50%.

#### 480 **Associations between different variables**

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33 481 Figure 4. presents the results of the multiple-correspondence analysis (MCA), showing  
34  
35 482 different associations between four dimensions: 1) type of study design; 2) quality of the  
36  
37 483 study; 3) type of migrant; and 4) main health dimension. Chi-square test results are utilised to  
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39 484 assess whether relationships among the different variables were statistically significant.

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46 486 [INSERT FIGURE 4]

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53 488 High-quality studies tend to include refugees and asylum seekers ( $X^2 = 17.005$ ,  $df = 4$ ,  $p$ -  
54  
55 489 value = 0.001928), focus on living conditions ( $X^2 = 131.94$ ,  $df = 6$ ,  $p$ -value =  $< 2.2e-16$ ), and  
56  
57 490 have a qualitative research design ( $X^2 = 656.35$ ,  $df = 12$ ,  $p$ -value =  $< 2.2e-16$ ). Moreover,  
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## Results

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3 491 studies that include foreign workers tend to focus on diseases and injuries ( $X^2 = 374.52$ ,  $df =$   
4  
5 492 6,  $p\text{-value} = < 2.2e-16$ ) and contain a case report study design ( $X^2 = 576.87$ ,  $df = 12$ ,  $p\text{-value}$   
6  
7 493  $= < 2.2e-16$ ). Furthermore, research that includes the unclassified migrant population tended  
8  
9 494 to study the risk behaviour and mortality and morbidity dimensions ( $X^2 = 374.52$ ,  $df = 6$ ,  $p\text{-}$   
10  
11 495  $value = < 2.2e-16$ ). Lastly, prevalence studies, and, to a lesser extent, analytical cross-  
12  
13 496 sectional studies, tend to have a low-quality score ( $X^2 = 656.35$ ,  $df = 12$ ,  $p\text{-value} = < 2.2e\text{-}$   
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For peer review only

Conclusion

## 500 Discussion

### 501 Key findings

502 This study describes the nature and quality of the existing evidence on migrant health in  
503 Malaysia. Future research priorities based on the existing evidence and identified gaps are  
504 summarised in Box 1.

506 [INSERT BOX 1]

508 Among the five BARHII health dimensions, institutional inequities and mortality and  
509 morbidity were the least represented. Yet, studies concerning the influence of governance on  
510 migrant health are of utmost importance, as overarching governance can affect health  
511 outcomes of other dimensions.<sup>92</sup> Similarly, epidemiological research on mortality and  
512 morbidity rates are necessary for population health statistics, to identify disease patterns,  
513 document changes over time, and inform plans of action to tackle these health issues.<sup>93</sup>  
514 Further research should focus on or incorporate migrant health governance, as well as  
515 epidemiological research on morbidity and mortality among both migrants and non-migrants,  
516 to better understand the effects of policies on migrant health, which is particularly relevant in  
517 low- and middle-income countries (LMICs) where the evidence gap is so acute.<sup>94</sup> Non-health  
518 policies, including restrictive immigration policies, were associated with poor health  
519 outcomes in a recent systematic review on high-income countries.<sup>95</sup> It is therefore important  
520 that policies in other sectors (potentially including, e.g., immigration, labour, education) are  
521 assessed for their potential consequences for migrant health.

## Conclusion

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2  
3 522 Living conditions were represented in eleven studies and focused mainly (n=9/11) on the  
4  
5 523 service environment by addressing the healthcare setting. However, there is scarce  
6  
7 524 information on the social and economic environments that different categories of migrants  
8  
9 525 must navigate and no data on the physical environment at all. Research conducted in other  
10  
11 526 countries demonstrates the importance of these three subdimensions on migrant health.<sup>96 97 98</sup>  
12  
13 527 Shao et al<sup>96</sup> argued that inequalities regarding the level of income (economic environment)  
14  
15 528 influenced health outcomes among internal migrant workers in China. He & Wong<sup>97</sup> stated  
16  
17 529 that poor mental health among female migrant workers in China was related to gender-  
18  
19 530 specific stressors (social environment). Al-Khatib et al<sup>98</sup> demonstrated that poor housing  
20  
21 531 conditions (physical environment) in a refugee camp were directly associated with various  
22  
23 532 upper respiratory tract diseases. These studies underscore the importance of different  
24  
25 533 environments on migrant health, motivating a focus of future research on the effects of living  
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27 534 conditions on different health problems, besides just focussing on associations between living  
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29 535 conditions and healthcare utilization.  
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36 536 Ten studies in the Malaysian context were conducted on risk behaviour with different  
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38 537 subdimensions, from hygiene and sanitation to violent and abusive behaviour. However, all  
39  
40 538 of these subdimensions were under-researched, as only limited elements of each  
41  
42 539 subdimension were discussed. For instance, three studies focused on sexual behaviour by  
43  
44 540 addressing HPV knowledge.<sup>54 55 83</sup> Yet, no attention was given to other sexual behaviour-  
45  
46 541 related topics, such as condom use, HIV knowledge, and birth control. Although these studies  
47  
48 542 have been conducted in Malaysia, this research is lacking in the migration-context.<sup>99 100 101</sup>  
49  
50 543 Therefore, future research should focus on broader aspects of each subdimension, as  
51  
52 544 demonstrated in research elsewhere. For example, Renzaho & Burns<sup>102</sup> addressed the 'poor  
53  
54 545 nutrition' subdimension by showing that dietary patterns among African migrants changed  
55  
56 546 negatively after arriving in Australia due to the increase intake of fast food and processed  
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## Conclusion

1  
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3 547 food. Ganle et al<sup>103</sup> concentrated on the sexual risk behaviour subdimension and stated that  
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5 548 71% of the sampled refugees in Ghana had transactional sex, and only 12% used  
6  
7  
8 549 contraceptives. Bosdriesz et al<sup>104</sup> compared smoking between migrants and non-migrants in  
9  
10 550 the United States (US) and showed that migrants smoke less than US citizens. As a  
11  
12 551 significant number of migrants in Malaysia come from Indonesia, a population that smokes  
13  
14 552 almost twice as much as Malaysians, smoking behaviour among this migrant group may  
15  
16 553 differ from locals.<sup>105</sup> Therefore, future research could further explore the differences in  
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18 554 smoking behaviours between Malaysians and migrants in Malaysia.  
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23 555 Disease and Injury was the most researched dimension, representing more than two-thirds of  
24  
25 556 the evidence base on migrant health in Malaysia. Despite the strong representation, over half  
26  
27 557 the research papers concentrated on communicable diseases, while only a few examined non-  
28  
29 558 communicable diseases. As the World Health Organisation (WHO)<sup>106</sup> states that  
30  
31 559 approximately 74% of all deaths in Malaysia are attributable to non-communicable disease,  
32  
33 560 in particular cardiovascular disease, chronic respiratory disease, and diabetes, there is a need  
34  
35 561 to expand research on non-communicable disease trends and outcomes among migrant  
36  
37 562 population in Malaysia.  
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42 563 We found that most studies were on foreign workers (n=41/67), and only 10 studies  
43  
44 564 examined asylum seekers and refugees as the primary population of interest. Furthermore,  
45  
46 565 eleven studies did not specify the included migrant population. The latter issue could have  
47  
48 566 occurred due to lacking information on the data used. For example, the Ministry of Health  
49  
50 567 (MOH) will not report anything more detailed than 'non-Malaysian', as no further  
51  
52 568 information on non-citizens are collected during patient registration at MOH facilities.  
53  
54 569 Ideally, all research on migrants should clearly specify the type of migrants being studied and  
55  
56 570 not omit crucial details, such as gender, visa status, and country of origin. Also, human  
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## Conclusion

1  
2  
3 571 trafficking could significantly affect a person's health and vulnerability, no studies were  
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6 572 found that examined the health of trafficked persons and victims of forced labour in  
7  
8 573 Malaysia.<sup>107</sup> While the vulnerabilities experienced by the trafficked person intersects with  
9  
10 574 other migration-related vulnerabilities like gender, ethnicity or documentation status, victims  
11  
12 575 of human trafficking should be categorised separately, to reflect their own unique status and  
13  
14 576 vulnerability. The travel routes or modes of transportation used by migrants to come to  
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17 577 Malaysia may influence migrant health in different ways, as various different routes or modes  
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19 578 of transportation may be linked with specific hazards. Related to this issue is the lack of  
20  
21 579 evidence on migrant health with specific stages of migration, including pre-departure, travel,  
22  
23 580 destination interception, and return, where health outcomes might differ between these  
24  
25  
26 581 stages.<sup>108</sup>

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29 582 Lastly, this scoping review revealed that the average quality of studies on migrant health in  
30  
31 583 Malaysia is poor (49.2%) and that most of these studies have level 3 (n=27/65) or level 2  
32  
33 584 (n=25/65) evidence. Only qualitative studies with more rigour (level 2 evidence) and those  
34  
35 585 that focus on living conditions and include the refugee and asylum seeker populations, tend to  
36  
37 586 have a high-quality score. Therefore, there is a clear need to improve the quality of the  
38  
39 587 evidence base and produce papers with a higher level of evidence. Creating standard research  
40  
41 588 design-specific guidelines, if not existing already, and, subsequently, promoting these  
42  
43 589 materials among academics and research institutions, could increase the quality of future  
44  
45 590 research work. Furthermore, researchers should ensure that they follow study design specific  
46  
47 591 reporting guidelines (cite STROBE, CONSORT), to ensure that all relevant information is  
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49 592 captured in publications for further evidence synthesis, such as this review.  
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## 593 **Limitations**

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## Conclusion

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3 594 This study is the first systematic literature synthesis and scoping review on migrant health in  
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5 595 Malaysia and presents a comprehensive overview of all identified peer-reviewed articles.  
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7 596 Specific recommendations based on this research are provided to improve the evidence base  
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10 597 on migrant health in Malaysia. Furthermore, this paper makes methodological contributions  
11  
12 598 to migrant health research by providing a modified JBI toolkit and a decision tree to identify  
13  
14 599 the type of study design and corresponding level of evidence, both of which can be utilised in  
15  
16 600 other research fields as well. Yet, our review has several limitations. As this paper focuses  
17  
18 601 exclusively on vulnerable migrant populations within the non-citizen community in Malaysia,  
19  
20 602 we excluded other non-citizen groups such as expatriates and international students, based on  
21  
22 603 the assumption that these groups are less vulnerable. However, we acknowledge that other  
23  
24 604 non-citizen groups may face challenges in obtaining proper healthcare in Malaysia, such as  
25  
26 605 issues related to cultural competency among foreign students and retirees.<sup>109 110</sup> In addition,  
27  
28 606 papers including non-citizens without further description were excluded, although these  
29  
30 607 studies may have included the vulnerable migrant population.  
31  
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36 608 Only academic peer-reviewed studies were included, thus excluding grey literature,  
37  
38 609 editorials, and opinion papers. Also, only English language articles were included, and papers  
39  
40 610 in Bahasa Malaysia (the Malay language) were not included.<sup>111</sup> As a result, much relevant  
41  
42 611 information that could potentially be used to inform both policies and practice could have  
43  
44 612 been excluded from this review.  
45  
46  
47  
48  
49 613 Inter-rater reliability was limited to a 20% sample of the records in the first screening stage,  
50  
51 614 and no data extraction nor quality assessment was verified by a second reviewer due to  
52  
53 615 resource constraints. Also, a decision tree or another selection format to objectively classify  
54  
55 616 the BARHII dimension and subdimension of each paper was not developed, and, therefore,  
56  
57 617 this paper might suffer from some selection bias. Yet, we anticipate low bias as the first  
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## Conclusion

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3 618 reviewer was the main researcher and was very familiar with the study design and included  
4  
5 619 frameworks.

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8  
9 620 Besides the BARHII framework, various conceptual models of public health are available;  
10  
11 621 using a different framework could lead to the identification of other gaps in the evidence base  
12  
13 622 related to specific dimensions of health. For instance, the WHO Commission on Social  
14  
15 623 Determinants of Health (CSDH) framework includes material circumstances, such as food  
16  
17 624 availability, whereas this dimension is not included in the BARHII framework.<sup>112</sup> Similarly,  
18  
19 625 critical appraisal tools other than the JBI toolkit are available and could affect the scores of  
20  
21 626 the quality assessment. Yet, the JBI toolkit offers a wider range of study-design specific tools  
22  
23 627 compared to others. Both the BARHII framework as well as the JBI toolkit were compared to  
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25 628 other public health models and critical appraisal tools, respectively, and seemed to be the best  
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27 629 fit for this study.

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33 630 Likewise, a decision tree was developed by using the characteristics of the used definitions of  
34  
35 631 different research designs as well as the specific traits of Tomlin & Borgetto's<sup>23</sup> level of  
36  
37 632 evidence model. Using other definitions and level of evidence models could result in a  
38  
39 633 different level of evidence categorisation. However, we believe this review makes a strong  
40  
41 634 methodological contribution by combining study designs and level of evidence in a unified  
42  
43 635 decision tree, which can be used by researchers conducting systematic or scoping reviews  
44  
45 636 where accurate classifications of study design and associated evidence levels, is important.

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50 637 In order to conduct the multiple-correspondence analysis (MCA), the dataset could only  
51  
52 638 include one unit per dimension for each paper. As some studies included multiple BARHII  
53  
54 639 dimensions, only the most prominent dimension was included in the analysis. As a result, the  
55  
56 640 analysis may suffer from some selection bias and present slightly different outcomes  
57  
58 641 compared to an analysis that includes the other BARHII dimensions.



## Conclusion

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3 642 Lastly, no adjustments were made for outliers in the quality assessment. Therefore, some  
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5 643 papers with extremely high or low scores could have influenced specific dimensions and  
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8 644 might not reflect the quality of those dimensions perfectly.  
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10  
11 645 **Conclusion**

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14 646 Migrant health remains an issue in Malaysia, yet the quality of the evidence needed to inform  
15  
16 647 policy is currently lacking. Research-specific reporting guidelines should be followed to  
17  
18 648 improve the credibility and quality of the evidence base. Furthermore, future research should  
19  
20 649 focus more on evidence gaps in the ‘mortality and morbidity’ and ‘institutional inequities’  
21  
22 650 dimensions, as well as certain subdimensions, such as non-communicable disease, housing  
23  
24 651 conditions, and physical inactivity, in order to provide a comprehensive picture of migrant  
25  
26 652 health in Malaysia. Apart from demonstrating the research gaps, this paper also makes  
27  
28 653 methodological contributions to migrant health research by providing a modified JBI toolkit  
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30 654 and a decision tree that identifies the type of study design and corresponding level of  
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32 655 evidence, both of which can be utilised in other research fields as well.  
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7

8  
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12  
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14  
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18  
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27  
28  
29 689 This manuscript is an honest, accurate, and transparent account of the study being reported.  
30  
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For peer review only

## References

**Box**

## Box 1. Main recommendations to improve future research on migrant health.

- Improve the description of the target migrant population by including information regarding the type of migrant (e.g. foreign worker, refugee), visa status (e.g. regular, irregular), country of origin, socioeconomic variables (e.g. level of education, income), mode of transport during migration journey (e.g. boat, car), and the existence of forced entry (e.g. human trafficking, forced marriage).
- Create associations between different stages of migration (pre-departure, travel, destination, interception, and return phase) and health outcomes.
- More research output concerning governance and institutional inequities and mortality and morbidity, and, consequently, conduct a time series analysis between these two dimensions to identify any possible relationships.
- More research output regarding non-communicable diseases, especially on the main causes of death in Malaysia; cardiovascular diseases, chronic respiratory diseases, and diabetes.
- More research output concerning several subdimensions of risk behaviour, especially on smoking, physical inactivity, and alcohol abuse.
- Evaluate the impact of health and non-health policies on migrant health.
- Explore living conditions regarding the physical environment, such as housing and environmental conditions, and the impact on migrant health outcomes.
- Promotion of guidelines on study conduct and reporting among researchers.



## Figure Legends

1166 **Tables**

1167 Table 1. Definitions of included study designs.

Study design	Definition
<b>Analytical studies</b>	Studies that strive to quantify the relationship between a particular exposure or intervention and the outcome of interest, where these studies include a comparison group to compare the outcome rates. <sup>18</sup>
Systematic review	A study that is conducted systematically to collect all published evidence – that comply with the specified inclusion criteria – and provide a summary of the results to answer a specific research question. <sup>19</sup>
Randomised controlled trial (RCT)	An experimental study that includes at least two groups – treatment group and control group – to compare the outcomes between the group that received the intervention/drug and the group that received a placebo/no treatment. The participants of the group are randomly allocated to one of the groups. <sup>20</sup>
Quasi-experimental study/non-RCT	An experimental study that includes at least two groups – treatment group and control group – to compare the outcomes between the group that received the intervention/drug and the group that received a placebo. The participants of the group are <b>not</b> randomly allocated to one of the groups. <sup>21</sup>
Cohort study	A study that follows a group of people over time, where the participants are sampled based on the presence or absence of a particular exposure to compare the outcome of interest with a control group. <sup>20</sup>
Case-control study	A study that includes a group of people selected on the outcome of interest (cases) and a group without the outcome of interest (controls), followed by assessing previous exposure of both groups to determine if there is a relationship between the level of exposure and outcome of interest. <sup>20</sup>
Analytical cross-sectional	A study that looks at two groups – exposed and unexposed – and the outcome of interest at a particular point or period of time to compare the differences between the two groups. <sup>20</sup>
<b>Descriptive studies</b>	Studies that do not strive to quantify a relationship between variables, but simply describe the disease outcome and characteristics within a defined population. Note that descriptive studies can still include analytic components. <sup>18</sup>
Prevalence study	A study that looks at a population at a particular point or period of time to describe the prevalence of an outcome of interest. <sup>20</sup>
Case series	A study where only subjects are included with a particular outcome of interest to describe the shared and diverging characteristics of this study population. <sup>22</sup>
Case report	A study that describes an unfamiliar or extraordinary outcome of one individual. <sup>22</sup>

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## Tables

1169 Table 2. Level of evidence for each study design.

Research design	Level of evidence	Abbreviation
<b>Descriptive research</b>		
Systematic review of descriptive studies	1	Des-1
Prevalence study with analytical component	2	Des-2
Case series and prevalence study without analytical component	3	Des-3
Case report	4	Des-4
<b>Experimental research</b>		
Systematic review/meta-analysis of experimental studies	1	Exp-1
Randomised controlled trial	2	Exp-2
Group quasi-experimental study (a.k.a. non-RCT)	3	Exp-3
Quasi-experimental study with single subject	4	Exp-4
<b>Observational research</b>		
Systematic review/meta-analysis of observational studies	1	Obs-1
Cohort study	2	Obs-2
Case-control	3	Obs-3
Analytical cross-sectional study	4	Obs-4
<b>Qualitative research</b>		
Systematic review/meta-synthesis of qualitative studies	1	Qual-1
Group qualitative studies with more rigor <sup>1</sup>	2	Qual-2
Group qualitative studies with less rigor	3	Qual-3
Qualitative study with a single informant	4	Qual-4

1170 1 = Highest level of evidence; 4 = lowest level of evidence. Modifications have been made in the terminology to make this  
 1171 model more align with the included research designs in this study and are shown in the footnote below.<sup>2</sup>

<sup>1</sup> Rigor was subjectively assessed and based on the number of included participants, amount of collected data, and detailed explanation how the study was conducted.

<sup>2</sup> The following terminology of Tomlin & Borgetto's (2011) have been modified: association/correlation studies = prevalence studies with analytical component; normative/descriptive studies = prevalence studies without analytical component; individual case studies = case report; controlled-clinical trials = group quasi-experimental study; single-subject studies = quasi-experimental study with single subject; pre-existing groups comparisons with covariate analysis = cohort study; one-group pre-post studies = analytical cross-sectional study.

## Tables

Table 3. Summary table of included articles.

Reference	Study design	Study period	Type of migrant	Sample population	Main category	Subcategory	Quality score	Summary
Scheutz et al <sup>26</sup>	Prevalence (Des-3)	January to May 1982	Asylum seekers & refugees	361 Vietnamese refugees	Disease & injury	Non-communicable disease (Oral health)	Moderate (55.6)	Mental health of refugees was examined, and the study showed a positive relationship between the average number of tooth decay and missing teeth and increase in age among younger refugees.
Levy <sup>27</sup>	Prevalence (Des-2)	July to August 1984	Asylum seekers & refugees	297 children (94 Filipino, 104 Muruts, 99 Kadazan)	Disease & injury	Communicable disease (Parasite)	Low (44.4)	Three groups of children – one refugee group and two indigenous groups – were examined for six types of intestinal parasites. Among the three groups, Filipino refugee children presented significant higher rates of trichuris trichiura and ascaris lumbricoides compared to both groups.
Kassim et al <sup>28</sup>	Case series (Des-3)	1985 to 1986	Unclassified migrants <sup>1</sup>	86 children (7 migrants, <sup>2</sup> 34 Malays, 16 Chinese, 3 mixed origin)	Risk behaviour	Violence & abuse (Neglect)	Moderate (60.0)	In total, 86 children were identified as cases suffering from different types of abuse. Among this group were 7 regular migrant children, where they were identified as neglected, due to lacking nutritional and physical needs.
Zulkifli et al <sup>29</sup>	Analytical cross-sectional (Obs-4)	N/A <sup>2</sup>	Unclassified migrants	1,515 people (336 migrants, <sup>2</sup> 1,075 citizens)	Living conditions	Service environment (Healthcare utilisation)	Low (33.3)	A comparison between migrants and locals regarding maternal and child health outcomes were studied. Migrant women had a lower usage of contraceptives and antenatal care, but used the services of traditional birth attendants more compared to local women. In addition, migrant women had statistically significantly higher rates regarding infant mortality compared to locals.
Rajeswari et al <sup>30</sup>	Prevalence (Des-3)	N/A <sup>2</sup>	Foreign workers <sup>3</sup>	456 children (10 Indonesians, 357 Malays, 78 Orang Asli, 11 Indian)	Disease & injury	Communicable disease (Parasite)	Low (22.2)	School children were examined for different types of helminths and protozoa, and the study showed that children from migrant workers had the highest prevalence.

## Tables

Jeyakumar <sup>31</sup>	Case series (Des-3)	10 May 1993 to 08 July 1993	Unclassified migrants <sup>1,4</sup>	27 migrants (23 Bangladeshi, 4 Indonesians)	Risk behaviour	Poor nutrition (Nutrition deficiency)	Low (40.0)	Twenty-seven detained irregular migrants were sent to the hospital to treat ankle oedema, where they showed a positive response to thiamine treatment.
Jamaiah et al <sup>32</sup>	Case series (Des-3)	1983 to 1992	Unclassified migrants <sup>1</sup>	134 people (22 Indonesian, 22 Others, <sup>2,5</sup> 40 Chinese, 37 Malays, 13 Indians)	Disease & injury	Communicable disease (Parasite)	Low (40.0)	A total of 134 malaria cases were admitted to University Hospital Kuala Lumpur between 1983 and 1992, including 22 irregular Indonesian migrants (16.4%) and (16.4%) other foreigners (such as other irregular migrants from Bangladesh, India, and Thailand, as well as vietnamese refugees. In addition, chloroquine-resistance was found in 9 irregular Indonesian migrants and 6 other foreigners.
Krahl & Hashim <sup>33</sup>	Prevalence (Des-3)	January 1994 to June 1996	Foreign workers <sup>6,7</sup>	39 people (20 Indonesians, 16 Filipinos, 1 Bruneian, 1 Singaporean, 1 Thai)	Disease & Injury	Mental health (Psychiatric disorders)	High (77.8)	Within a two-year period, 39 foreigners were admitted to the psychiatric wards of UHKL., including 30 migrant workers that suffered from a psychiatric disorder. Domestic workers represented with 23 cases the largest group among these foreign workers.
Zabedah et al <sup>34</sup>	Prevalence (Des-2)	N/A <sup>2</sup>	Unclassified migrants	37 people identified; 27 people included (17 Filipinos, 10 locals)	Risk behaviour	Alcohol & other drugs (Inhalant)	Low (22.2)	Among the 37 suspected solvent abusers (glue sniffers) that were admitted to Bukit Padang Psychiatric Hospital, 17 children admitted using these inhalants. Almost two-third of the cases were Filipino immigrants.
Dony et al <sup>35</sup>	Prevalence (Des-3)	N/A <sup>2</sup>	Unclassified migrants	3,908 people (943 foreigners, <sup>2</sup> 2,965 nationals)	Mortality & Morbidity	Morbidity rates (Tuberculosis & leprosy)	Moderate (62.5)	In an epidemiological study aimed to present the tuberculosis and leprosy trends in Sabah. Since 1990, at least 24% of the annual tuberculosis cases were among Indonesian and Filipino migrants, where the annual rate differed between 100 to 200 cases per 100,000 population between 1990 and 2000. Furthermore, leprosy rates among migrants differed from 4.39 cases to 6.19 cases per 100,000 population between 1996 and 2001.

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Chandran et al <sup>36</sup>	Case report (Des-4)	N/A <sup>2</sup>	Foreign workers	1 Myanmar	Disease & injury	Communicable disease (Parasite)	High (83.3)	Jabouley procedure was carried out to treat a 30-year-old Myanmar worker that suffered from a filarial infection. After the procedure, the patient was discharged, but did not show for the follow-up.
Nissapatorn et al <sup>37</sup>	Prevalence (Des-3)	January 2000 to April 2004	Foreign workers	1,885 patients <sup>2</sup>	Disease & injury	Communicable disease (Parasite)	Low (50.0)	Within a four-year period, 1,885 medical records of the university of Malaya Medical Centre were reviewed to identify the prevalence of four common protozoan infections. In total, 28 malaria cases were identified, where 60.7% was among foreigners. The majority of this group consisted of foreign workers.
Sobri et al <sup>38</sup>	Case series (Des-3)	January 1995 to December 2001	Unclassified migrants	42 people (7 Indonesians, 1 Burmese, 1 Siamese (Thai), 1 Bangladeshi, 1 Nepalese, 23 Malays, 6 Chinese, 2 Indians)	Disease & injury	Communicable disease (Bacteria)	Low (50.0)	In total, 42 patients were diagnosed with tuberculosis meningitis at the Kuala Lumpur Hospital during a 7-year period. Eleven (9.5%) out of the 42 tuberculosis meningitis patients were among immigrants.
Leong <sup>39</sup>	Prevalence (Des-3)	1 January 1997 to 31 December 2004	Foreign workers	3,117 Indonesians	Disease & injury	Various diseases (various diseases)	Low (44.4)	During an 8-year-period, 3,117 female migrant (domestic) workers were screened at a private clinic in Johor Bahru, where 223 (7.2%) of them presented medical problems. Hypertension, pulmonary tuberculosis and hepatitis B were the top three major issues.
Sasidharan et al <sup>40</sup>	Prevalence (Des-2)	June 1999 to September 2001	Foreign workers	697 people (26 Bangladeshi, 276 Malays, 229 Chinese, 166 Indians)	Disease & injury	Communicable disease (Bacteria)	High (77.8)	From 1999 to 2002, a total of 697 patients were examined for Helicobacter pylori infection. Twenty-six Bangladeshi foreign workers were among this group, and the infection was present in 6 of them.
Masitah et al <sup>41</sup>	Case series (Des-3)	N/A <sup>2</sup>	Foreign workers	N/A <sup>2</sup>	Disease & injury	Communicable disease (Parasite)	Low (22.2)	During a 6-year period, different malaria registries were reviewed to identify the number of cases in Selangor. The number of annual malaria cases decreased from 172 people in 2001 to 90 people in 2006, while the proportion

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								cases among migrant workers increased from 57% to 66%, respectively.
Shailendra & Prepageran <sup>42</sup>	Case report (Des-4)	N/A <sup>2</sup>	Foreign workers	1 Myanmar	Disease & injury	Communicable disease (Parasite)	High (75.0)	A 38-year-old Myanmar migrant worker presented a case of oropharyngeal rhinosporidiosis. The abnormal growths were removed, and the patient did not show any recurrence of the disease after a 3-month follow-up.
Chan et al <sup>43</sup>	Analytical cross-sectional (Obs-4)	N/A <sup>2</sup>	Foreign workers <sup>1</sup>	699 people (336 Indonesians, 45 Bangladeshi, 45 Indians, 26 Nepalese, 22 Myanmar, 17 Pakistani, 3 Africans, <sup>2</sup> 3 Sri Lankans, 3 Thai, 1 Chinese, 198 Malaysians)	Disease & injury	Communicable disease (Parasite)	Low (0.0)	A sample of 699 people were screened for toxoplasmosis, including 501 migrant workers. Among the migrant workers, 171 (34.1%) cases tested positive for the IgG antibodies test and 26 (5.2%) cases tested positive for the IgM antibodies test. The statistical analysis showed that the infection rate – using the IgG test – was significantly higher among local residents compared to the foreign workers.
Farhana et al <sup>44</sup>	Case series (Des-3)	1999 to 2008	Foreign workers	34 people (3 Myanmar, 1 Indonesian, 1 Pakistani, 14 Chinese, 9 Malays, 6 Indians)	Disease & injury	Communicable disease (Parasite)	Low (60.0)	A total of 34 amoebiasis cases were admitted to Universiti Malaya Medical Centre during a 10-year-period, including five foreign workers.
Chan et al <sup>45</sup>	Analytical cross-sectional (Obs-4)	N/A <sup>2</sup>	Foreign workers <sup>1</sup>	699 people (336 Indonesians, 45 Bangladeshi, 45 Indians, 26 Nepalese, 22 Myanmar, 17 Pakistani, 3 Africans, <sup>2</sup> 3 Sri Lankans, 3 Thai, 1 Chinese, 198 Malaysians)	Disease & injury	Communicable disease (Parasite)	Low (0.0)	A sample of 699 people were screened for toxoplasmosis, including 501 migrant workers. Among the migrant workers, 171 (34.1%) cases tested positive for the IgG antibodies test and 26 (5.2%) cases tested positive for the IgM antibodies test. The statistical analysis showed that the infection rate – using the IgG test – was significantly higher among local residents compared to the foreign workers.

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Murty <sup>46</sup>	Case report (Des-4)	N/A <sup>2</sup>	Foreign workers	1 Myanmar	Disease & injury	Non-communicable disease (Benign)	High (80.0)	37-year-old foreign worker was found dead, and the post-mortem examination showed that the case suffered from a cystic tumour in the heart.
Murty et al <sup>47</sup>	Case series (Des-3)	1996 to 2005	Foreign workers	27 people (16 Indonesians, 1 Bangladeshi, 1 Punjabi, <sup>2</sup> 1 Bajau, <sup>2</sup> 5 Malays, 2 Indians, 1 Chinese)	Disease & injury	Injury (Physical trauma)	Low (44.4)	During a 10-year study period, 27 cases of fatal lightning strikes were identified. The majority of the cases were among foreign workers, where Indonesians had with 16 people (59.3%) the highest prevalence.
Mustafa et al <sup>48</sup>	Prevalence (Des-2)	August 2006 to March 2009	Foreign workers	558 patients (34 foreign labour; <sup>2</sup> 347 Malays; 97 Indians; 80 Chinese)	Disease & injury	Communicable disease (Virus)	Low (44.4)	A total of 558 suspected dengue cases were identified, including 34 migrant workers. Among the foreign labour group, 20 patients presented acute dengue, 4 patients presented recent dengue, and 10 patients tested negative for dengue.
Su et al <sup>49</sup>	Analytical cross- sectional (Obs-4)	3 January 2007 to 24 April 2007	Foreign workers	194 people <sup>8</sup> (95% Indonesians, 5% Bangladeshi)	Disease & injury	Injury (Physical syndrome)	Moderate (57.1)	During a 4-month cross-sectional study, 234 migrant workers were examined for level of occupational vibration exposure and health outcomes. In total, 18% of the migrant workers suffered from hand-arm vibration syndrome (HAVS). In addition, different HAVS-related symptoms were significantly higher among workers with high levels of exposure compared to migrant workers with low levels of exposure.
Daher et al <sup>50</sup>	Prevalence (Des-2)	September 2009 to April 2010	Unclassified migrants	253 Iraqi	Disease & injury	Mental health (Quality of life)	High (75.0)	Health-related quality of life of 253 Iraqi migrants was examined, showing that their quality of life was moderate and statically significant higher levels were found among males and married people.
Ratnasingam et al <sup>51</sup>	Prevalence (Des-2)	January 2010 to	Foreign workers	5,340 people (1,348 Bangladeshi, 843 Myanmar, 743	Disease & injury	Injury (Physical trauma)	Low (11.1)	A total of 5,340 workers in the furniture industry were examined, where 59% of this population was foreign labour. Compared to local workers, migrant workers had

## Tables

		November 2010		<i>Nepalese, 217 Indonesians, 2,190 Malaysians)</i>					less occupational accidents and a more positive work-oriented mentality.
Ab Rahman & Abdullah <sup>52</sup>	Case report (Des-4)	N/A <sup>2</sup>	Foreign workers	<i>1 Nepalese</i>	Disease & injury	Communicable disease (Parasite)	High (87.5)		24-year-old Nepalese migrant worker presented a long medical history of different symptoms, including fever, abdominal pain, and poor appetite. Clinical examination showed that the patient suffered from a visceral leishmaniasis and malaria co-infection, and he was treated with chloroquine and amphotericin B. A follow-up was carried out after 6 months and the man remained well.
Taib & Baba <sup>53</sup>	Case series (Des-3)	2006 to 2009	Foreign workers	<i>75 patients (38 foreigners,<sup>8</sup> 37 locals)</i>	Disease & injury	Communicable disease (Bacteria)	Low (30.0)		total of 75 leprosy cases were detected at the Hospital Kuala Lumpur Hansen's Clinic during a 4-year period. With 38 patients, foreign workers represented more than half of the cases.
Osman et al <sup>54</sup>	Prevalence (Des-3)	June 2012 to September 2012	Unclassified migrants	<i>108 Iraqi</i>	Risk behaviour	Sexual behaviour (HPV knowledge)	Low (50.0)		knowledge and awareness regarding cervical cancer and pap smear tests were assessed among 108 Iraqi migrant women. In general, this population lacks understanding regarding cervical cancer and the importance of pap smear tests.
Minhat et al <sup>55</sup>	Prevalence (Des-2)	April 2010 to June 2010	Unclassified migrants	<i>271 Iranians</i>	Risk behaviour	Sexual behaviour (HPV knowledge)	Low (25.0)		The knowledge regarding HPV vaccination of 271 Iranian male migrants was evaluated and showed that the majority of the study population has poor knowledge regarding this matter. Marital status was the only predictive factor that was statistically significant, where married women were 3.6 times more likely to have good HPV knowledge.
Mendelsohn et al <sup>56</sup>	Qualitative (Qual-2)	July 2010 to September 2010	Asylum seekers & refugees	<i>14 Myanmar<sup>9</sup></i>	Living conditions	Service environment (Healthcare utilisation)	High (90.0)		fourteen Myanmar refugees were interviewed to explore the difficulties that this group has in accessing anti-retroviral therapy (ART). Barriers to comply to ART



## Tables

								include lack of an UNHCR identity card, fear of arrest during travelling to the hospital, corruption, financial issues, and receiving small quantities of ART medication for refill.
Mendelsohn et al <sup>57</sup>	Analytical cross-sectional (Obs-4)	April 2010 to July 2010	Asylum seekers & refugees	299 people (146 Myanmar, 5 Others, <sup>2</sup> 148 Malaysians)	Living conditions	Service environment (Healthcare utilisation)	High (83.3)	ART compliance and virological outcomes were compared between HIV-infected refugees and locals, where the study showed that both groups had similar rates of compliance and unsuppressed viral loads.
Kwan et al <sup>58</sup>	Case series (Des-3)	2008 to 2013	Unclassified migrants	27 people (3 Indonesians, 2 Indians, 2 Nepalese, 2 Myanmar, 1 Sri Lankan, 17 Malaysians)	Disease & injury	Communicable disease (Bacteria)	Low (40.0)	Between 2008 and 2013, 27 leprosy cases were identified by reviewing the Dermatology Clinic census. Out of the 27 identified leprosy cases, 37% of them were among immigrants.
Santos et al <sup>59</sup>	Prevalence (Des-3)	February 2013 to June 2013	Foreign workers	317 people (110 Sri Lankans, 85 Indonesians, 71 Indians, <sup>8</sup> 22 Nepalese, 20 Indians, <sup>8</sup> 9 Myanmar)	Disease & injury	Injury (Physical syndrome)	Moderate (55.6)	A sample of 317 migrant workers were examined to explore the prevalence of musculoskeletal pain among this group. Almost two-third (203 people) of the surveyed migrant workers suffered from work-related musculoskeletal complaints. Pain in the knee/leg/foot area was the most common, as 85 migrant workers reported this outcome.
Razali et al <sup>60</sup>	Case series (Des-3)	2000 to 2012	Unclassified migrants	18 females (2 Indonesians, 1 Myanmar, 6 Malays, 5 Chinese, 3 Indians, 1 Punjabi)	Risk behaviour	Violence & abuse (Murder)	High (80.0)	Clinical records of two forensic psychiatric institutions were reviewed during 2000 and 2012. A total of 18 cases that committed maternal filicide were detected, including 3 immigrant women that suffered from adverse life events.
Elmi et al <sup>61</sup>	Case control (Obs-3)	January 2010 to April 2014	Unclassified migrants	209 cases (49 migrants, <sup>2</sup> 265 locals)	Disease & injury	Communicable disease (Bacteria)	Low (50.0)	A case control study was conducted to identify risk factors regarding multidrug-resistant tuberculosis (MDR-TB) development. The study showed that MDR-TB was more prevalent than non-MDR-TB among foreign patients, and

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								that MDR-TB was significantly higher among migrants compared to locals.
Santos et al <sup>62</sup>	Prevalence (Des-2)	March 2013 to April 2013	Foreign workers	317 people (110 Sri Lankans, 85 Indonesians, 71 Indians, <sup>8</sup> 22 Nepalese, 20 Indians, <sup>8</sup> 9 Myanmar)	Living conditions	Economic & work environment (Occupational hazards)	Low (44.4)	The study assessed overall levels of pain and identified perceived environmental hazards among a group of foreign workers. In total, 204 out of 317 migrant workers suffered from musculoskeletal pain, and noise (37.5%) and dust (37.2%) were perceived as the main environmental hazards among this group.
William et al <sup>63</sup>	Prevalence (Des-2)	4 July 2012 to 3 July 2014	Unclassified migrants	176 people (53 Filipinos, 6 Indonesians, 106 Indigenous, 10 Chinese, 1 Indian)	Disease & injury	Communicable disease (Bacteria & Virus)	High (77.8)	During a 2-year study, 176 participants that tested positive for pulmonary tuberculosis at the Luyang Clinic in Kota Kinabalu were enrolled in the study. More than one-third of the patients (33.5%) were migrants. In addition, out of the three patients with a HIV co-infection, one was a migrant.
Siah et al <sup>64</sup>	Prevalence (Des-2)	N/A <sup>2</sup>	Asylum seekers & refugees	89 children (39.3% Myanmar, 21.3% Somali, 22.5% Sudanese, 16.9% Others <sup>2</sup> )	Disease & injury	Mental health (Quality of life)	Low (11.1)	A total of 89 refugee children were surveyed to investigate factors that influence their quality of life. Experiencing deportation, lower levels of education and unemployment of their fathers were significantly associated with a lower quality of life.
Guinto et al <sup>65</sup>	Scoping review <sup>10</sup>	2000 to 2014	Foreign workers	N/A	Institutional inequities	Laws & regulations (Universal Health Coverage)	N/A	The study presented implementation challenges of universal health coverage (UHC) in Southeast Asian countries. Malaysia implemented some measures regarding healthcare for migrant workers, however, government-run UHC is still lacking.
Vijian et al <sup>66</sup>	Analytical cross-sectional (Obs-4)	2010 to 2015	Foreign workers	50 people (8 Bangladeshi, 6 Nepalese, 3 Myanmar, 1 African, <sup>2,11</sup> 1 Pakistani,	Disease & injury	Non-communicable disease (Perforation)	Low (16.7)	Twenty foreign workers and 30 local patients that suffered from perforated peptic ulcers were compared to each other to assess the difference in characteristics between these two groups. Several characteristics were

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					<i>1 Vietnamese, 14 Malays, 12 Chinese, 4 Indians)</i>				significantly different, where foreign workers were on average 18 years younger (mean age = 30.4), suffered from smaller-sized ulcers, and experienced lower levels of post-operative complications.
Azian et al <sup>67</sup>	Prevalence (Des-2)	N/A <sup>2</sup>	Foreign workers	<i>2,153 samples<sup>12</sup> (1,422 Bangladeshi, 349 Indians, 201 Nepalese, 78 Indonesians, 58 Vietnamese, 45 Myanmar)</i>	Disease & injury	Communicable disease (Parasite)	Low (11.1)		A total of 2,153 blood samples were taken from migrant workers that were located in seven states of Peninsular Malaysia and were tested for leishmaniasis infection. More than half (55.3%) of the collected blood samples were found positive.
Sahimin et al <sup>68</sup>	Prevalence (Des-2)	September 2014 to August 2015	Foreign workers	<i>388 people (167 Indonesians, 81 Nepalese, 70 Bangladeshi, 47 Indians, 23 Myanmar)</i>	Disease & injury	Communicable disease (Parasite)	Low (33.3)		A cross-sectional study was conducted to examine the prevalence of different intestinal parasitic infections among foreign labour. Out of the 388 migrant workers, infection rates were between 52.1% and 84%. Higher infection rates significantly associated with migrants from Nepal and India, recently arrived in the country, and less than 1-year work experience in Malaysia.
Noh et al <sup>69</sup>	Prevalence (Des-2)	N/A <sup>2</sup>	Foreign workers	<i>600 foreign workers<sup>2</sup></i>	Living conditions	Service environment (Healthcare utilisation)	Low (22.2)		Data of 600 foreign workers was obtained to explore their healthcare utilisation. Most of them utilise health services occasionally (88.5%) and the majority (61.4%) goes to government hospitals.
Kamaludin & How <sup>70</sup>	Analytical cross-sectional (Obs-4)	February 2016 to April 2016	Foreign workers	<i>120 people<sup>2</sup> (60 foreign workers, 60 local workers)</i>	Risk behaviour	Hazard & safety awareness (environmental risk)	Low (50.0)		The study compared environmental health awareness between 60 local workers and 60 migrant workers, where the latter group showed significant lower levels of awareness.
Min et al <sup>71</sup>	Prevalence (Des-3)	January 2011 to	Foreign workers	<i>440 people (46 Indonesians, 37 Bangladeshi, 33</i>	Disease & injury	Injury (Physical trauma)	Moderate (62.5)		Medical records of the Hospital Sultan Ismail in Johor Bahru were reviewed between January 2011 and December 2013 to describe the prevalence of work-

Tables

		December 2013		<i>Nepalese, 17 Myanmar, 11 Pakistani, 8 Others,<sup>2</sup> 226 Malays, 32 Chinese, 20 Others,<sup>2</sup> 10 Indians)</i>					related ocular traumas. More than one-third of the ocular injuries were among foreign workers and contributed to two-third of the open eye traumas.
Woh et al <sup>72</sup>	Prevalence (Des-3)	N/A <sup>2</sup>	Foreign workers	<i>317 people (140 Indians, 80 Nepalese, 36 Indonesians, 29 Bangladeshi, 18 Myanmar, 7 Pakistani, 4 Sri Lankans, 2 Vietnamese, 1 Thai)</i>	Disease & injury	Communicable disease (Bacteria)	Low (44.4)		A cross-sectional study was conducted among 317 migrant food handlers from Ipoh, Kuala Terengganu, and Shah Alam to assess the Salmonella prevalence of this group, resulting in nine (2.8%) people testing positive. Seven out of these 9 cases presented multidrug resistance towards trimethoprim-sulfamethoxazole (6 cases), streptomycin (7 cases), ampicillin (4 cases), chloramphenicol (4 cases), sulphonamides (6 cases), and tetracycline (7 cases).
Tanabe et al <sup>73</sup>	Mixed-method <sup>10</sup>	N/A <sup>2</sup>	Asylum seekers & refugees	<i>Participants per method<sup>9</sup> (422 Myanmar - survey; 66 Myanmar - focus group; 6 people<sup>2</sup> - interviews; 4 facility assessments)</i>	Living conditions	Service environment (Healthcare utilisation)	N/A		A multiple-country study was conducted to explore barriers regarding family planning services among refugees, where the main challenges included lack of understanding and misinformation concerning contraceptives, language barriers, financial issues, retention concerns, and distance of service delivery points.
Ratnalingam et al <sup>74</sup>	Prevalence (Des-2)	N/A <sup>2</sup>	Foreign workers	<i>207 patients<sup>2</sup></i>	Disease & injury	Communicable disease (Bacteria)	Low (33.3)		A total of 207 patients from four different hospitals in Malaysia were enrolled in the study to describe the characteristics and risk factors of microbial keratitis. More than one-fourth of the cases were due to work-related traumas, where 34.2% of these cases were among male migrant workers.
Woh et al <sup>75</sup>	Prevalence (Des-2)	N/A <sup>2</sup>	Foreign workers	<i>383 swab samples<sup>12</sup></i>	Risk behaviour	Hygiene & sanitation (Food preparation)	Low (22.2)		A total of 383 hand swabs were obtained from migrant food handlers to investigate the prevalence of aerobic

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## Tables

					<i>(Indians, Nepalese, Indonesians, Bangladeshi, Myanmar, Pakistani, Sri Lankans, Thai, Vietnamese)</i>				face counts (APC), <i>Staphylococcus aureus</i> , and <i>Escherichia coli</i> , resulting in 99.5%, 64.4%, and 20.8% testing positive, respectively. In general, levels of the first two exceeded the acceptable standard. Infection rates were significantly higher among food handles from India compared food handlers from Nepal. In addition, significant higher rates were found among cooks, followed by waiters, compared to managers.
Noor & Shaker <sup>76</sup>	Analytical cross-sectional (Obs-4) <sup>13</sup>	N/A <sup>2</sup>	Foreign workers	119 Indonesians	Disease & injury	Mental health (Stress)	High (85.7)		A sample of 119 migrant workers were examined to explore the relationship between psychological distress and workplace discrimination, and the effect of coping strategy on stress levels. The study showed that workplace discrimination increased levels of stress. In addition, problem-oriented coping strategies were related to lower stress levels, while the emotional and avoidance coping strategy was associated to higher levels of stress.
Noordin et al <sup>77</sup>	Prevalence (Des-3)	September 2014 to August 2015	Foreign workers	484 foreign labour (246 Indonesians, 103 Nepalese, 69 Bangladeshi, 51 Indians, 14 Myanmar, 1 Vietnamese)	Disease & injury	Communicable disease (Parasite)	Low (33.3)		Lymphatic filariasis prevalence among foreign labour was determined by screening 484 migrant workers, showing that 6.8% and 2.1% suffered from bancroftian filariasis and brugian filariasis, respectively.
Sahimin et al <sup>78</sup>	Prevalence (Des-2)	September 2014 to August 2015	Foreign workers	484 people (247 Indonesians, 99 Nepalese, 72 Bangladeshi, 52 Indians, 14 Myanmar)	Disease & injury	Communicable disease (Parasite)	Low (44.4)		A total of 484 foreign workers were sampled to describe the prevalence of <i>Toxoplasma gondii</i> and factors related to higher infection rates. In total, 278 migrant workers (57.4%) tested positive for <i>T gondii</i> , where significant higher levels of infection were associated with Nepalese origin, newly arrived in Malaysia, and working in manufacturing.

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Labao et al <sup>79</sup>	Prevalence (Des-3)	N/A <sup>2</sup>	Foreign workers	60 <i>Filipinos</i>	Disease & injury	Injury (Physical syndrome)	Moderate (55.6)	A cross-sectional study was conducted to investigate which body regions were presenting the most work-related musculoskeletal complaints among migrant workers. The major affected areas included the shoulder (40%), lower back (60%), upper back (48.3%), and neck (25%) regions.
Shaw et al <sup>80</sup>	Randomised controlled trial (Exp-2)	N/A <sup>2</sup>	Asylum seekers & refugees	39 <i>Afghans</i>	Disease & injury	Mental health (Stress)	Low (30.8)	In order to assess the impact of cognitive behavioural therapy (CBT) on emotional distress, an 8-week intervention was conducted among 39 female refugees. As a result, the intervention significantly lowered levels of posttraumatic stress, anxiety, emotional distress, and depression.
Rahman et al <sup>81</sup>	Case control (Obs-3)	N/A <sup>2</sup>	Unclassified migrants <sup>4</sup>	61 <i>people</i> (52 <i>Myanmar</i> , 9 <i>Others</i> <sup>2</sup> )	Risk behaviour	Poor nutrition (Nutrition deficiency)	Moderate (60.0)	A case control study was conducted to determine the factors that were related to bilateral leg swelling among detained irregular migrants. Out of the 226 inmates, 21 Myanmar were identified as cases and were compared to 21 controls from Myanmar, Indonesia, Nepal, and Vietnam. The study showed that the illness was caused due to a thiamine deficiency, as the patients lacked the consumption of meat. Intravenous and oral thiamine treatment was provided, and the patients responded well to it.
Sahimin et al <sup>82</sup>	Prevalence (Des-2)	September 2014 to August 2015	Foreign workers	388 <i>people</i> (167 <i>Indonesians</i> , 81 <i>Nepalese</i> , 70 <i>Bangladeshi</i> , 47 <i>Indians</i> , 23 <i>Myanmar</i> )	Disease & injury	Communicable disease (Parasite)	Low (44.4)	A sample of 388 foreign workers were examined to describe the prevalence of <i>Giardia duodenalis</i> and <i>Cryptosporidium parvum</i> , showing that 42 people (10.8%) and 12 people (3.1%) tested positive, respectively. Indonesian nationality, work in the manufacturing and service sector, and newly arrived in Malaysia were significantly associated with G.

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								modenalis, while <i>C. parvum</i> was only significantly associated with employment in the food industry.
Nwabichie et al <sup>83</sup>	Prevalence (Des-2)	N/A <sup>2</sup>	Unclassified migrants	320 people <sup>2</sup> (50% Nigerians, 15% Ghanaians, 35% Others [from Sudan, Tanzania, Kenya and South Africa])	Risk behaviour	Sexual behaviour (HPV knowledge)	High (77.8)	In total, 320 African female migrants were surveyed to investigate risk factors that are related to higher HPV risk behaviour. Only 27.2% of the sample obtained cervical cancer screening, where higher levels of screening were significantly associated with having knowledge regarding cervical cancer, being married, having a standard health care provider, and no perceived barriers when obtaining the check-up.
Jeffrey et al <sup>84</sup>	Case control (Obs-3)	N/A <sup>2</sup>	Foreign workers	470 people <sup>2</sup>	Disease & injury	Communicable disease (Parasite)	Moderate (60.0)	A case-control study was conducted to determine the risk factors related to a malaria outbreak, where rubber tappers including one migrant worker – presented a higher infection rate.
Zerguine et al <sup>85</sup>	Analytical cross-sectional (Obs-4)	June 2016 to September 2016	Foreign workers	323 people (155 Bangladeshi, 126 Indonesians, 25 Pakistani, 11 Nepalese, 6 Chinese)	Disease & injury	Injury (Physical trauma)	Moderate (57.1)	A total of 323 migrant workers were sampled to investigate the prevalence and causes of workplace injuries, and examine the relationship between these traumas and safety commitment variables. The study showed that 22.6% of the foreign workers suffered from work-related injury, mostly due to falls from heights (1.5%), and that there was a significant association between various injuries and different safety commitment-related variables, such as safe equipment and safety training.
Ya'acob et al <sup>86</sup>	Randomised controlled Trial (Exp-2)	N/A <sup>2</sup>	Foreign workers	54 Indonesians	Disease & injury	Injury (Physical syndrome)	Low (38.5)	A workplace intervention was conducted to assess the effect of Kiken Yochi training on musculoskeletal symptoms among foreign workers, where the study showed that the intervention significantly decreased

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								musculoskeletal symptoms in feet and ankle areas compared to the control group.
Chuah et al <sup>10</sup>	Qualitative (Qual-2)	July 2016 to November 2017	Asylum seekers & refugees	20 stakeholders <sup>14</sup>	Living conditions	Service environment (Healthcare utilisation)	High (80.0)	Twenty stakeholders were interviewed to explore the barriers that refugees and asylum seekers encounter during healthcare utilisation, showing that cultural competency, insufficient health literacy, healthcare expenses, and not being aware of their rights were the main challenges.
Loganathan et al <sup>87</sup>	Qualitative (Qual-2)	July 2018 to September 2018	Foreign workers	18 stakeholders <sup>14</sup>	Living conditions	Service environment (Healthcare utilisation)	High (80.0)	A qualitative study with 18 stakeholders demonstrated that migrant workers face several complications with respect to utilising healthcare, including financial issues, discrimination, lack of valid passports and work permits, cultural competency, and physical barriers.
Rahman et al <sup>88</sup>	Prevalence (Des-3)	N/A <sup>2</sup>	Foreign workers	314 Bangladeshi	Living conditions	Service environment (Healthcare utilisation)	Low (33.3)	A group of 314 migrant workers were sampled to present the distribution of diseases and healthcare utilisation pattern. Fever and sprains were the most reported diseases among the group that suffered from an illness in the last two weeks, while fever and gastrointestinal diseases were the most prevalent among the group that suffered from an illness in the last month. In addition, the majority (approx. 70%) visited hospitals to seek treatment.
Siah et al <sup>89</sup>	Qualitative (Qual-3)	N/A <sup>2</sup>	Asylum seekers & refugees	8 stakeholders (5 refugees, <sup>2</sup> 3 locals)	Living conditions	Social environment (Prejudice)	Low (50.0)	Eight people stakeholders were interviewed to explore the forms of discrimination that refugee children experience. The study shows that refugee children suffer from denied access to health care, not receiving proper education, and being judged by their social environment.



## Tables

Sahimin et al <sup>90</sup>	Prevalence (Des-2)	September 2014 and August 2015	Foreign workers	<i>610 people (246 Indonesians, 99 Nepalese, 72 Bangladeshi, 52 Indians, 14 Myanmar)</i>	Disease & injury	Communicable disease (Parasite)	Low (33.3)	Four different diagnostic tests were applied to identify <i>Strongyloides stercoralis</i> among migrant workers, where prevalence rates differed between 0.8% and 35.8%
Chuah et al <sup>91</sup>	Qualitative (Qual-2)	July 2016 to January 2018	Asylum seekers & refugees	20 stakeholders <sup>14</sup>	Living conditions	Service environment (Healthcare utilisation)	High (80.0)	Twenty stakeholders were interviewed to identify the challenges with respect to accessing healthcare among refugees, showing that out of pocket healthcare spending, language and cultural competency barriers, and access to medication are the top healthcare challenges.

\*Sample population in *italic* represents the migrant population;

\*\*The following abbreviations are used in the table: N/A = Data not available; HPV = Human Papilloma Virus

<sup>1</sup>Includes irregular migrants.

<sup>2</sup>Data to present detailed information is lacking.

<sup>3</sup>Includes children of migrant workers, which is according to the IOM (2011) definition still classified as migrant workers

<sup>4</sup>Includes detained migrants.

<sup>5</sup>Includes refugees, international students, expats, and unclassified migrants.

<sup>6</sup>Includes 3 expats; <sup>7</sup>Includes 6 transnational marriage migrants.

<sup>8</sup>Ambiguous reporting of the data.

<sup>9</sup>Includes a multiple-country study, and, therefore, subjects that were included in countries other than Malaysia are not reported in this table.

<sup>10</sup>Level of evidence and quality appraisal is not available for this study design.

<sup>11</sup>Includes an international student.

<sup>12</sup>Number of samples might not be similar to the number of study participants.

Tables

<sup>13</sup>Despite of lacking a comparison group, this study was identified as an analytical cross-sectional study due to the aim – testing two hypotheses – and comprehensive statistical analysis.

<sup>14</sup>Representing the population of interest (as shown in the ‘type of migrant’ category).

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## Tables

Table 4. Number and average quality of included articles disaggregated by type of migrant and BARHII dimensions

Category	Number of studies per study design with level of evidence									Total # studies	Mean quality	References
	CR-4	AC-4	QL-3	CS-3	PR-3	CC-3	QL-2	PR-2	RC-2			
<i>Type of migrant</i>												
Asylum seekers & refugees	-	1	1	-	1	-	3	2	1	10 <sup>1</sup>	58.4%	26 27 56 57 64 73 80 89 91
Foreign workers	4	7	-	4	10	1	1	12	1	41 <sup>2</sup>	45.7%	33 36 37 39-49 51-53 59 62 65-72 74-79 82 84-88 90
Unclassified migrants	-	1	-	6	2	2	-	5	-	16	52.7%	29 31 32 34 35 38 50 54 55 58 60 61 63 81 83
<i>Dimension of BARHII framework</i>												
Institutional inequities	-	-	-	-	-	-	-	-	-	1 <sup>2</sup>	-	
Living conditions	-	2	1	-	1	-	4	2	-	11 <sup>1</sup>	59.7%	29 56 57 62 69 73 87-89 91
Risk behaviour	-	1	-	3	1	1	-	4	-	10	48.7%	31 34 54 55 60 70 75 81 83
Disease & injury	4	6	-	7	11	2	-	14	2	46	46.3%	27 30 32 33 36-53 58 59 61-64 66-68 71 72 74 76-80 82 84-86 88 90
Mortality & morbidity	-	1	-	-	1	-	-	-	-	2	47.9%	35
<i>Subdimensions of institutional inequities</i>												
Laws & regulations	-	-	-	-	-	-	-	-	-	1 <sup>2</sup>	-	
<i>Subdimensions of living conditions</i>												
Social environment	-	-	1	-	-	-	-	-	-	1	50.0%	
Economic and work environment	-	-	-	-	-	-	-	1	-	1	44.4%	
Service environment	-	2	-	-	1	-	4	1	-	9 <sup>1</sup>	62.8%	29 56 57 69 73 87 88 91
<i>Subdimensions of risk behaviour</i>												
Poor nutrition	-	-	-	1	-	1	-	-	-	2	50.0%	81
Violence & abuse	-	-	-	2	-	-	-	-	-	2	70.0%	60
Alcohol & other drugs	-	-	-	-	-	-	-	1	-	1	22.2%	
Sexual behaviour	-	-	-	-	1	-	-	2	-	3	50.9%	55 83
Hygiene & sanitation	-	-	-	-	-	-	-	1	-	1	22.2%	
Hazard & safety awareness	-	1	-	-	-	-	-	-	-	1	50.0%	
<i>Subdimensions of disease &amp; injury</i>												

Tables

Communicable disease	3	2	-	6	4	2	-	10	-	27	44.2%	30 32 36-38 40-45 48 52 53 58 61 63 67 68 72 74 77 78 82 84 90
Non-communicable disease	1	1	-	-	1	-	-	-	-	3	50.8%	46 66
Injury	-	2	-	1	3	-	-	2	1	9	47.4%	49 51 59 62 71 79 85 86
Mental health	-	1	-	-	1	-	-	2	1	5	56.1%	50 64 76 80
Various diseases	-	-	-	-	2	-	-	-	-	2	38.9%	88
<i>Subdimensions of mortality &amp; morbidity</i>												
Mortality rates	-	1	-	-	-	-	-	-	-	1	33.3%	
Morbidity rates	-	-	-	-	1	-	-	-	-	1	62.5%	
<b>Total</b>	<b>4</b>	<b>9</b>	<b>1</b>	<b>10</b>	<b>13</b>	<b>3</b>	<b>4</b>	<b>19</b>	<b>2</b>	<b>67<sup>1,2</sup></b>	<b>49.2%</b>	67

\*Abbreviations for the type of study with the related level of evidence (the number after the dash) are used to describe the included studies: CR-4 = case report; AC-4 = analytical cross-sectional study; QL-3 = qualitative study with less rigour; CS-3 = case series; PR-3 = prevalence study without analytical component; CC-3 = case control; QL-2 = qualitative study with more rigour; PR-2 = prevalence study with analytical component; RC-2 = randomised controlled trial.

\*\*Level of evidence ranks from 1 to 4, where 1 is the highest level of evidence and 4 is the lowest level.

<sup>1</sup>Includes a mixed-method design, which was not appraised for level of evidence nor quality of the study;

<sup>2</sup>Includes a scoping review design, which was not appraised for level of evidence nor quality of the study.

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## Tables

Table 5. Number and average quality of included articles disaggregated by research design category.

Research design	Level of evidence	Included studies	Mean quality	References
<i>Descriptive research</i>				
Systematic review of descriptive studies	1	-	-	-
Prevalence study with analytical component	2	19	39.7%	27 34 40 48 50 51 55 62-64 67-69 74 75 78 82 83 90
Case series	3	10	46.7%	28 31 32 38 41 44 47 53 58 60
Prevalence study without analytical component	3	13	49.8%	26 30 33 35 37 39 54 59 71 72 77 79 88
Case report	4	4	81.5%	36 42 46 52
Total		46	47.7%	26-28 30-42 44 46-48 50-55 58-60 62-64 67-69 71 72 74 75 77-79 82 83 88 90
<i>Experimental research</i>				
Systematic review/meta-analysis of experimental studies	1	-	-	-
Randomised controlled trial	2	2	34.7%	80 86
Group quasi-experimental study (non-randomised)	3	-	-	-
Quasi-experimental study with single subject	4	-	-	-
Total		2	34.7%	80 86
<i>Observational research</i>				
Systematic review/meta-analysis of observational studies	1	-	-	-
Cohort study	2	-	-	-
Case-control	3	3	56.7%	61 81 84
Analytical cross-sectional study	4	9	42.6%	29 43 45 49 57 66 70 76 85
Total		12	46.1%	29 43 45 49 57 61 66 70 76 81 84 85
<i>Qualitative research</i>				
Systematic review/meta-synthesis of qualitative studies	1	-	-	-
Group qualitative studies with more rigor	2	4	82.5%	10 56 87 91
Group qualitative studies with less rigor	3	1	50.0%	89
Qualitative study with a single informant	4	-	-	-
Total		5	76.0%	10 56 87 89 91
<b>Total</b>		<b>67<sup>1</sup></b>	<b>49.2%</b>	1-67

Tables

<sup>1</sup>Includes a mixed-method design and a scoping review, which were both not assessed for the level of evidence nor quality appraisal.

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## Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
<b>TITLE</b>			
Title	1	Identify the report as a scoping review.	
<b>ABSTRACT</b>			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	
<b>INTRODUCTION</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	
<b>METHODS</b>			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	





SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
<b>RESULTS</b>			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	
<b>DISCUSSION</b>			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	
Limitations	20	Discuss the limitations of the scoping review process.	
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	
<b>FUNDING</b>			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

\* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med.* 2018;169:467–473. doi: [10.7326/M18-0850](https://doi.org/10.7326/M18-0850).



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## Supplementary file 2. Detailed search strategy

### I.1. EconLit

Database name	EconLit
Database search engine	OvidSP
Dates of database coverage	1886 to September 12, 2019
Date search conducted	17 September 2019
Total number of hits	348

#	Searches	Results
1	asylum* OR displaced OR emigra* OR emigre* OR foreign born OR foreign labor OR foreign labour OR foreign work* OR foreign-born OR foreign-work* OR foreigner* OR immigra* OR migra* OR people of concern OR person of concern OR persons of concern OR refugee* OR smuggl* OR traffick* OR transient* OR transmigrant*	120,090
2	abnormalit* OR abortion* OR abscess* OR accident* OR ache* OR aids OR ailment* OR alcohol* OR allerg* OR anorexia OR AMR OR antibiotic resistan* OR antimicrobial resistan* OR anxiet* OR allerg* OR apnoea OR arthritis OR ascariasis OR assault* OR asthma OR attack* OR bacteri* OR bipolar OR bite* OR blastoma* OR bleed* OR blind OR blood OR burn* OR cancer* OR cardio* OR Chagas OR chlamydia OR cholesterol OR coma OR complication* OR condition* OR condom* OR contraception OR cyst* OR dead OR deaf OR death* OR decay OR deform* OR dehydrat* OR dementia OR dengue OR depress* OR diabetes OR diarrhoea OR disabilit* OR disease* OR disorder* OR dracunculiasis OR drug* OR dysfunction* OR eczema OR enlargement* OR epilep* OR exhaust* OR failure OR fatal* OR fatigue OR fever* OR filariasis OR flu OR gall stone* gallstone* OR gonorrhoea OR headache* OR health OR healthcare OR hearing loss OR helminth* OR hepatitis OR hernia* OR herpe* OR HIV OR hookworm* OR HPV OR hypertension OR illness* OR indigestion* OR infect* OR inflame* OR injur* OR leishmaniasis OR leprosy OR leukaemia OR leukemia OR lice OR life expectancy OR malaria OR malformat* OR malnutrition OR measles OR medical OR melanoma* OR mental* OR migraine OR miscarriage* OR morbidit* OR mortalit* OR muscl* OR myeloma OR nausea OR neuro* OR nutrition* OR onchocerciasis OR osteoarthritis OR osteoporosis OR pain* OR parasite* OR patient care OR physical activ* OR pneumonia OR poison* OR	373,019

	psoriasis OR psychiatric OR psychos* OR rabies OR rape* OR reproductiv* OR rheuma* OR ringworm* OR sarcoma* OR scabies OR schistosomiasis OR schizophren* OR seizure* OR sepsis* OR sexual* OR shock* OR sick* OR smoking OR sore* OR STD* OR stillbirth* OR stress* OR stroke* OR suicid* OR sunburn* OR syndrome* OR syphilis OR TB OR thrombosis OR tobacco OR STI* OR toothache* OR trachoma OR trauma* OR trichuriasis OR trichomoniasis OR trypanosomiasis OR tuberculosis OR tumor* OR tumour* OR ulcer* OR violence OR virus* OR vomit* OR wart* OR well-being OR wellbeing OR worm* OR wound*	
3	Malaysia OR Johor OR Kedah OR Kelantan OR Kuala Lumpur OR Labuan OR Malacca OR Melaka OR Malaya OR Negeri Sembilan OR Pahang OR Penang OR Perak OR Perlis OR Putrajaya OR Sabah OR Sarawak OR Selangor OR Terengganu	6,883
4	Malaysian	1,654
5	area* OR Borneo OR city OR cities OR district* OR island* OR isle* OR province* OR region* OR state* OR territor* OR village*	367,269
6	4 AND 5	361
7	3 OR 6	6,925
8	1 AND 2 AND 7	348
9	Animal migration OR bird migration OR cell* OR membrane* OR molecu*	2,622
10	8 NOT 9	348

## I.2. Embase

Database name	Embase
Database search engine	OvidSP
Dates of database coverage	1947 to 2019 September 13
Date search conducted	17 September 2019
Total number of hits	549

#	Searches	Results
1	asylum* OR displaced OR emigra* OR emigre* OR foreign born OR foreign labor OR foreign labour OR foreign work* OR foreign-born OR foreign-work* OR foreigner* OR immigra* OR migra* OR people of concern OR person of concern OR persons of concern OR refugee* OR smuggl* OR traffick* OR transient* OR transmigrant*	1,124,805
2	asylum seeker [MeSH]	793
3	emigrant [MeSH]	293
4	foreign worker [MeSH]	5,306
5	human trafficking [MeSH]	697
6	migrant worker [MeSH]	1,548
7	migrant [MeSH]	35,567
8	migration [MeSH]	45,436
9	immigrant [MeSH]	16,376
10	refugee [MeSH]	12,425
11	refugee camp [MeSH]	553
12	undocumented immigrant [MeSH]	350
13	1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12	1,125,119
14	abnormalit* OR abortion* OR abscess* OR accident* OR ache* OR aids OR ailment* OR alcohol* OR allerg* OR anorexia OR AMR OR antibiotic resistan* OR antimicrobial resistan* OR anxiet* OR allerg* OR apnoea OR arthritis OR ascariasis OR assault* OR asthma OR attack* OR bacteri* OR bipolar OR bite* OR blastoma*	31,271,711

	OR bleed* OR blind OR blood OR burn* OR cancer* OR cardio* OR Chagas OR chlamydia OR cholesterol OR coma OR complication* OR condition* OR condom* OR contraception OR cyst* OR dead OR deaf OR death* OR decay OR deform* OR dehydrat* OR dementia OR dengue OR depress* OR diabetes OR diarrhoea OR disabilit* OR disease* OR disorder* OR dracunculiasis OR drug* OR dysfunction* OR eczema OR enlargement* OR epilep* OR exhaust* OR failure OR fatal* OR fatigue OR fever* OR filariasis OR flu OR gall stone* gallstone* OR gonorrhoea OR headache* OR health OR healthcare OR hearing loss OR helminth* OR hepatitis OR hernia* OR herpe* OR HIV OR hookworm* OR HPV OR hypertension OR illness* OR indigestion* OR infect* OR inflame* OR injur* OR leishmaniasis OR leprosy OR leukaemia OR leukemia OR lice OR life expectancy OR malaria OR malformat* malnutrition OR measles OR medical OR melanoma* OR mental* OR migraine OR miscarriage* OR morbidit* OR mortalit* OR muscl* OR myeloma OR nausea OR neuro* OR nutrition* OR onchocerciasis OR osteoarthritis OR osteoporosis OR pain* OR parasite* OR patient care OR physical activ* OR pneumonia OR poison* OR psoriasis OR psychiatric OR psychos* OR rabies OR rape* OR reproductiv* OR rheuma* OR ringworm* OR sarcoma* OR scabies OR schistosomiasis OR schizophren* OR seizure* OR sepsis* OR sexual* OR shock* OR sick* OR smoking OR sore* OR STD* OR stillbirth* OR stress* OR stroke* OR suicid* OR sunburn* OR syndrome* OR syphilis OR TB OR thrombosis OR tobacco OR STI* OR toothache* OR trachoma OR trauma* OR trichuriasis OR trichomoniasis OR trypanosomiasis OR tuberculosis OR tumor* OR tumour* OR ulcer* OR violence OR virus* OR vomit* OR wart* OR well-being OR wellbeing OR worm* OR wound*	
15	accident [MeSH]	209,815
16	diseases [MeSH]	23,553,673
17	health [MeSH]	688,819
18	health behavior [MeSH]	396,908
19	health care [MeSH]	5,107,719
20	health care facility [MeSH]	1,641,961
21	health care policy [MeSH]	188,812
22	health service [MeSH]	5,405,209
23	infection [MeSH]	3,626,633
24	injury [MeSH]	2,303,491
25	malnutrition [MeSH]	178,039

26	morbidity [MeSH]	361,003
27	mortality [MeSH]	1,081,969
28	neoplasm [MeSH]	4,683,051
29	parasite [MeSH]	36,154
30	virus [MeSH]	907,130
31	14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 21 OR 22 OR 23 OR 24 OR 25 OR 26 OR 27 OR 28 OR 29 OR 30	32,849,152
32	Malaysia OR Johor OR Kedah OR Kelantan OR Kuala Lumpur OR Labuan OR Malacca OR Melaka OR Malaya OR Negeri Sembilan OR Pahang OR Penang OR Perak OR Perlis OR Putrajaya OR Sabah OR Sarawak OR Selangor OR Terengganu	28,901
33	Malaysian	1,611
34	area* OR Borneo OR city OR cities OR district* OR island* OR isle* OR province* OR region* OR state* OR territor* OR village*	7,357,992
35	33 AND 34	395
36	32 OR 35	29,057
37	13 AND 31 AND 36	651
38	Animal migration OR bird migration OR cell* OR membrane* OR molecu*	10,280,170
39	37 NOT 38	549

### I.3. Global Health

Database name	Global Health
Database search engine	OvidSP
Dates of database coverage	1910 to 2019 Week 36
Date search conducted	17 September 2019
Total number of hits	382

#	Searches	Results
1	asylum* OR displaced OR emigra* OR emigre* OR foreign born OR foreign labor OR foreign labour OR foreign work* OR foreign-born OR foreign-work* OR foreigner* OR immigra* OR migra* OR people of concern OR person of concern OR persons of concern OR refugee* OR smuggl* OR traffick* OR transient* OR transmigrant*	89,712
2	immigrants [MeSH]	7,830
3	migrant labour [MeSH]	1,006
4	migrants [MeSH]	3,576
5	migration [MeSH]	3,819
6	refugees [MeSH]	3,687
7	1 OR 2 OR 3 OR 4 OR 5 OR 6	89,712
8	abnormalit* OR abortion* OR abscess* OR accident* OR ache* OR aids OR ailment* OR alcohol* OR allerg* OR anorexia OR AMR OR antibiotic resistan* OR antimicrobial resistan* OR anxiet* OR allerg* OR apnoea OR arthritis OR ascariasis OR assault* OR asthma OR attack* OR bacteri* OR bipolar OR bite* OR blastoma* OR bleed* OR blind OR blood OR burn* OR cancer* OR cardio* OR Chagas OR chlamydia OR cholesterol OR coma OR complication* OR condition* OR condom* OR contraception OR cyst* OR dead OR deaf OR death* OR decay OR deform* OR dehydrat* OR dementia OR dengue OR depress* OR diabetes OR diarrhoea OR disabilit* OR disease* OR disorder* OR dracunculiasis OR drug* OR dysfunction* OR eczema OR enlargement* OR epilep* OR exhaust* OR failure OR fatal* OR fatigue OR fever* OR filariasis OR flu OR gall stone* gallstone* OR gonorrhoea OR headache* OR health OR healthcare OR hearing loss OR helminth* OR hepatitis OR hernia* OR herpe* OR HIV OR hookworm* OR HPV OR hypertension OR illness* OR	3,675,317

	indigestion* OR infect* OR inflame* OR injur* OR leishmaniasis OR leprosy OR leukaemia OR leukemia OR lice OR life expectancy OR malaria OR malformat* OR malnutrition OR measles OR medical OR melanoma* OR mental* OR migraine OR miscarriage* OR morbidit* OR mortalit* OR muscl* OR myeloma OR nausea OR neuro* OR nutrition* OR onchocerciasis OR osteoarthritis OR osteoporosis OR pain* OR parasite* OR patient care OR physical activ* OR pneumonia OR poison* OR psoriasis OR psychiatric OR psychos* OR rabies OR rape* OR reproductiv* OR rheuma* OR ringworm* OR sarcoma* OR scabies OR schistosomiasis OR schizophren* OR seizure* OR sepsis* OR sexual* OR shock* OR sick* OR smoking OR sore* OR STD* OR stillbirth* OR stress* OR stroke* OR suicid* OR sunburn* OR syndrome* OR syphilis OR TB OR thrombosis OR tobacco OR STI* OR toothache* OR trachoma OR trauma* OR trichuriasis OR trichomoniasis OR trypanosomiasis OR tuberculosis OR tumor* OR tumour* OR ulcer* OR violence OR virus* OR vomit* OR wart* OR well-being OR wellbeing OR worm* OR wound*	
9	accidents [MeSH]	14,359
10	diseases [MeSH]	2,302,791
11	health [MeSH]	283,009
12	health behaviour [MeSH]	11,560
13	health care [MeSH]	91,876
14	health policy [MeSH]	20,150
15	health services [MeSH]	88,605
16	infection [MeSH]	100,189
17	injuries [MeSH]	3,171
18	malnutrition [MeSH]	28,215
19	morbidity [MeSH]	28,845
20	mortality [MeSH]	135,836
21	neoplasm [MeSH]	225,495
22	parasites [MeSH]	488,622
23	viruses [MeSH]	496,168
24	8 OR 9 OR 10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23	3,688,190



25	Malaysia OR Johor OR Kedah OR Kelantan OR Kuala Lumpur OR Labuan OR Malacca OR Melaka OR Malaya OR Negeri Sembilan OR Pahang OR Penang OR Perak OR Perlis OR Putrajaya OR Sabah OR Sarawak OR Selangor OR Terengganu	17,417
26	Malaysian	3,366
27	area* OR Borneo OR city OR cities OR district* OR island* OR isle* OR province* OR region* OR state* OR territor* OR village*	1,392,874
28	26 AND 27	1,138
29	25 OR 28	17,513
30	7 AND 24 AND 29	429
31	Animal migration OR bird migration OR cell* OR membrane* OR molercul*	833,650
32	30 NOT 31	382

#### I.4. Medline

Database name	Medline
Database search engine	OvidSP
Dates of database coverage	1946 to September Week 1 2019
Date search conducted	17 September 2019
Total number of hits	364

#	Searches	Results
1	asylum* OR displaced OR emigra* OR emigre* OR foreign born OR foreign labor OR foreign labour OR foreign work* OR foreign-born OR foreign-work* OR foreigner* OR immigra* OR migra* OR people of concern OR person of concern OR persons of concern OR refugee* OR smuggl* OR traffick* OR transient* OR transmigrant*	720,051
2	“Emigrants and Immigrants” [MeSH]	11,337
3	“Emigration and Immigration” [MeSH]	24,805
4	Human Trafficking [MeSH]	347
5	Refugees [MeSH]	9,508
6	“Transients and Migrants”	10,955
7	1 OR 2 OR 3 OR 4 OR 5 OR 6	720,051
8	abnormalit* OR abortion* OR abscess* OR accident* OR ache* OR aids OR ailment* OR alcohol* OR allerg* OR anorexia OR AMR OR antibiotic resistan* OR antimicrobial resistan* OR anxiet* OR allerg* OR apnoea OR arthritis OR ascariasis OR assault* OR asthma OR attack* OR bacteri* OR bipolar OR bite* OR blastoma* OR bleed* OR blind OR blood OR burn* OR cancer* OR cardio* OR Chagas OR chlamydia OR cholesterol OR coma OR complication* OR condition* OR condom* OR contraception OR cyst* OR dead OR deaf OR death* OR decay OR deform* OR dehydrat* OR dementia OR dengue OR depress* OR diabetes OR diarrhoea OR disabilit* OR disease* OR disorder* OR dracunculiasis OR drug* OR dysfunction* OR eczema OR enlargement* OR epilep* OR exhaust* OR failure OR fatal* OR fatigue OR fever* OR filariasis OR flu OR gall stone* gallstone* OR gonorrhoea OR headache* OR health OR healthcare OR hearing loss OR helminth* OR hepatitis OR hernia* OR herpe* OR HIV OR hookworm* OR HPV OR hypertension OR illness* OR	21,089,958

	indigestion* OR infect* OR inflame* OR injur* OR leishmaniasis OR leprosy OR leukaemia OR leukemia OR lice OR life expectancy OR malaria OR malformat* OR malnutrition OR measles OR medical OR melanoma* OR mental* OR migraine OR miscarriage* OR morbidit* OR mortalit* OR muscl* OR myeloma OR nausea OR neuro* OR nutrition* OR onchocerciasis OR osteoarthritis OR osteoporosis OR pain* OR parasite* OR patient care OR physical activ* OR pneumonia OR poison* OR psoriasis OR psychiatric OR psychos* OR rabies OR rape* OR reproductiv* OR rheuma* OR ringworm* OR sarcoma* OR scabies OR schistosomiasis OR schizophren* OR seizure* OR sepsis* OR sexual* OR shock* OR sick* OR smoking OR sore* OR STD* OR stillbirth* OR stress* OR stroke* OR suicid* OR sunburn* OR syndrome* OR syphilis OR TB OR thrombosis OR tobacco OR STI* OR toothache* OR trachoma OR trauma* OR trichuriasis OR trichomoniasis OR trypanosomiasis OR tuberculosis OR tumor* OR tumour* OR ulcer* OR violence OR virus* OR vomit* OR wart* OR well-being OR wellbeing OR worm* OR wound*	
9	Accidents [MeSH]	182,330
10	“Delivery of Health Care” [MeSH]	1,028,923
11	Disease [MeSH]	181,324
12	Health [MeSH]	344,725
13	Health Behavior [MeSH]	301,243
14	Health Facilities [MeSH]	756,386
15	Health Policy [MeSH]	102,614
16	Health Services [MeSH]	2,044,089
17	Infection [MeSH]	765,299
18	Malnutrition [MeSH]	118,335
19	Morbidity [MeSH]	524,764
20	Mortality [MeSH]	364,390
21	Neoplasms [MeSH]	3,212,183
22	Parasites [ MeSH]	6,776
23	Viruses [MeSH]	754,871
24	“Wounds and Injuries” [MeSH]	873,897

25	8 OR 9 OR 10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23 OR 24	21,770,503
26	Malaysia OR Johor OR Kedah OR Kelantan OR Kuala Lumpur OR Labuan OR Malacca OR Melaka OR Malaya OR Negeri Sembilan OR Pahang OR Penang OR Perak OR Perlis OR Putrajaya OR Sabah OR Sarawak OR Selangor OR Terengganu	17,824
27	Malaysian	4,673
28	area* OR Borneo OR city OR cities OR district* OR island* OR isle* OR province* OR region* OR state* OR territor* OR village*	4,572,673
29	27 AND 28	1,297
30	26 OR 29	18,038
31	7 AND 25 AND 30	404
32	Animal migration OR bird migration OR cell* OR membrane* OR molecu*	6,952,122
33	31 NOT 32	364

### I.5. PsychInfo

Database name	PsychInfo
Database search engine	OvidSP
Dates of database coverage	1806 to September Week 2 2019
Date search conducted	17 September 2019
Total number of hits	91

#	Searches	Results
1	asylum* OR displaced OR emigra* OR emigre* OR foreign born OR foreign labor OR foreign labour OR foreign work* OR foreign-born OR foreign-work* OR foreigner* OR immigra* OR migra* OR people of concern OR person of concern OR persons of concern OR refugee* OR smuggl* OR traffick* OR transient* OR transmigrant*	112,729
2	Asylum seeking [MeSH]	487
3	Foreign workers [MeSH]	530
4	Human migration [MeSH]	12,788
5	Human trafficking [MeSH]	844
6	Immigration [MeSH]	21,250
7	Refugees [MeSH]	5,580
8	1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7	113,572
9	abnormalit* OR abortion* OR abscess* OR accident* OR ache* OR aids OR ailment* OR alcohol* OR allerg* OR anorexia OR AMR OR antibiotic resistan* OR antimicrobial resistan* OR anxiet* OR allerg* OR apnoea OR arthritis OR ascariasis OR assault* OR asthma OR attack* OR bacteri* OR bipolar OR bite* OR blastoma* OR bleed* OR blind OR blood OR burn* OR cancer* OR cardio* OR Chagas OR chlamydia OR cholesterol OR coma OR complication* OR condition* OR condom* OR contraception OR cyst* OR dead OR deaf OR death* OR decay OR deform* OR dehydrat* OR dementia OR dengue OR depress* OR diabetes OR diarrhoea OR disabilit* OR disease* OR disorder* OR dracunculiasis OR drug* OR dysfunction* OR eczema OR enlargement* OR epilep* OR exhaust* OR failure OR fatal* OR fatigue OR fever* OR filariasis OR flu OR gall stone* gallstone* OR gonorrhoea OR headache*	3,197,191

	OR health OR healthcare OR hearing loss OR helminth* OR hepatitis OR hernia* OR herpe* OR HIV OR hookworm* OR HPV OR hypertension OR illness* OR indigestion* OR infect* OR inflame* OR injur* OR leishmaniasis OR leprosy OR leukaemia OR leukemia OR lice OR life expectancy OR malaria OR malformat* OR malnutrition OR measles OR medical OR melanoma* OR mental* OR migraine OR miscarriage* OR morbidit* OR mortalit* OR muscl* OR myeloma OR nausea OR neuro* OR nutrition* OR onchocerciasis OR osteoarthritis OR osteoporosis OR pain* OR parasite* OR patient care OR physical activ* OR pneumonia OR poison* OR psoriasis OR psychiatric OR psychos* OR rabies OR rape* OR reproductiv* OR rheuma* OR ringworm* OR sarcoma* OR scabies OR schistosomiasis OR schizophren* OR seizure* OR sepsis* OR sexual* OR shock* OR sick* OR smoking OR sore* OR STD* OR stillbirth* OR stress* OR stroke* OR suicid* OR sunburn* OR syndrome* OR syphilis OR TB OR thrombosis OR tobacco OR STI* OR toothache* OR trachoma OR trauma* OR trichuriasis OR trichomoniasis OR trypanosomiasis OR tuberculosis OR tumor* OR tumour* OR ulcer* OR violence OR virus* OR vomit* OR wart* OR well-being OR wellbeing OR worm* OR wound*	
10	Accidents [MeSH]	13,047
11	Chronic illness [MeSH]	27,898
12	“Death and Dying” [MeSH]	37,732
13	Health [MeSH]	239,359
14	Health Behavior [MeSH]	29,441
15	Health Care Delivery [MeSH]	93,926
16	Health Care Policy [MeSH]	11,882
17	Health Care Services [MeSH]	199,129
18	Health Care Utilization [MeSH]	15,311
19	Infectious disorders [MeSH]	60,085
20	Injuries [MeSH]	25,738
21	Morbidity [MeSH]	7,010
22	Neoplasms [MeSH]	49,460
23	Nutritional deficiencies [MeSH]	3,952
24	Parasitic disorders [MeSH]	1,068
25	Viral disorders [MeSH]	50,123

26	9 OR 10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23 OR 24 OR 25	3,211,923
27	Malaysia OR Johor OR Kedah OR Kelantan OR Kuala Lumpur OR Labuan OR Malacca OR Melaka OR Malaya OR Negeri Sembilan OR Pahang OR Penang OR Perak OR Perlis OR Putrajaya OR Sabah OR Sarawak OR Selangor OR Terengganu	3,636
28	Malaysian	1,676
29	area* OR Borneo OR city OR cities OR district* OR island* OR isle* OR province* OR region* OR state* OR territor* OR village*	1,025,257
30	28 AND 29	391
31	27 OR 30	3,727
32	8 AND 26 AND 31	91
33	Animal migration OR bird migration OR cell* OR membrane* OR molercul*	184,060
34	32 NOT 33	91

## I.6. Social Policy and Practice

Database name	Social Policy and Practice
Database search engine	OvidSP
Dates of database coverage	N/A
Date search conducted	17 September 2019
Total number of hits	5

#	Searches	Results
1	asylum* OR displaced OR emigra* OR emigre* OR foreign born OR foreign labor OR foreign labour OR foreign work* OR foreign-born OR foreign-work* OR foreigner* OR immigra* OR migra* OR people of concern OR person of concern OR persons of concern OR refugee* OR smuggl* OR traffick* OR transient* OR transmigrant*	10,050
2	abnormalit* OR abortion* OR abscess* OR accident* OR ache* OR aids OR ailment* OR alcohol* OR allerg* OR anorexia OR AMR OR antibiotic resistan* OR antimicrobial resistan* OR anxiet* OR allerg* OR apnoea OR arthritis OR ascariasis OR assault* OR asthma OR attack* OR bacteri* OR bipolar OR bite* OR blastoma* OR bleed* OR blind OR blood OR burn* OR cancer* OR cardio* OR Chagas OR chlamydia OR cholesterol OR coma OR complication* OR condition* OR condom* OR contraception OR cyst* OR dead OR deaf OR death* OR decay OR deform* OR dehydrat* OR dementia OR dengue OR depress* OR diabetes OR diarrhoea OR disabilit* OR disease* OR disorder* OR dracunculiasis OR drug* OR dysfunction* OR eczema OR enlargement* OR epilep* OR exhaust* OR failure OR fatal* OR fatigue OR fever* OR filariasis OR flu OR gall stone* gallstone* OR gonorrhea OR headache* OR health OR healthcare OR hearing loss OR helminth* OR hepatitis OR hernia* OR herpe* OR HIV OR hookworm* OR HPV OR hypertension OR illness* OR indigestion* OR infect* OR inflame* OR injur* OR leishmaniasis OR leprosy OR leukaemia OR leukemia OR lice OR life expectancy OR malaria OR malformat* OR malnutrition OR measles OR medical OR melanoma* OR mental* OR migraine OR miscarriage* OR morbidit* OR mortalit* OR muscl* OR myeloma OR nausea OR neuro* OR nutrition* OR onchocerciasis OR osteoarthritis OR osteoporosis OR pain* OR parasite* OR patient care OR physical activ* OR pneumonia OR poison* OR psoriasis OR psychiatric OR psychos* OR rabies OR rape* OR reproductiv* OR rheuma* OR ringworm* OR sarcoma* OR scabies OR schistosomiasis OR schizophren* OR seizure* OR sepsis* OR sexual* OR shock* OR sick* OR smoking	197,274



	OR sore* OR STD* OR stillbirth* OR stress* OR stroke* OR suicid* OR sunburn* OR syndrome* OR syphilis OR TB OR thrombosis OR tobacco OR STI* OR toothache* OR trachoma OR trauma* OR trichuriasis OR trichomoniasis OR trypanosomiasis OR tuberculosis OR tumor* OR tumour* OR ulcer* OR violence OR virus* OR vomit* OR wart* OR well-being OR wellbeing OR worm* OR wound*	
3	Malaysia OR Johor OR Kedah OR Kelantan OR Kuala Lumpur OR Labuan OR Malacca OR Melaka OR Malaya OR Negeri Sembilan OR Pahang OR Penang OR Perak OR Perlis OR Putrajaya OR Sabah OR Sarawak OR Selangor OR Terengganu	113
4	Malaysian	21
5	area* OR Borneo OR city OR cities OR district* OR island* OR isle* OR province* OR region* OR state* OR territor* OR village*	92,897
6	4 AND 5	5
7	3 OR 6	114
8	1 AND 2 AND 7	5
9	Animal migration OR bird migration OR cell* OR membrane* OR molecu*	447
10	8 NOT 9	5

**I.7. Summary of the identified records**

<b>Database</b>	<b>Hits</b>
Econlit	348
Embase	549
Global Health	382
Medline	364
PsycInfo	91
Social Policy & Practice	5
<b>Total</b>	<b>1,739</b>

## Supplementary file 3. Modified JBI tool – Randomised controlled trial

### **1. Was true randomisation used for the assignment of participants to treatment groups?**

'Yes' should be selected if the authors mention that randomised allocation of participants was conducted to create the treatment and control group. In addition, the randomising process should be explained and can only be a 'yes' answer if it was a real randomised procedure.

'No' or 'Unclear' should be selected if the randomised procedure is not mentioned nor described.

### **2. Was allocation to treatment groups concealed?**

'Yes' should be selected if the researchers describe the concealed allocation procedure, where the allocating people were not able to know if they allocated the subjects to the treatment group or the control group.

'No' or 'Unclear' should be selected if there was no concealed allocation or if no clear information of the procedure was provided to assess if the allocating people were really prevented from knowing which group the treatment group or control group was.

### **3. Were treatment groups similar at the baseline?**

'Yes' if both groups have similar scores for each characteristic and P-scores are provided. At least age, gender, and the particular outcome of interest should be similar, and a P-value (> 0.05) should be provided for each of these categories in order to select 'yes.'

'No' or 'Unclear' should be selected if the scores of the characteristics differ too much, no P-value is provided, and/or the P-value is smaller than 0.05 for age, gender, and/or outcome of interest.

### **4. Were participants blind to treatment assignment?**

'Yes' should be selected if the researchers describe the blinding procedure of the participants to show that the participants were not able to know if they were selected for the treatment group or the control group.

'No' or 'Unclear' should be selected if there was no blinding of participants or if no clear information of the blinding procedure was provided to assess if the subjects were really prevented from knowing in which group they were in.

1  
2  
3 **5. Were those delivering treatment blind to treatment the assignment?**  
4

5  
6 'Yes' should be selected if the researchers describe the blinding procedure among the  
7 treatment providers, where the treatment providers were not able to know if they provided  
8 the treatment or the placebo to the participants.  
9

10  
11 'No' or 'Unclear' should be selected if there was no blinding procedure among the treatment  
12 providers or if no clear information of the procedure was provided to assess if the treatment  
13 providers were really prevented from knowing who received the treatment and who received  
14 the placebo.  
15

16  
17  
18 **6. Were outcomes assessors blind to treatment assignment?**  
19

20  
21 'Yes' should be selected if the researchers describe the blinding procedure among the  
22 assessors that measured the results, where these people were not able to know in which  
23 group the participants were in.  
24

25  
26 'No' or 'Unclear' should be selected if there was no blinding procedure among the assessors  
27 or if no clear information of the procedure was provided to assess if the assessors were really  
28 prevented from knowing who received the treatment and who received the placebo.  
29

30  
31  
32 **7. Were treatment groups treated identically other than the intervention of interest?**  
33

34  
35 'Yes' should be selected if the researchers describe the exact similar general treatment  
36 procedure for both groups, and that the treatment/intervention is the only differing  
37 component for the treatment group.  
38

39  
40 'No' or 'Unclear' should be selected if the general treatment procedure were different  
41 between the two groups or if the treatment procedure is not well described.  
42

43  
44 **8. Was follow up complete, and if not, were differences between groups in terms of their  
45 follow up adequately described and analysed?**  
46

47  
48 'Yes' should be selected if 'loss to follow up' is mentioned, and if there was a loss to follow  
49 up, the researchers should state at least one reason for losing the participants in the study  
50 and at least one measure that was taken to deal with this issue.  
51

52  
53 'No' or 'Unclear' should be selected if the researchers do not mention anything regarding 'loss  
54 to follow up' or if they do not give at least one reasons why people dropped out nor mention  
55 at least one measure that was taken to deal with the loss of follow up issue.  
56

57  
58 **9. Were participants analysed in the groups to which they were randomised?**  
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'Yes' should be selected if the researchers used the intention-to-treat (ITT) analysis method, where an analysis was conducted to measure the differences of the participants – regardless if they were in the treatment group or control group – before and after the trial.

'No' or 'Unclear' should be selected if there was no ITT analysis or no clear reported outcomes of an ITT analysis.

#### **10. Were outcomes measured in the same way for treatment groups?**

'Yes' should be selected if there is a statement that shows that all participants – both from the intervention and control group – were assessed in the same way.

'No' or 'Unclear' should be selected if there is a statement that shows that there was a difference in measurement between cases and controls.

#### **11. Were outcomes measured in a reliable way?**

'Yes' should be selected if there is a detailed description of how the outcome was measured, accompanied with a statement regarding the used standardised measurement tool or academic reference.

'No' or 'Unclear' should be selected if there is not a detailed description of how the outcome was measured and/or if the statement regarding the used standardised measurement tool or academic reference is lacking.

#### **12. Was an appropriate statistical analysis used?**

'Yes' should be selected if the name of the analysis method is mentioned, and justification is given why the researchers used this method.

'No' or 'Unclear' should be selected if the name of analysis method is not provided or if the justification for using this particular method is lacking.

#### **13. Was the trial design appropriate, and any deviations from the standard RCT design (individual randomisation, parallel groups) accounted for in the conduct and analysis of the trial?**

'Yes' should be selected if there was individual randomisation. 'Yes' can also be selected if there was cluster sampling, and the authors mention that weighting adjustment methods – such as propensity-score – have been used in order to solve quantitative imbalance issues.

'No' or 'Unclear' should be selected if a non-individual randomisation method has been used, and no information was given how the researchers dealt with potential imbalance issues.

## Supplementary file 4. Modified JBI tool – Case control

### **1. Were the groups comparable other than the presence of disease in cases or in the absence of disease in controls?**

'Yes' should be selected if the researchers state that they used an individual matching method and describe how they conducted this individual matching.

'No' or 'Unclear' should be selected if a non-individual matching was applied or if the researchers state that they used individual matching, but the description of the process is lacking.

### **2. Were cases and controls matched appropriately?**

'Yes' should be selected if the researchers state clearly what the source population was, referring to the population where cases and controls were recruited.

'No' or 'Unclear' should be selected if there is no information regarding where the cases and/or control were drawn from.

### **3. Were the same criteria used for the identification of cases and controls?**

'Yes' should be selected if eligibility criteria for both cases and controls were defined.

'No' or 'Unclear' should be selected if the researchers did not define the eligibility criteria for both cases and controls to be included in the study.

### **4. Was exposure measured in a standard, valid, and reliable way?**

'Yes' should be selected if there is a detailed description of how the exposure was measured, accompanied with a statement regarding the used standardised measurement tool or academic reference. In addition, there should be a statement that demonstrates the experience of the involved researcher(s), such as that the researcher was trained or have a background in that particular field or the profession of the researchers is mentioned (e.g. nurse, medical practitioner, microbiologist, etc.)

'No' or 'Unclear' should be selected if there is not a detailed description of how the exposure was measured and/or if the statement regarding the used standardised measurement tool or academic reference is lacking. In addition, 'no/unclear' should be selected if there is no information provided about the involved researchers and their experience.

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2  
3 'NA' should be selected if the exposure includes a factor that does not need to be measured  
4 by the researcher (e.g. visa status or location).  
5  
6  
7

8 **5. Was exposure measured in the same way for cases and controls?**  
9

10 'Yes' should be selected if there is a statement that shows that all participants/both cases and  
11 controls were assessed in the same way.  
12

13  
14 'No' or 'Unclear' should be selected if there is a statement that shows that there was a  
15 difference in measurement between cases and controls.  
16  
17

18  
19 **6. Were confounding factors identified?**  
20

21 'Yes' should be selected if the researcher states that confounders (other variables that can  
22 influence the association between a dependent and independent variable) or no confounders  
23 were identified. If a confounder was identified, the researcher should state what the  
24 confounding factor was.  
25  
26

27 'No' or 'Unclear' should be selected if there is no statement regarding potential confounding  
28 issues or if the researcher state that there was a confounder, but does not state what kind of  
29 confounder it was.  
30  
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34 **7. Were strategies to deal with confounding factors stated?**  
35

36 'Yes' should be selected if a strategy is described how the researchers dealt with the  
37 confounding factor(s)/controlled for other factors. If there is a statement that there were no  
38 confounders, no strategy is needed, and 'yes' can be selected.  
39  
40

41 'No' or 'Unclear' should be selected if no strategy was mentioned or if they only mention that  
42 they controlled for confounders without a detailed description of the methods used to do so.  
43  
44

45  
46 **8. Were outcomes assessed in a standard, valid, and reliable way for cases and controls?**  
47

48 'Yes' should be selected if there is a detailed description of how the outcome was measured,  
49 accompanied with a statement regarding the used standardised measurement tool or  
50 academic reference. In addition, there should be a statement that demonstrates the  
51 experience of the involved researcher(s), such as that the researcher was trained or have a  
52 background in that particular field or the profession of the researchers is mentioned (e.g.  
53 nurse, medical practitioner, microbiologist, etc.)  
54  
55

56  
57 'No' or 'Unclear' should be selected if there is not a detailed description of how the outcome  
58 was measured and/or if the statement regarding the used standardised measurement tool or  
59  
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2  
3 academic reference is lacking. In addition, 'no/unclear' should be selected if there is no  
4 information provided about the involved researchers and their experience.  
5  
6  
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8 **9. Was the exposure period of interest long enough to be meaningful?**  
9

10 'Yes' should be selected if justification was given for the X amount of exposure time used in  
11 the study.  
12

13  
14 'No' or 'Unclear' should be selected if no justification was given for the X amount of exposure  
15 time used in the study.  
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17

18  
19 **10. Was an appropriate statistical analysis used?**  
20

21 'Yes' should be selected if the name of the analysis method is mentioned and justification is  
22 given why the researchers used this method.  
23  
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25 'No' or 'Unclear' should be selected if the name of the analysis method is not provided or if  
26 the justification for using this particular method is lacking.  
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## Supplementary file 5. Modified JBI tool – Analytical cross-sectional

### **1. Were the criteria for inclusion in the sample clearly defined?**

'Yes' should be selected if the researchers make an exclusive statement regarding the inclusion/exclusion criteria to select the participants.

'No' or 'Unclear' should be selected if an exclusive statement concerning the inclusion/exclusion criteria is lacking.

### **2. Were the study subjects and the setting described in detail?**

'Yes' should be selected if different demographic variables are presented in absolute numbers, including age (aggregated in individual years or age categories), sex, and nationality. In addition, the setting should be described by providing the name of the location and/or a description of the location.

'No' or 'Unclear' should be selected if a description regarding age, sex, and/or nationality in absolute numbers are lacking. Note that using only means and ratios will not be sufficient to answer this question, and 'no/unclear' should be selected. In addition, 'no/unclear' should be selected if the name and/or description of the location is not given.

### **3. Was the exposure measured in a valid and reliable way?**

'Yes' should be selected if there is a detailed description of how the exposure was measured, accompanied with a statement regarding the used standardised measurement tool or academic reference. In addition, there should be a statement that demonstrates the experience of the involved researcher(s), such as that the researcher was trained or have a background in that particular field or the profession of the researchers is mentioned (e.g. nurse, medical practitioner, microbiologist, etc.)

'No' or 'Unclear' should be selected if there is not a detailed description of how the exposure was measured and/or if the statement regarding the used standardised measurement tool or academic reference is lacking. In addition, 'no/unclear' should be selected if there is no information provided about the involved researchers and their experience.

'N/A' should be selected if the exposure includes a factor that does not need to be measured by the researcher (e.g. visa status or location).

**NOTE: the following question – 4. Were objective, standard criteria used for measurement of the condition? – has been removed as no distinction between Q4 and Q7 was identified by the PI.**

#### **4. Were confounding factors identified?**

'Yes' should be selected if the researcher states that confounders (other variables that can influence the association between a dependent and independent variable) or no confounders have been identified. If a confounder was identified, the researcher should state what the confounding factor was.

'No' or 'Unclear' should be selected if there is no statement regarding potential confounding issues or if the researcher state that there was a confounder, but does not state what kind of confounder it was.

#### **5. Were strategies to deal with confounding factors stated?**

'Yes' should be selected if a strategy is described how the researchers dealt with the confounding factor(s)/controlled for other factors. If there is a statement that there were no confounders, no strategy is needed, and 'yes' can be selected.

'No' or 'Unclear' should be selected if no strategy was mentioned or if they only mention that they controlled for confounders without a detailed description of the methods used to do so.

#### **6. Were the outcomes measured in a valid and reliable way?**

'Yes' should be selected if there is a detailed description of how the outcome was measured, accompanied with a statement regarding the used standardised measurement tool or academic reference. In addition, there should be a statement that demonstrates the experience of the involved researcher(s), such as that the researcher was trained or have a background in that particular field or the profession of the researchers is mentioned (e.g. nurse, medical practitioner, microbiologist, etc.)

'No' or 'Unclear' should be selected if there is not a detailed description of how the outcome was measured and/or if the statement regarding the used standardised measurement tool or academic reference is lacking. In addition, 'no/unclear' should be selected if there is no information provided about the involved researchers and their experience.

#### **7. Was an appropriate statistical analysis used?**

'Yes' should be selected if the name of the analysis method is mentioned, justification is given why the researchers used this method, and evidence of the applied statistical method is shown (e.g. p-values in the text or tables).

'No' or 'Unclear' should be selected if the name of the analysis method is not provided, a justification for using this particular method is lacking, and/or no evidence is shown regarding the applied statistical method (e.g. such as p-values in the text or tables).

## Supplementary file 6. Modified JBI tool – Prevalence study

### **1. Was the sample frame appropriate to address the target population?**

Here, the sample frame is defined as the source that the participants were drawn from, and the target population is the population that the researcher would like to make a statement about. In order to assess this question, the author should provide a clear research question or study objective, including: 1) a defined population; 2) a specific geographic location or place; and 3) a clear outcome.

‘Yes’ should be selected if the participants from the particular source are in line with the population that the researcher would like to make a statement about.

‘No’ or ‘Unclear’ should be selected if the participants from the particular source are **not** in line with the population that the researcher would like to make a statement about.

### **2. Were study participants sampled in an appropriate way?**

In order to make a judgement, the sampling method should be in line with a clear research question, aim or study objective (see criteria in question 1). If the aim or objective is not present, ‘no/unclear’ should be selected.

‘Yes’ should be selected if one of the two following criteria is met:

1) If the target population refers to a wider population (e.g. to find out the prevalence of a certain disease among the population of an entire country), a random sample should have been taken;

2) if the target population refers to a more specific population (e.g. to find out the prevalence of a certain disease among patients of a specific hospital during a specific time period), consecutive sampling can be used.

‘No’ or ‘Unclear’ should be selected if one of the two criteria above is not met or if information to assess if one of these statements is met is lacking.

### **3. Was the sample size adequate?**

‘Yes’ should be selected if one of the two following criteria is met:

1) if a random sample is taken, the researcher should provide evidence – how the sample size was calculated – that an appropriate sample was used;

1  
2  
3 2) if a consecutive sampling method is used (e.g. all medical records of a specific time period  
4 were screened, and all people that met the inclusion criteria were included), the sample size  
5 can be considered as adequate.  
6  
7

8 'No' or 'Unclear' should be selected if one of the two criteria above is not met or if information  
9 to assess if one of these statements is met is lacking.  
10  
11

#### 12 13 **4. Were the study subjects and the setting described in detail?** 14

15 'Yes' should be selected if different demographic variables are presented, including age  
16 (aggregated in individual years or age categories), sex, and nationality in absolute numbers.  
17 In addition, the setting should be described by providing the name of the location and/or a  
18 description of the location.  
19  
20

21 'No' or 'Unclear' should be selected if a description regarding age, sex, and/or nationality in  
22 absolute numbers are lacking. Note that using only means and ratios will not be sufficient to  
23 answer this question, and 'no/unclear' should be selected. In addition, 'no/unclear' should be  
24 selected if the name and/or description of the location is not given.  
25  
26  
27

#### 28 29 **5. Was the data analysis conducted with sufficient coverage of the identified sample?** 30

31 Here, the variables to assess coverage bias will only include sex, age, and nationality.  
32 The answer to this question depends on the aim of the study and the sampling method. If the  
33 authors used a non-consecutive sampling method and are conducting a subgroup analysis  
34 using inferential statistics – e.g. examining whether an intervention had a differential effect  
35 by nationality – the subgroups being analysed should be roughly the same size. Therefore, all  
36 the previously mentioned demographic variables – sex, age, and nationality – should be  
37 presented in order to make a judgement. If the analysis is purely descriptive, and a  
38 consecutive sampling method is used, unbalanced groups are fine. Therefore, lacking  
39 variables concerning sex, age, and nationality will not result in 'no/unclear' in this question.  
40  
41  
42

43 As a general rule, 'Yes' should be selected if the subgroups of interest are roughly balanced  
44 (the difference between the highest and lowest group is less than 50%). E.g. nationality is  
45 measured for 60 people – 20 Bangladeshi, 19 Indonesians, and 11 Myanmar – the difference  
46 between Bangladeshi and Myanmar is still less than 50%, and, therefore, 'yes' should be  
47 selected. However, if a consecutive sampling method is used (including all the subjects of the  
48 population of interest), the groups do not have to be balanced, and 'yes' should be selected.  
49  
50

51 'No' or 'Unclear' should be selected if an unequal distribution is present, where this includes  
52 a difference of 50% or more between the highest and lowest group. E.g. sex is measured – 12  
53 females and 6 males – the difference is 50%, and, therefore, 'no' should be selected. Also,  
54 select 'no/unclear' if the sampling method and/or the aim of the study is not described unless  
55 the study included a consecutive sampling method.  
56  
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58  
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1  
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3 **6. Were valid methods used for the identification of the condition?**  
4

5 'Yes' should be selected if there is a detailed description of how the outcome was measured,  
6 accompanied with a statement regarding the used standardised measurement tool or  
7 academic reference.  
8

9  
10 'No' or 'Unclear' should be selected if there is not a detailed description of how the outcome  
11 was measured and/or if the statement regarding the used standardised measurement tool or  
12 academic reference is lacking.  
13  
14

15  
16  
17 **7. Was the condition measured in a standard, reliable way for all participants?**  
18

19 'Yes' should be selected if there is a statement that demonstrates the experience of the  
20 involved researcher(s), such as that the researcher was trained or have a background in that  
21 particular field or the profession of the researchers is mentioned (e.g. nurse, medical  
22 practitioner, microbiologist, etc.).  
23

24  
25 'No' or 'Unclear' should be selected if there is no information provided about the involved  
26 researchers and their experience.

27  
28 'N/A' should be selected if the used method does not need the involvement of the researcher  
29 to measure the condition (e.g. self-administered questionnaires).  
30  
31

32  
33 **8. Was there an appropriate statistical analysis?**  
34

35 'Yes' should be selected if the numerator and denominator in absolute numbers (relative  
36 numbers are optional) are presented for each variable that was included in the study if the  
37 study was classified as a prevalence study of 'level 3' evidence (purely descriptive). If the study  
38 was classified as a prevalence study of 'level 2' evidence (showing an association/correlation),  
39 the study should mention the name of the analysis method, provide a justification why the  
40 researchers used this analysis method, and show evidence of the applied statistical method  
41 (e.g. p-values in the text or tables).  
42  
43

44  
45 'No' or 'Unclear' should be selected if the numerator and/or denominator – in absolute  
46 numbers – for one or more variables that were included in the study are lacking for a  
47 prevalence study of 'level 3' evidence (purely descriptive). In addition, 'no/unclear' should be  
48 selected if the study was classified as a prevalence study of 'level 2' evidence (showing an  
49 association/correlation), and one or more of the following aspects is lacking: 1) name of the  
50 analysis method; 2) a justification why the researchers used this analysis method; 3) evidence  
51 of the applied statistical method (e.g. p-values in the text or tables).  
52  
53

54  
55  
56 **9. Was the response rate adequate, and if not, was the low response rate managed**  
57 **appropriately?**  
58  
59  
60

1  
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3 'Yes' should be selected if there is a statement regarding the response rate and if the response  
4 rate is 75% or more.  
5

6  
7 'No' or 'Unclear' should be selected if there is no statement regarding the response rate or if  
8 the non-response/refusal is more than 25%.  
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10  
11 'N/A' should be selected if the study included secondary data/medical records, as this kind of  
12 information is generally not available in this type of data.  
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## Supplementary file 7. Modified JBI tool – Case series

### **1. Were there clear criteria for inclusion in the case series?**

'Yes' should be selected if the researchers made an exclusive statement regarding the inclusion criteria to select the cases or a specific case definition was given.

'No' or 'Unclear' should be selected if an exclusive statement concerning the inclusion and/or exclusion criteria or specific case definition was lacking.

### **2. Was the condition measured in a standard, reliable way for all participants included in the case series?**

'Yes' should be selected if there is a statement that demonstrates the experience of the involved researcher(s), such as that the researcher was trained or have a background in that particular field or the profession of the researchers is mentioned (e.g. nurse, medical practitioner, microbiologist, etc.).

'No' or 'Unclear' should be selected if there is no information provided about the involved researchers and their experience.

### **3. Were valid methods used for identification of the condition for all participants included in the case series?**

'Yes' should be selected if there is a detailed description of how the outcome was measured, accompanied with a statement regarding the used standardised measurement tool or academic reference.

'No' or 'Unclear' should be selected if there is not a detailed description of how the outcome was measured and/or if the statement regarding the used standardised measurement tool or academic reference is lacking.

### **4. Did the case series have consecutive inclusion of participants?**

'Yes' should be selected if the time period is mentioned.

'No' or 'Unclear' should be selected if the time period is not mentioned.

### **5. Did the case series have complete inclusion of participants?**

'Yes' should be selected if there is a clear statement that 'all' cases from the specific time period were included.

1  
2  
3  
4 'No' or 'Unclear' should be selected if the word 'all' is not included in the statement.  
5  
6  
7

8 **6. Was there clear reporting of the demographics of the participants in the study?**  
9

10 'Yes' should be selected if different demographic variables are presented, including age  
11 (aggregated in individual years or age categories), sex, and nationality in absolute numbers.  
12  
13

14 'No' or 'Unclear' should be selected if a description regarding age, sex, and/or nationality in  
15 absolute numbers are lacking. Note that using only means and ratios will not be sufficient to  
16 answer this question, and 'no/unclear' should be selected.  
17  
18

19  
20 **7. Was there clear reporting of clinical information of the participants?**  
21

22 'Yes' should be selected if information on one or more comorbidities, stage of the disease,  
23 results of a diagnostic test, and/or classification of subgroups of the disease is provided. Note  
24 that there should be information available of all the included cases in order to answer 'yes'  
25 to this question.  
26  
27

28 'No' or 'Unclear' should be selected if no information on one or more comorbidities, stage of  
29 the disease, results of a diagnostic test, and/or classification of subgroups of the disease is  
30 provided. In addition, this answer should be selected if information about a certain number  
31 of cases is missing (e.g. if the study includes 100 cases, but the presented clinical information  
32 includes only 25 cases. As clinical information of 75 people is missing, 'no/unclear' should be  
33 selected).  
34  
35  
36  
37

38  
39 **8. Were the outcomes or follow up results of cases clearly reported?**  
40

41 'Yes' should be selected if there is a statement that treatment was provided, what type of  
42 treatment it was, and how many people in relative numbers – benefited from the treatment.  
43  
44

45 'No' or 'Unclear' should be selected if any information was lacking regarding the treatment  
46 that was provided, what type of treatment it was, and how many people in absolute numbers  
47 benefited from the treatment. In addition, 'no/unclear' should be selected if the treatment  
48 statement does not involve the entire case population, but only a certain amount of the cases  
49 (e.g. 24 out of the 60 cases received treatment, but information regarding the other 36 cases  
50 is lacking).  
51  
52  
53

54  
55 **9. Was there clear reporting of the presenting site(s)/clinic(s) demographic information?**  
56

57 'Yes' should be selected if the setting was described by providing the name and/or description  
58 of the location.  
59  
60



1  
2  
3 'No' or 'Unclear' should be selected if there was no description or name of the location.  
4  
5  
6

7 **10. Was the statistical analysis appropriate?**  
8

9 'Yes' should be selected if the numerator and denominator in absolute numbers (relative  
10 numbers are optional) are presented for each variable that was included in the study. All  
11 other statistical methods are optional.  
12  
13

14 'No' or 'Unclear' should be selected if the numerator and/or denominator – in absolute  
15 numbers – for one or more variables that were included in the study are lacking.  
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## Supplementary file 8. Modified JBI tool – Case report

### **1. Were patient's demographic characteristics clearly described?**

'Yes' should be selected if at least the following three demographic variables are described: sex, age, and nationality.

'No' or 'Unclear' should be selected if information regarding sex, age and/or nationality is lacking.

### **2. Was the patient's history clearly described and presented as a timeline?**

'Yes' should be selected if the case report states when (month and year) and where (the location where the person was at that time) disease/health issue started. In addition, the report should clearly state if the patients did or did not seek previous medical treatment. If the person did seek medical treatment before, the following information should be included: type of treatment, location of the treatment (name/type of clinic and location), and date of treatment (month and year).

'No' or 'Unclear' should be selected if any of the above aspects are lacking in the description of the patient's history.

### **3. Was the current clinical condition of the patient on presentation clearly described?**

'Yes' should be selected if the report includes a description of the symptoms.

'No' or 'Unclear' should be selected if the description of the symptoms is lacking.

### **4. Were diagnostic tests or assessment methods and the results clearly described?**

'Yes' should be selected if a detailed description of how the outcome was measured accompanied with a statement regarding the used standardised measurement tool or academic reference if applicable.

'No' or 'Unclear' should be selected if there is not a detailed description of how the outcome was measured and/or if the statement regarding the used standardised measurement tool or academic reference is lacking.

### **5. Was the intervention or treatment procedure clearly described?**

'Yes' should be selected if a proper description of the treatment is given, including the name of the treatment and the dosage if applicable.

1  
2  
3  
4  
5 'No' or 'Unclear' should be selected if there was no treatment or if the report simply states  
6 that a certain drug/treatment was provided without giving specific details.  
7

8 'N/A' should be selected if the case included a patient that was already found dead before  
9 the medical examination/intervention was conducted.  
10  
11  
12

### 13 **6. Was the post-intervention clinical condition clearly described?**

14  
15 'Yes' should be selected if the patient's condition regarding the disease/symptoms was  
16 described after the treatment/intervention (e.g. the symptoms were gone or reduced).  
17

18  
19 'No' or 'Unclear' should be selected if the post-intervention clinical condition was not  
20 assessed.  
21

22  
23 'N/A' should be selected if the patient disappeared after the treatment (e.g. due to loss to  
24 follow up or death).  
25  
26  
27

### 28 **7. Were adverse events (harms) or unanticipated events identified and described?**

29  
30 'Yes' should be selected if there is an explicit statement regarding the side effects – either  
31 that there were side effects or there were no side effects (e.g. patient remained well during  
32 treatment). If the report states that there were side effects, these symptoms should be  
33 described, and information should be provided on how long these side effects were lasting.  
34  
35

36  
37 'No' or 'Unclear' should be selected if there is no explicit statement regarding the side effects  
38 of the treatment or if the report states that side effects were present, but a description of the  
39 symptoms and the duration of these symptoms were not given.  
40

41  
42 'N/A' should be selected if the patient disappeared after the treatment (e.g. due to loss to  
43 follow up or death).  
44  
45

### 46 **8. Does the case report provide takeaway lessons?**

47  
48 'Yes' should be selected if the author provides a statement regarding any of the following  
49 three elements: 1) future plan of action to cure, prevent, reduce or control the particular  
50 disease; 2) treatment advice for the particular disease; 3) future research regarding the  
51 particular disease.  
52  
53

54  
55 'No' or 'Unclear' should be selected if there is no takeaway lesson or if the takeaway lesson  
56 does not include one of the three elements mentioned above.  
57  
58  
59  
60

## Supplementary file 9. Modified JBI tool – Qualitative study

### **1. Is there congruity between the stated philosophical perspective and the research methodology?**

'Yes' should be selected if a clear philosophical or theoretical perspective/framework, and there is an explanation of how the selected qualitative method could be useful within this perspective/framework.

'No' or 'Unclear' should be selected if no clear philosophical or theoretical perspective is given or if the researcher does not explain how the used qualitative methods fit within this framework.

### **2. Is there congruity between the research methodology and the research questions or objectives?**

'Yes' should be selected if the objective/research question is more exploratory and focuses more on obtaining an in-depth understanding of why the particular social phenomenon is happening.

'No' or 'Unclear' should be selected if the objective/research question is more conclusive and focuses more on what within a social phenomenon is happening.

### **3. Is there congruity between the research methodology and the methods used to collect data?**

'Yes' should be selected if a qualitative method was used to collect the data, such as interviews and focus group discussions.

'No' or 'Unclear' should be selected if the method is not described or if a quantitative method was applied, such as a survey questionnaire.

### **4. Is there congruity between the research methodology and the representation and analysis of data?**

'Yes' should be selected if a qualitative analysis is used (e.g. thematic analysis) and shows evidence that different voices were represented (e.g. using quotes from different individuals).

'No' or 'Unclear' should be selected if a quantitative analysis has been used (e.g. a simple descriptive presentation of the data) and/or evidence regarding the representation of different voices were lacking.

1  
2  
3  
4 **5. Is there congruity between the research methodology and the interpretation of results?**  
5  
6

7 'Yes' should be selected if the interpretation of the results is in line with the provided quotes.  
8

9 'No' or 'Unclear' should be selected if the interpretation of the results is not in line with the  
10 given quotes or if the quotes are not provided (lack of evidence to assess if the interpretation  
11 of results and data are aligned.  
12  
13

14  
15 **6. Is there a statement locating the researcher culturally or theoretically?**  
16  
17

18 'Yes' should be selected if there is a statement where the involved researchers are coming  
19 from in terms of cultural and/or theoretical background.  
20

21 'No' or 'Unclear' should be selected if there is no statement regarding the researchers'  
22 cultural or theoretical background.  
23  
24

25  
26 **7. Is the influence of the researcher on the research, and vice-versa, addressed?**  
27  
28

29 'Yes' should be selected if there is at least one statement regarding how the researcher could  
30 have influenced the research and if at least one strategy is given to deal with this issue.  
31

32 'No' or 'Unclear' should be selected if no statement and/or strategy has been given to deal  
33 with the "researcher's influence" issue.  
34  
35

36  
37 **8. Are participants, and their voices, adequately represented?**  
38  
39

40 'Yes' should be selected if there is evidence – such as quotes – of different people, where  
41 these quotes come from at least half of the total number of participants. For instance, if ten  
42 people have been interviewed, quotes from at least five different people – marked by initials,  
43 nicknames, or short descriptions of the interviewees – are shown. In addition, the number of  
44 these quotes among these people should be divided fairly equal as well  
45  
46

47 'No' or 'Unclear' should be selected if there is no (sufficient) evidence to show that the voices  
48 are represented equally. For example, if 20 quotes are selected from ten participants, but 12  
49 of these quotes are from two participants, 'no/unclear' should be selected.  
50  
51

52  
53 **9. Is the research ethical according to current criteria or, for recent studies, and is there  
54 evidence of ethical approval by an appropriate body?**  
55  
56

57 'Yes' should be selected if there is a statement that shows that ethics have been obtained by  
58 a certain ethics committee.  
59  
60

1  
2  
3 'No' or 'Unclear' should be selected if there is no statement that shows that ethics have been  
4 obtained by a certain ethics committee.  
5  
6  
7

8 **10. Do the conclusions drawn in the research report flow from the analysis, or**  
9 **interpretation, of the data?**  
10

11 'Yes' should be selected if at least one conclusion is based on the results of the study.  
12  
13

14 'No' or 'Unclear' should be selected if not one conclusion is based on the results of the study.  
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# Supplementary file 10. Individual scores of the quality assessment

No.	Reference	Study design	Level of evidence	Answer to the quality appraisal question													Total score	Score in percentage	Quality of the study
				1	2	3	4	5	6	7	8	9	10	11	12	13			
1	Scheutz et al <sup>26</sup>	Prevalence	Des-3	V	X	X	V	V	V	V	X	X	-	-	-	5/9	55.6	Moderate	
2	Levy <sup>27</sup>	Prevalence	Des-2	X	X	V	X	V	V	X	X	V	-	-	-	4/9	44.4	Low	
3	Kassim et al <sup>28</sup>	Case series	Des-3	X	V	X	V	X	V	V	X	V	V	-	-	6/10	60.0	Moderate	
4	Zulkifli et al <sup>29</sup>	Analytical cross-sectional	Obs-4	X	X	N/A	V	V	X	X	-	-	-	-	-	2/6	33.3	Low	
5	Rajeswari et al <sup>30</sup>	Prevalence	Des-3	X	X	X	V	X	V	X	X	X	-	-	-	2/9	22.2	Low	
6	Jeyakumar <sup>31</sup>	Case series	Des-3	X	X	X	V	X	X	X	V	V	V	-	-	4/10	40.0	Low	
7	Jamaiah et al <sup>32</sup>	Case series	Des-3	X	X	X	V	V	X	X	X	V	V	-	-	4/10	40.0	Low	
8	Krahl & Hashim <sup>33</sup>	Prevalence	Des-3	V	V	V	X	V	V	V	V	X	-	-	-	7/9	77.8	High	
9	Zabedah et al <sup>34</sup>	Prevalence	Des-2	X	X	X	X	V	V	X	X	X	-	-	-	2/9	22.2	Low	
10	Dony et al <sup>35</sup>	Prevalence	Des-3	V	V	V	X	V	X	X	V	N/A	-	-	-	5/8	62.5	Moderate	
11	Chandran et al <sup>36</sup>	Case report	Des-4	V	X	V	V	V	N/A	N/A	V	-	-	-	-	5/6	83.3	High	
12	Nissapatorn et al <sup>37</sup>	Prevalence	Des-3	X	X	V	X	V	V	X	V	N/A	-	-	-	4/8	50.0	Low	
13	Sobri et al <sup>38</sup>	Case series	Des-3	X	V	V	V	V	X	X	X	V	X	-	-	5/10	50.0	Low	
14	Leong <sup>39</sup>	Prevalence	Des-3	V	X	X	X	X	V	V	V	X	-	-	-	4/9	44.4	Low	
15	Sasidharan et al <sup>40</sup>	Prevalence	Des-2	V	V	V	X	V	V	V	V	X	-	-	-	7/9	77.8	High	

16	Masitah et al <sup>41</sup>	Case series	Des-3	V	X	X	X	X	X	V	X	X	X	-	-	2/9	22.2	Low
17	Shailendra & Prepageran <sup>42</sup>	Case report	Des-4	V	X	V	V	V	V	X	V	-	-	-	-	6/8	75.0	High
18	Chan et al <sup>43</sup>	Analytical cross-sectional	Obs-4	X	X	N/A	X	X	X	X	-	-	-	-	-	0/6	0.0	Low
19	Farhana et al <sup>44</sup>	Case series	Des-3	X	X	X	V	V	V	V	X	V	V	-	-	6/10	60.0	Low
20	Chan et al <sup>45</sup>	Analytical cross-sectional	Obs-4	X	X	N/A	X	X	X	X	-	-	-	-	-	0/6	0.0	Low
21	Murty <sup>46</sup>	Case report	Des-4	V	V	V	V	N/A	N/A	N/A	X	-	-	-	-	4/5	80.0	High
22	Murty et al <sup>47</sup>	Case series	Des-3	X	X	X	V	X	X	V	N/A	V	V	-	-	4/9	44.4	Low
23	Mustafa et al <sup>48</sup>	Prevalence	Des-2	V	X	X	X	X	V	V	V	X	-	-	-	4/9	44.4	Low
24	Su et al <sup>49</sup>	Analytical cross-sectional	Obs-4	V	X	V	X	X	V	V	-	-	-	-	-	4/7	57.1	Moderate
25	Daher et al <sup>50</sup>	Prevalence	Des-2	V	V	X	V	X	V	N/A	V	V	-	-	-	6/8	75.0	High
26	Ratnasingam et al <sup>51</sup>	Prevalence	Des-2	X	X	X	X	X	X	X	V	X	-	-	-	1/9	11.1	Low
27	Ab Rahman & Abdullah <sup>52</sup>	Case report	Des-4	V	V	V	V	V	V	X	V	-	-	-	-	7/8	87.5	High
28	Taib & Baba <sup>53</sup>	Case series	Des-3	X	X	X	V	X	X	V	X	V	X	-	-	3/10	30.0	Low
29	Osman et al <sup>54</sup>	Prevalence	Des-3	X	X	X	V	X	V	N/A	V	V	-	-	-	4/8	50.0	Low
30	Minhat et al <sup>55</sup>	Prevalence	Des-2	X	X	X	X	X	V	N/A	X	V	-	-	-	2/8	25.0	Low
31	Mendelsohn et al <sup>56</sup>	Qualitative	Qual-2	V	V	V	V	V	X	V	V	V	V	-	-	9/10	90.0	High
32	Mendelsohn et al <sup>57</sup>	Analytical cross-sectional	Obs-4	V	V	N/A	V	V	X	V	-	-	-	-	-	5/6	83.3	High



33	Kwan et al <sup>58</sup>	Case series	Des-3	X	V	X	V	X	X	V	X	X	V	-	-	4/10	40.0	Low
34	Santos et al <sup>59</sup>	Prevalence	Des-3	X	X	X	X	V	V	V	V	V	-	-	-	5/9	55.6	Moderate
35	Razali et al <sup>60</sup>	Case series	Des-3	V	V	V	V	X	V	V	X	V	V	-	-	8/10	80.0	High
36	Elmi et al <sup>61</sup>	Case control	Obs-3	X	V	V	X	V	X	V	X	X	V	-	-	5/10	50.0	Low
37	Santos et al <sup>62</sup>	Prevalence	Des-2	X	X	X	X	V	V	V	X	V	-	-	-	4/9	44.4	Low
38	William et al <sup>63</sup>	Prevalence	Des-2	V	V	V	X	V	V	V	V	X	-	-	-	7/9	77.8	High
39	Siah et al <sup>64</sup>	Prevalence	Des-2	X	X	X	X	X	V	X	X	X	-	-	-	1/9	11.1	Low
40	Guinto et al <sup>65</sup>	Scoping review	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41	Vijjian et al <sup>66</sup>	Analytical cross-sectional	Obs-4	V	X	N/A	X	X	X	X	-	-	-	-	-	1/6	16.7	Low
42	Azian et al <sup>67</sup>	Prevalence	Des-2	X	X	X	X	X	V	X	X	X	-	-	-	1/9	11.1	Low
43	Sahimin et al <sup>68</sup>	Prevalence	Des-2	X	X	X	X	X	V	V	V	X	-	-	-	3/9	33.3	Low
44	Noh et al <sup>69</sup>	Prevalence	Des-2	X	X	X	X	X	V	X	V	X	-	-	-	2/9	22.2	Low
45	Kamaludin & How <sup>70</sup>	Analytical cross-sectional	Obs-4	V	X	N/A	X	X	V	V	-	-	-	-	-	3/6	50.0	Low
46	Min et al <sup>71</sup>	Prevalence	Des-3	V	V	V	X	V	X	X	V	N/A	-	-	-	5/8	62.5	Moderate
47	Woh et al <sup>72</sup>	Prevalence	Des-3	X	X	X	V	V	V	X	V	X	-	-	-	4/9	44.4	Low
48	Tanabe et al <sup>73</sup>	Mixed method	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
49	Ratnalingam et al <sup>74</sup>	Prevalence	Des-2	V	X	X	X	V	V	X	X	X	-	-	-	3/9	33.3	Low

50	Woh et al <sup>75</sup>	Prevalence	Des-2	X	X	X	X	X	V	X	V	X	-	-	-	2/9	22.2	Low	
51	Noor & Shaker <sup>76</sup>	Analytical cross-sectional	Obs-4	V	X	V	V	V	V	V	-	-	-	-	-	6/7	85.7	High	
52	Noordin et al <sup>77</sup>	Prevalence	Des-3	X	X	X	X	V	V	X	V	X	-	-	-	3/9	33.3	Low	
53	Sahimin et al <sup>78</sup>	Prevalence	Des-2	X	X	X	V	X	V	V	V	X	-	-	-	4/9	44.4	Low	
54	Labao et al <sup>79</sup>	Prevalence	Des-3	X	X	X	X	V	V	V	V	V	-	-	-	5/9	55.6	Moderate	
55	Shaw et al <sup>80</sup>	Randomised controlled trial	Exp-2	X	X	X	X	X	X	X	X	V	V	V	V	X	4/13	30.8	Low
56	Rahman et al <sup>81</sup>	Case control	Obs-3	X	V	V	X	V	X	V	X	V	V	-	-	-	6/10	60.0	Moderate
57	Sahimin et al <sup>82</sup>	Prevalence	Des-2	X	X	X	V	X	V	V	V	X	-	-	-	4/9	44.4	Low	
58	Nwabichie et al <sup>83</sup>	Prevalence	Des-2	V	V	X	X	V	V	V	V	V	-	-	-	7/9	77.8	High	
59	Jeffree et al <sup>84</sup>	Case control	Obs-3	X	V	V	X	V	X	X	V	V	V	-	-	-	6/10	60.0	Moderate
60	Zerguine et al <sup>85</sup>	Analytical cross-sectional	Obs-4	X	V	V	X	X	V	V	-	-	-	-	-	4/7	57.1	Moderate	
61	Ya'acob et al <sup>86</sup>	Randomised controlled Trial	Exp-2	X	X	V	X	X	X	V	X	X	V	V	V	X	5/13	38.5	Low
62	Chuah et al <sup>10</sup>	Qualitative	Qual-2	V	V	V	V	V	X	V	X	V	V	-	-	-	8/10	80.0	High
63	Loganathan et al <sup>87</sup>	Qualitative	Qual-2	X	V	V	V	V	X	V	V	V	V	-	-	-	8/10	80.0	High
64	Rahman et al <sup>88</sup>	Prevalence	Des-3	X	X	X	X	V	X	X	V	V	-	-	-	3/9	33.3	Low	
65	Siah et al <sup>89</sup>	Qualitative	Qual-3	X	V	X	V	V	X	X	X	V	V	-	-	-	5/10	50.0	Low
66	Sahimin et al <sup>90</sup>	Prevalence	Des-2	X	X	X	V	X	V	X	V	X	-	-	-	3/9	33.3	Low	

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67	Chuah et al <sup>91</sup>	Qualitative	Qual-2	V	V	V	V	V	X	V	X	V	V	-	-	8/10	80.0	High
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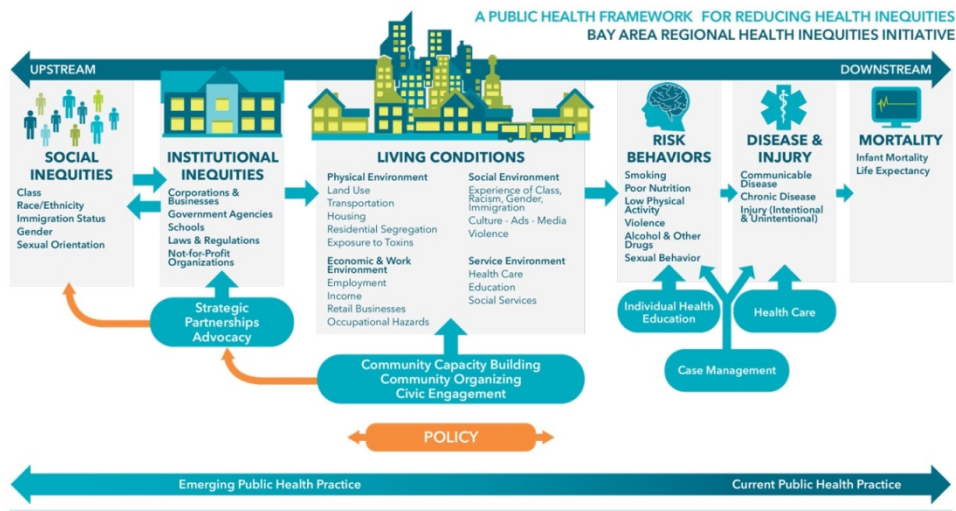


Figure 1. Bay Area Regional Health Inequities Initiative (BARHII) framework.

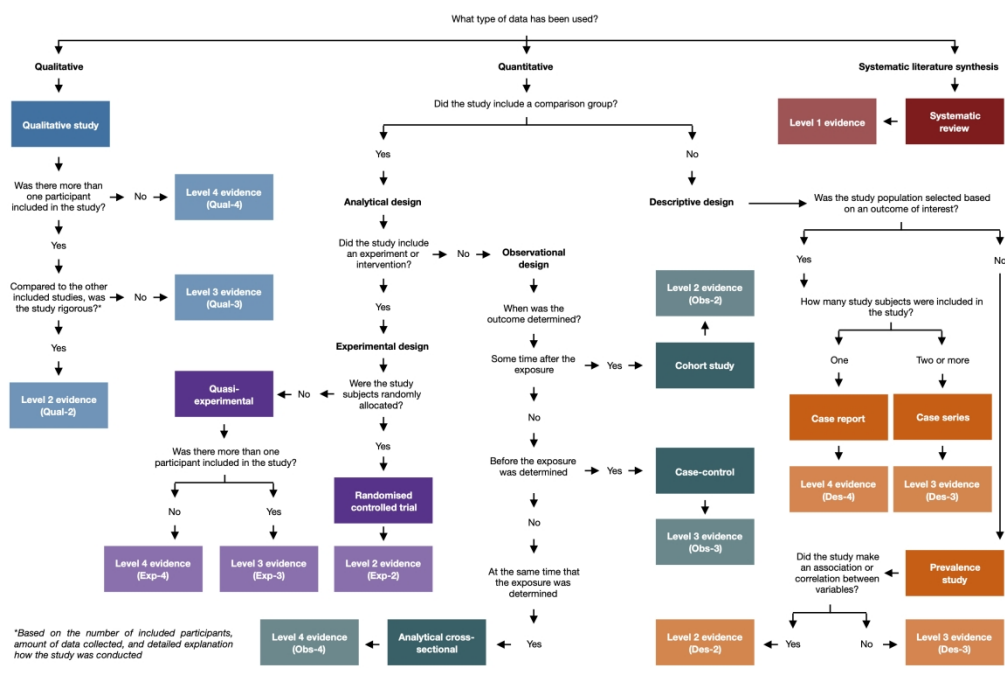


Figure 2. Decision tree to identify the type of study design and corresponding level of evidence.

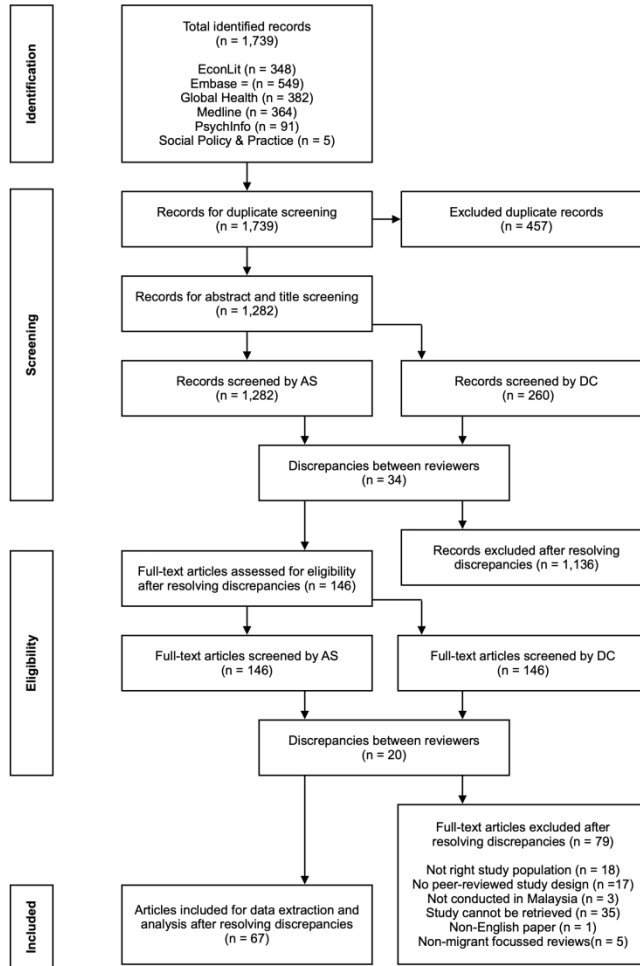


Figure 3. Flowchart of the data selection process.

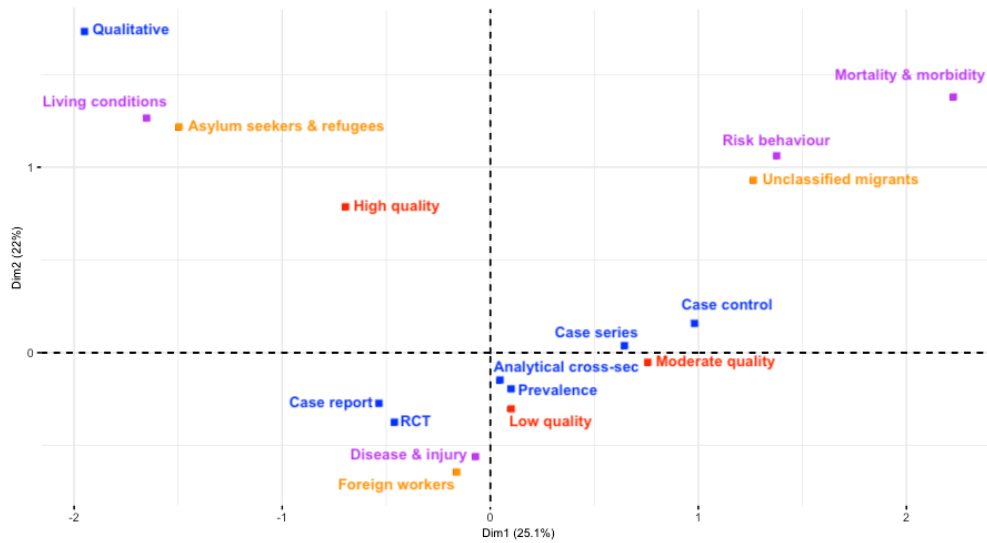


Figure 4. Results of the multiple-correspondence analysis (MCA).

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# BMJ Open

## Developing an evidence assessment framework and appraising the academic literature on migrant health in Malaysia: a scoping review

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TITLE

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5 1 **Developing an evidence assessment framework and**  
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8 2 **appraising the academic literature on migrant**  
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12 3 **health in Malaysia: a scoping review**  
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18 5 Allard W. de Smalen<sup>1, 2, 3</sup>, Zhie X. Chan<sup>3</sup>, Claudia A. Lopes<sup>3</sup>, Michaella Vanore<sup>1, 2</sup>, Tharani  
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56 20 Word count: 6736  
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## ABSTRACT

**Abstract**

**Background:** A large number of international migrants in Malaysia face challenges in procuring proper health, the extent of which is still relatively unknown. This study aims to map the existing academic literature on migrant health in Malaysia and to provide an overview of the quality and level of evidence of these scientific studies.

**Methods:** A scoping review was conducted using six databases, including Econlit, Embase, Global Health, Medline, PsycInfo, and Social Policy and Practice. Studies were eligible for inclusion if they were conducted in Malaysia, peer-reviewed, focused on a health dimension according to the Bay Area Regional Health Inequities Initiative (BARHII) framework, and targeted the vulnerable international migrant population. Data were extracted by using the BARHII framework and a self-developed decision tree to identify the type of study design and corresponding level of evidence. Modified Joanna Briggs Institute (JBI) checklists were used to assess study quality, and a multiple-correspondence analysis (MCA) was conducted to identify associations between different variables.

**Results:** 67 publications met the selection criteria and were included in the study. The majority (n=41) of studies included foreign workers. Over two-thirds (n=46) focused on disease and injury, and a similar number (n=46) had descriptive designs. The average quality of the papers was low, yet quality differed significantly between research designs and health dimensions. The MCA showed that high-quality studies were mostly qualitative designs that included refugees and focused on living conditions, while prevalence and analytical cross-sectional studies were mostly low quality.

## ABSTRACT

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3 43 **Conclusion:** This study provides an overview of the scientific literature on migrant health in  
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5 44 Malaysia. In general, the quality of these studies is low, and various health dimensions (e.g.,  
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7 45 institutional inequities, mortality and morbidity) have not been thoroughly researched.  
8  
9 46 Therefore, researchers should address these issues to improve the evidence base to support  
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11 47 policymakers with high-quality evidence for decision-making.  
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15 48 **Key Words:** Malaysia, migrant, health, refugee, foreign worker, disease, evidence  
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18 49 assessment framework  
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## ABSTRACT

**Article summary****Strengths and limitations of this study**

- This study provides a comprehensive overview of migrant health research in Malaysia, including a summary table, critical assessment tables, and a multiple-correspondence analysis (MCA).
- Methodological contributions by creating an evidence assessment framework, including a decision tree that identifies the type of study design and corresponding level of evidence, and modified Joanna Briggs Institute (JBI) checklists.
- Exclusive focus on vulnerable migrants within the non-citizen population in Malaysia.
- Only English peer-reviewed academic articles were included in this study, and, therefore, much relevant information that could potentially be used to inform both policies and practice may have been excluded from this review.

## 62 Introduction

63 Worldwide, the international migrant population accounts for approximately 272 million  
64 people, with almost one-third within Asia.<sup>1</sup> Due to its strategic geographic location and high  
65 labour demand, Malaysia is among the top destination countries for international migrants in  
66 the Asian region.<sup>2</sup> According to the Department of Statistics Malaysia (DOSM), the  
67 documented non-citizen population represented 3.2 million people in 2019, which accounts  
68 for 10% of Malaysia's total population.<sup>3</sup> DOSM defines a non-citizen as a person that resides  
69 in Malaysia for six months or more in the reference year.<sup>4</sup> However, no subcategories were  
70 included in this definition. According to the Office of the United Nations High Commissioner  
71 for Human Rights (OHCHR), a non-citizen is an individual that does not have an effective  
72 connection with the location where the person is situated according to the host nation, and  
73 includes various types of migrants, such as foreigners with permanent residency, refugees,  
74 asylum seekers, foreign labour, international students, stateless individuals, and victims of  
75 human trafficking.<sup>5</sup> Other definitions of migrant-related terms that are used in this paper are  
76 presented in Table 1.

77  
78 [INSERT TABLE 1]

79  
80 The vast majority of non-citizens in Malaysia are migrant workers, where foreign labour can  
81 be divided according to their visa status into regular and irregular migrant workers.  
82 According to the Ministry of Home Affairs (MOHA), Malaysia issued 2 million work permits  
83 to documented migrant workers in 2019.<sup>7</sup> However, the total number of migrant workers,  
84 both documented and undocumented, is estimated to fall between 4.2 and 6.2 million people.<sup>2</sup>  
85 Another group that contributes significantly to the non-citizen population in Malaysia are

## Materials and Methods

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3 86 refugees and asylum seekers. The terms refugees and asylum seekers are often used  
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5 87 interchangeably, yet, these populations differ by their legal status in destination countries and  
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7 88 subsequent vulnerabilities (see definitions in Table 1). In 2019, an approximate 178,580  
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9 89 refugees and asylum seekers were registered with the United Nations High Commissioner for  
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11 90 Refugees (UNHCR) in Malaysia, where 153,770 (86%) came from Myanmar. The remaining  
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13 91 number (14%) came from Yemen, Syria, Afghanistan, Iraq, Palestine, Pakistan, Sri Lanka,  
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15 92 Somalia, and other countries.<sup>8</sup>  
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22 94 Refugees, asylum seekers, and both documented and undocumented low-skilled foreign  
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24 95 workers can be classified as vulnerable migrants in Malaysia, as these populations may face  
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26 96 significant hardships in their new country of residence.<sup>9 10</sup> Vulnerable migrants are more  
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28 97 prone to being exploited and abused, have an increased need to be protected by duty-bearers,  
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30 98 and are not able to fully benefit from their human rights.<sup>11</sup> Health is among these affected  
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32 99 human rights, as migrant workers and refugees could encounter various challenges to  
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34 100 maintain proper health and prevent poor health outcomes, including difficulties in accessing  
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36 101 healthcare and obtaining quality health services.<sup>11-13</sup> According to Sweileh et al,<sup>14</sup> assessing  
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38 102 the current status of scientific output and identifying research gaps could positively contribute  
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40 103 towards improving the evidence base for advocating for migrant health needs. Scoping  
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42 104 reviews can be helpful to map the academic literature and have been used by different  
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44 105 researchers to present the available evidence on migrant health in other countries.<sup>15 16</sup>  
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53 107 Despite the burgeoning academic literature on migrant health in Malaysia, health information  
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55 108 on migrant-related issues is still limited, and public data remains difficult to access.  
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57 109 Aggravating the matter, there is no overall picture currently available of the evidence base on  
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## Materials and Methods

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3 110 migrant health in Malaysia, including critical appraisal of the quality of research. Therefore,  
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5 111 this study aims to map the existing academic literature on migrant health in Malaysia since  
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8 112 1965 to identify the gaps in this field, as well as to present an overview of the quality and  
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10 113 level of evidence of these scientific studies.  
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## 114 **Method**

### 115 **General methods**

116 A scoping review was conducted, following the Preferred Reporting Items for Systematic  
117 reviews and Meta-Analyses – Extension for Scoping Reviews (PRISMA-ScR) guidelines<sup>17</sup>  
118 (Supplementary file 1). A pre-review protocol was developed to guide decisions for literature  
119 selection and structure of the review, and included the review question, aim, search strategy,  
120 selection criteria, and risk of bias assessment. However, the protocol was not formally  
121 registered and changed to some extent over the course of this review. The pre-review  
122 protocol can be accessed on request from the first author. Data were extracted and organised  
123 using the Bay Area Regional Health Inequities Initiative (BARHII) framework.<sup>18</sup> In addition,  
124 a decision tree was developed to classify the type of study design and level of evidence of  
125 each journal article. Subsequently, a quality assessment of the included literature was  
126 conducted by using the Joanna Briggs Institute (JBI) critical appraisal toolkit. Lastly, the data  
127 was analysed and a multiple-correspondence analysis (MCA) was applied to explore existing  
128 relationships between variables.

### 129 **Patient and public involvement**

130 There were no patients involved in this study. The findings of this study were presented at the  
131 Migrant Health Research Dissemination Workshop in Kuala Lumpur to stakeholders working  
132 on migrant health in Malaysia.<sup>19</sup>

### 133 **Conceptual framework**

134 The Bay Area Regional Health Inequities Initiative (BARHII) framework was utilised to  
135 organise the identified literature in this scoping review into specific factors that shape  
136 equitable health outcomes (Figure 1). The BARHII framework was selected due to its

## Materials and Methods

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3 137 comprehensive nature and inclusion of various health dimensions, whereas other models  
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5 138 focused on specific public health elements or lacked clear explanation regarding the included  
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8 139 health-related components of the model.<sup>20 21</sup>  
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14 141 [INSERT FIGURE 1]  
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20 143 The BARHII framework consists of six dimensions: 1) social inequities; 2) institutional  
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22 144 inequities; 3) living conditions; 4) risk behaviour; 5) disease and injury; and 6) mortality.

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24 145 Except for ‘social inequities,’ the other five categories were used to describe which health  
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26 146 dimension the particular articles focused on. The social inequities element was incorporated  
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28 147 by describing the population of interest, which were divided into three categories: foreign  
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30 148 workers, asylum seekers and refugees, and unclassified migrants. The lattermost category  
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32 149 was applied if a paper used the term ‘migrants’ or ‘immigrants’ but lacked specific  
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34 150 information to classify the study population as foreign workers or asylum seekers/refugees.  
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39 151 Institutional inequities include the practices of corporations, businesses, government  
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41 152 agencies, schools, not-for-profit organisations as well as laws, regulations, and policies that  
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43 153 could influence health outcomes (e.g., a regulation that obligates companies to financially  
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45 154 compensate an individual in case of a work incident).  
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49 155 Living conditions consist of the physical environment (e.g., indoor air pollution), economic  
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51 156 and work environment (e.g., unemployment), social environment (e.g., discrimination in the  
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53 157 neighbourhood), and service environment (e.g., healthcare) that people live in, and that play a  
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55 158 role in determining their health outcomes (e.g., denied healthcare access due to visa status).  
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## Materials and Methods

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3 159 Risk behaviour includes smoking, poor nutrition, low physical activity, violence, alcohol and  
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5 160 other drugs, and sexual behaviour. This dimension reflects the way someone acts and how  
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7 161 that increases or decreases the risk of obtaining a particular health outcome (e.g., the attitude  
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9 162 and related behaviour towards smoking could influence an individual's level of risk of  
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11 163 developing lung cancer).

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15 164 Disease and injury consist of communicable diseases (also known as infectious diseases; e.g.,  
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17 165 chlamydia), chronic diseases (also known as non-communicable diseases; e.g., cancer), and  
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19 166 injuries (e.g., fractured bone). This dimension describes the number of people or individual  
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21 167 cases with a particular health outcome (e.g., ten out of the 100 people suffered from cancer).

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25 168 Mortality was changed to 'mortality and morbidity' and focused on death and disease rates of  
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27 169 the study population (e.g., ten out of 1,000 live births of children under the age of one died)  
28  
29 170 to distinguish epidemiological studies with larger samples from descriptive studies with  
30  
31 171 smaller samples, where the latter were categorised as disease and injury studies.

32  
33  
34  
35 172 Furthermore, some additional subdimensions were created during the data extraction stage, as  
36  
37 173 these were lacking in the original BARHII framework (e.g., the subdimension 'mental health'  
38  
39 174 was added to the disease and injury dimension).

### 175 **Search strategy**

176 Based on the guidelines of the London School of Hygiene and Tropical Medicine<sup>22</sup> and  
177 Bramer et al<sup>23</sup> on selecting the number and types of databases that should be included in  
178 biomedical systematic searches, six databases were selected for this study: Econlit, Embase,  
179 Global Health, Medline, PsycInfo, and Social Policy and Practice. This scoping review  
180 includes studies from 1965 onwards until 2019. However, all records (including records  
181 published before 1965) were retrieved to manually screen the data for publication date-related  
182 issues. The search process was conducted by AS and included a two-stage procedure to

## Materials and Methods

1  
2  
3 183 ensure that the search was exhaustive and to minimise the risk of missing potentially eligible  
4  
5 184 studies. The first stage focused on identifying English-language key words and Medical  
6  
7 185 Subject Headings (MeSH) terms for migrants (e.g., immigrants, foreign workers, refugees),  
8  
9 186 health (e.g., disease, infection, disorder), and Malaysia (e.g., Sabah, Kuala Lumpur) through  
10  
11 187 reading search strategies of other review studies on migrant health as well as looking over  
12  
13 188 medical terminology of renowned medical institutions, such as the Mayo Clinic.  
14  
15 189 Subsequently, these items were combined by using Boolean operators (e.g., migrant AND  
16  
17 190 health AND Malaysia) in the search platform of each database (Supplementary file 2).  
18  
19  
20  
21

22 **191 Selection criteria**

23  
24  
25 192 Studies were eligible for inclusion if they met the following inclusion criteria: 1) conducted  
26  
27 193 in Malaysia, including cross-national studies in which Malaysia was included; 2) published in  
28  
29 194 peer-reviewed academic journals; 3) primary outcomes of the study included a health-related  
30  
31 195 variable from at least one of the five health dimensions of the BARHII framework; 4)  
32  
33 196 employment of one of the following study designs: literature synthesis (systematic review,  
34  
35 197 meta-analysis, other scientific review designs), qualitative (interviews, focus group  
36  
37 198 discussions), and/or quantitative (randomised controlled trial, cohort, case-control, cross-  
38  
39 199 sectional, case series, case report) study design; 5) written in English; 6) inclusion of  
40  
41 200 international (im)migrants, foreign workers, asylum seekers, and refugees, as these groups  
42  
43 201 were considered as vulnerable migrant populations in Malaysia. Articles that included both  
44  
45 202 migrants and the general population were included in this study if sufficient information  
46  
47 203 concerning the migrant population was available.  
48  
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53 204 Studies were excluded if they were: 1) conducted or included data from 1965 or earlier, as  
54  
55 205 Singapore was part of Malaysia until 1965, and this study is careful to only include Malaysia  
56  
57 206 studies without Singapore; 2) grey literature; 3) opinion papers, editorials, fieldnotes of  
58  
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60

## Materials and Methods

1  
2  
3 207 symposia, conferences and workshop abstracts; 4) focused on non-citizens and foreigners,  
4  
5 208 where it was unclear whether a vulnerable migrant population was included (such as  
6  
7 209 permanent residents, naturalised persons, expatriates, temporary visitors, tourists, Malaysian  
8  
9 210 returnees, and international students); 5) only presented migrants as a control variable and no  
10  
11 211 other information regarding migrants was available.  
12  
13  
14

212 **Data extraction**

15  
16  
17  
18 213 Three reviewers (AS, ZC, and NP) were involved in the screening process, where all had  
19  
20 214 experience in the domain of public health and AS and NP had practical knowledge with  
21  
22 215 respect to conducting systematic reviews due to previous research work. Titles and abstracts  
23  
24 216 were exported by AS and subsequently moved into Rayyan, an open-source software  
25  
26 217 designed to support systematic reviews. AS and ZC were the main reviewers, where AS  
27  
28 218 conducted an entire screening of titles and abstracts and ZC assessed a randomly selected  
29  
30 219 20% sample. Independent screening was carried out by using the 'blind' function of Rayyan,  
31  
32 220 with both researchers working separately. The first stage involved screening titles and  
33  
34 221 abstracts according to the selection criteria. Subsequently, AS and ZC conducted an  
35  
36 222 independent full-text screening of all potential articles and attached comments to each article  
37  
38 223 on why the paper was included or excluded. After each screening stage, AS and ZC  
39  
40 224 compared their findings and discussed the discrepancies. In both stages, the discrepancies  
41  
42 225 were about 13% to 14% of the papers and were mostly around the study design and target  
43  
44 226 populations. Conflicts were examined and resolved by NP.  
45  
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51 227 Following the full-text screening stage, the data were extracted by one reviewer (AS) and  
52  
53 228 disaggregated by the different dimensions of the BARHII framework, including the type of  
54  
55 229 migrant (social inequities), main health dimension (institutional inequities, living conditions,  
56  
57 230 risk behaviour, disease and injury, and mortality and morbidity), and health subdimensions.  
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## Materials and Methods

231 Data extraction and categorisation into the BARHII framework categories was not cross-  
232 checked by a second reviewer due to time and human resource constraints.

233 For the next stage, a decision tree was developed to ensure that the correct quality appraisal  
234 tool by study design was selected and to identify the level of evidence of the included  
235 literature (Figure 2). Although various research designs were included in the decision tree,  
236 some study designs did not fit in this model, such as the mixed-method design.

237  
238 [INSERT FIGURE 2]

239  
240 The decision tree built on the study design tree from the Centre for Evidence-Based Medicine  
241 (CEBM)<sup>24</sup> and essentially allowed research of varying designs to be consistently, reliably  
242 classified into one of several design families. The newly developed decision tree was created  
243 through a two-step process. First, a definitions table of included research designs was  
244 developed to adapt specific characteristics of each definition into the decision tree to identify  
245 the paper's study design (Table 2).

246  
247 [INSERT TABLE 2]

248  
249 Second, Tomlin & Borgetto's<sup>29</sup> model was utilised to identify the level of evidence of the  
250 included literature, as the study designs that were included in their model were in line with  
251 the research designs in the definitions table. In addition, it was one of the few models that  
252 deconstructed the single-hierarchy framework and assigned study designs to different  
253 categories depending on the study objective (e.g., if the study design did not aim to provide a

## Materials and Methods

1  
2  
3 254 causal-relationship, but simply describe a particular outcome, the study design would be  
4  
5 255 classified as descriptive research), and, therefore, valued studies with different objectives  
6  
7  
8 256 equally. Tomlin & Borgetto's model consists of four dimensions, including descriptive  
9  
10 257 research, experimental research, outcome research, and qualitative research. Each of these  
11  
12 258 dimensions contains four subclasses to show the level of evidence within each class, where  
13  
14  
15 259 level 1 is the highest level of evidence and level 4 the lowest. The assignment of these levels  
16  
17 260 to the different study designs are based on the degree of internal validity/authenticity and  
18  
19 261 external validity/transferability, where level 1 is regarded with the highest level of these two  
20  
21 262 measures and level 4 ranks the lowest. Table 3 shows the different research dimensions that  
22  
23  
24 263 correspond with the included study designs and level of evidence.

25  
26  
27 26428  
29  
30 265 [INSERT TABLE 3]31  
32  
33 266

34  
35  
36 267 After incorporating feedback on the questions used to identify the research design and  
37  
38 268 multiple testing rounds to assess if the questions were specific enough to distinguish these  
39  
40 269 designs within the full set of articles, the final version of the decision tree – as seen in Figure  
41  
42 270 2 – was used to extract the data.

### 271 **Quality appraisal and level of evidence assessment**

272 The quality assessment of the included studies was conducted by one reviewer (AS) based on  
273 the Joanna Briggs Institute (JBI) critical appraisal tools,<sup>30</sup> as this toolkit includes checklists  
274 for a wide variety of study designs that are most in line with the research designs included in  
275 this study. Additional objective criteria specific to migrant health studies were developed for  
276 each question of the JBI checklists to increase the reliability of the quality assessment. After  
277 discussing the additional criteria and piloting the tools, slight modifications were made for

## Materials and Methods

1  
2  
3 278 the JBI tools, and these final versions were used to assess the quality of the papers. The  
4  
5 279 modified checklists can be accessed on request from the first author.  
6  
7  
8 280 Questions were answered with ‘Yes (V)’ if the study met the criteria according to  
9  
10 281 descriptions provided in the final version of the JBI toolkit. ‘No/Unclear (X)’ was selected if  
11  
12 282 the study did not address the question or if information to assess the given criteria was  
13  
14 283 lacking. The score concerning the quality of the study was determined by summing up all  
15  
16 284 ‘Yes’ answers and dividing this number by the total number of answered questions, which  
17  
18 285 differed by study design in the JBI tools. Questions that were answered with ‘Not applicable  
19  
20 286 (N/A)’ were excluded from the calculation. As the JBI toolkit has no standard scoring index,  
21  
22 287 the following scoring system was applied: 1) low quality = 0% to 50%; 2) moderate quality =  
23  
24 288 above 50% and below 75%; 3) high quality = 75% or higher. Although a four-band scoring  
25  
26 289 system – where each category would include a 25% scoring range – was considered, a three-  
27  
28 290 band scoring system was selected because the three given categories – low, moderate, and  
29  
30 291 high – would simplify the interpretation concerning the quality of the study. In a four-band  
31  
32 292 system, the distinction and classification of the two middle categories are less straightforward  
33  
34 293 compared to the three-band scoring system. Further, the first two categories in a four-band  
35  
36 294 scoring system would still represent a poor-quality study, and, hence, should be used to signal  
37  
38 295 more cautious interpretation of the study results among readers. The cut-off score was based  
39  
40 296 on the idea that if a study could answer ‘yes’ to only half or less of the questions, it would not  
41  
42 297 be sufficient to transmit a reliable message to the audience. Therefore, at least more than half  
43  
44 298 of the questions should be answered with ‘yes’ to obtain a moderate score. The 75% cut-off  
45  
46 299 was still based on the idea of having four equal scoring categories, where 75% and above  
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48 300 would be classified as a high-quality study and would inform the audience with a more  
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50 301 credible message.  
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302 **Data analysis**



## Materials and Methods

1  
2  
3 303 Data concerning the type of migrant, health dimension, health subdimension, research design,  
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5 304 level of evidence, and quality assessment score were imported into Microsoft Excel for Mac  
6  
7  
8 305 (version 16.28). Mean quality scores were calculated for the different variables by using  
9  
10 306 Microsoft Excel, including the type of migrant, health dimension, health subdimension,  
11  
12 307 research design, and level of evidence. RStudio (version 1.0.136; Macintosh; Intel Mac OS X  
13  
14 308 10\_15) was utilised to conduct chi-square tests and a multiple-correspondence analysis  
15  
16 309 (MCA). An MCA is a descriptive technique that can be utilised to visually demonstrate  
17  
18 310 relationships among the levels of several categorical variables – here, these include the type  
19  
20 311 of migrant, main health dimension, quality of the study, and research design – in a two-  
21  
22 312 dimensional space. The MCA projects categories in a two-dimensional space with axes  
23  
24 313 defined by latent dimensions (and, therefore, it is not possible to label the axes), based on  
25  
26 314 weighted Euclidean distances.<sup>31</sup> The MCA allows categories with similar profiles to be  
27  
28 315 grouped together, where a closer distance of categories within the same quadrant  
29  
30 316 demonstrates a stronger relationship, whereas categories that are further apart and in opposite  
31  
32 317 quadrants present weaker associations.<sup>32</sup> In addition to the MCA, chi-square tests were  
33  
34 318 conducted to assess whether categorical variables were independent (e.g., not associated). It  
35  
36 319 should be noted that a few studies included two BARHII dimensions, yet, the analysis only  
37  
38 320 allowed one dimension to be included. Therefore, only the most prominent dimension, based  
39  
40 321 on the amount of attention given to the specific dimension in the article, was selected and  
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44  
45 322 used for the analysis.  
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## Results

**Results**

The study selection process is presented in Figure 3. After removing the duplicates, 1,282 original records were identified. A total of 1,136 papers were excluded after the title and abstract screening stage due to focusing on another population of interest, lacking focus on a BARHII health dimension, not being a peer-reviewed academic article, and including data before 1965. As a result, 146 articles were eligible for the full-text screening stage. Subsequently, full-text articles were retrieved from these 146 records, and eventually, 67 papers met the inclusion criteria and were included in this review.

[INSERT FIGURE 3]

**Characteristics of included papers**

This section first demonstrates the findings of each BARHII dimension, followed by the results on the quality and level of evidence of the included studies. Lastly, existing relationships between the type of study design, study quality of the study, type of migrant, and main health dimension are shown. Table 4 presents a descriptive summary of all included articles, including the study design and corresponding level of evidence, study period, type of migrant, sample population, main health dimension, health subdimension, quality assessment score and a short description of the study.

[INSERT TABLE 4]

## Results

**345 Health dimension and type of migrant**

346 The literature was first assessed to understand the topical coverage of research against the six  
347 dimensions of the BARHII public health framework. The first dimension, social inequities,  
348 was used to describe the population of interest and refers to the type of migrant (e.g., foreign  
349 workers, asylum seekers and refugees, or unclassified migrants). The other five dimensions  
350 focused on elements that influence the health status of the population of interest, including  
351 institutional inequities, living conditions, risk behaviour, disease and injury, and mortality  
352 and morbidity. These latter five categories are outlined below and include results on the types  
353 of migrants researched within these dimensions. Figures 4 and 5 present overviews of the  
354 number of studies disaggregated by health dimension and type of migrant, respectively.

356 [INSERT FIGURE 4]

357

358 [INSERT FIGURE 5]

359

**360 Institutional inequities**

361 One paper addressed the institutional inequities dimension<sup>72</sup> by exploring the inclusion of  
362 migrant workers into national universal health coverage (UHC) policies in five countries of  
363 the Association of Southeast Asian Nations (ASEAN): Indonesia, Philippines, Malaysia,  
364 Thailand and Singapore. The researchers stated that Malaysia has implemented a medical  
365 insurance policy for foreign labour by obligating documented migrant workers to be enrolled  
366 in private insurance schemes, as non-citizens have no access to UHC at public facilities.

## Results

367 ***Living conditions***

368 Eleven papers were classified under the living conditions dimension, where most articles  
369 (n=9/11) addressed the service environment subdimension.<sup>9 36 63 64 76 80 94 95 98</sup> All of these  
370 papers studied the asylum seeker and refugee population, except for one article that focused  
371 on migrant workers.<sup>94</sup> Half the studies used qualitative methods to explore barriers to  
372 healthcare utilisation and showed that language difficulties, discrimination, insufficient health  
373 literacy, and cultural differences were common issues. One study focused on the social  
374 environment subdimension and showed that refugee children experienced discrimination by  
375 locals and other refugees of different ethnicities and national origins, such as stereotyping  
376 them as criminals.<sup>96</sup> Santos et al<sup>69</sup> assessed elements related to the work environment  
377 subdimension by investigating perceived environmental hazards among foreign workers,  
378 demonstrating that noise and dust were perceived as the greatest occupational health threats.

379 ***Risk behaviour***

380 Ten studies researched the risk behaviour dimension, with most articles (n=8/10) conducted  
381 on general migrant populations without clear identification of which migrant categories were  
382 included in their study.<sup>35 38 41 61 62 67 88 90</sup> Three of these articles focused on the sexual  
383 behaviour subdimension, exploring risk behaviour related to human papillomavirus (HPV).  
384 The studies showed that a significant number of migrant women have high HPV risk  
385 behaviour due to lack of understanding with respect to cervical cancer, the screening process,  
386 and poor knowledge concerning HPV vaccination.<sup>61 62 90</sup> Two papers, classified within the  
387 poor nutrition subdimension, showed poor health outcomes among detained migrants due to  
388 nutrition deficiencies.<sup>38 88</sup> The other articles among unclassified migrants included two  
389 studies on violence and abuse, exploring maternal filicide<sup>67</sup> and neglecting children<sup>35</sup>; and  
390 one study on alcohol and other drugs, pertaining to inhalants' usage.<sup>41</sup> These three studies

## Results

1  
2  
3 391 simply showed that migrants represent a certain proportion of the identified cases. Only the  
4  
5 392 study on the use of inhalants presented more cases among migrants than locals. Two final  
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7  
8 393 studies included foreign workers and explored the hygiene and sanitation and hazard and  
9  
10 394 safety awareness subdimensions.<sup>77 82</sup> Kamaludin & How<sup>77</sup> stated that migrant workers had  
11  
12 395 significantly less knowledge regarding environmental health, such as air quality, natural  
13  
14 396 hazards, sanitation, and industrial hazards, compared to local workers. Woh et al<sup>82</sup>  
15  
16  
17 397 investigated the level of hygiene among migrant food handlers and argued that personal  
18  
19 398 hygiene and sanitation measures should be improved among this population.  
20  
21  
22

**399 Disease and injurie**

23  
24  
25  
26 400 With a total of 46 studies, the disease and injury dimension presented the largest study field  
27  
28 401 of interest related to the BARHII framework. Most articles (n=36/46) studied foreign  
29  
30 402 workers,<sup>37 40 43 44 46-56 58-60 66 69 73-75 78 79 81 83-86 89 91-93 95 97</sup> while only six and four articles  
31  
32 403 included unclassified migrants<sup>39 45 57 65 68 70</sup> and refugee populations,<sup>33 34 71 87</sup> respectively. The  
33  
34 404 majority (n=27/46) of the articles studied communicable diseases, where 18 of these studies  
35  
36 405 focused on parasites,<sup>34 37 39 43 44 48-52 59 74 75 84 85 89 91 97</sup> eight on bacteria,<sup>45 47 60 65 68 70 79 81</sup> and  
37  
38 406 two on viruses.<sup>55 70</sup> Most of the studies were descriptive and presented that migrants,  
39  
40 407 irrespective of the defined type, represented a significant share among the study populations.  
41  
42  
43 408 Non-communicable diseases were studied far less compared to communicable diseases and  
44  
45 409 were only specifically addressed in three articles.<sup>33 53 73</sup> Scheutz et al<sup>33</sup> found high numbers of  
46  
47 410 different non-communicable oral complications among Vietnamese refugees, such as tooth  
48  
49 411 decay and missing teeth. Vijian et al<sup>73</sup> compared the difference in characteristics between  
50  
51 412 foreign workers and Malaysian patients with perforated peptic ulcers, showing that the  
52  
53  
54 413 treated foreign labour population were younger, experienced fewer post-operative  
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## Results

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3 414 complications, and had smaller-sized ulcers compared to locals. Murty<sup>53</sup> reported a case  
4  
5 415 study, presenting a deceased migrant worker due to a cystic tumour in the heart region.  
6  
7  
8  
9 416 In addition to the studies that focused on single disease outcomes, two studies were  
10  
11 417 conducted that presented distributions of various diseases among foreign workers, including  
12  
13 418 communicable and non-communicable disorders.<sup>46 95</sup> Five studies focused on the mental  
14  
15 419 health subdimension, where these studies concentrated on describing psychiatric disorders,<sup>40</sup>  
16  
17 420 determining quality of life-related risk factors,<sup>57 71</sup> and testing the effect of different coping  
18  
19 421 mechanisms and therapy sessions on the level of stress.<sup>83 87</sup> Nine studies explored the injury  
20  
21 422 subdimension, where nearly all (n=8/9) studies focused on work-related injuries. Most of  
22  
23 423 these studies examined the prevalence of particular injuries and traumas, including fatal  
24  
25 424 lightning strikes,<sup>54</sup> ocular traumas,<sup>78</sup> and musculoskeletal pain.<sup>66 69 86</sup> Ratnasingam et al<sup>58</sup>  
26  
27 425 compared the number of occupational incidents between local workers and migrant workers,  
28  
29 426 where foreign workers had less accidents. In addition, two papers described risk factors for  
30  
31 427 work-related injuries, such as high machine-related vibration exposure<sup>56</sup> and low levels of the  
32  
33 428 company's safety commitment (as assessed by foreign workers themselves).<sup>92</sup> Ya'acob et al<sup>93</sup>  
34  
35 429 conducted an RCT to evaluate the impact of a specific workplace intervention on  
36  
37 430 musculoskeletal symptoms (MMS) among foreign labour and showed that the intervention  
38  
39 431 reduced musculoskeletal symptoms in the foot and ankle regions significantly compared to  
40  
41 432 the control group.

**433 Mortality and morbidity**

434 Two papers addressed the mortality and morbidity dimension by showing incidence rates  
435 among general cohorts of migrants. Zulkifli et al<sup>36</sup> conducted a study on maternal and child  
436 health in Sabah and identified that infant mortality rates were significantly higher for  
437 migrants compared to locals. Dony et al<sup>42</sup> also conducted a study in Sabah and showed that at

## Results

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2  
3 438 least 24% of new tuberculosis cases detected since 1990 were among migrants and that  
4  
5 439 leprosy incidence rates among migrants were on average 3.7 times higher than incidence rates  
6  
7  
8 440 among Malaysians.  
9

10  
11 441 **Level of evidence and quality of the study**  
12

13  
14 442 In total, 65 articles were included in the quality assessment; Tables 5 and 6 show the mean  
15  
16 443 quality scores of the papers disaggregated by BARHII dimension and level of evidence,  
17  
18 444 respectively. Two articles – representing a scoping review<sup>72</sup> and mixed-method design<sup>80</sup> –  
19  
20 445 were excluded from this assessment, as the JBI toolkit does not accommodate these study  
21  
22 446 designs. The quality assessment scores can be found in Supplementary file 3. In addition,  
23  
24 447 Figure 6 shows an overview of the number of studies disaggregated by research design.  
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33 449 [INSERT TABLE 5]  
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40 451 [INSERT TABLE 6]  
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47 453 [INSERT FIGURE 6]  
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50 454  
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53  
54 455 In general, the quality of the evidence base on migrant health in Malaysia is low (49.2%) and  
55  
56 456 consists mostly of level 3 evidence papers (n=27/65). Level 2 evidence represents 38.5% of  
57  
58 457 the evidence base (n=25/65), followed by level 4 evidence papers (n=13/65). No level 1  
59  
60

## Results

1  
2  
3 458 evidence studies (systematic reviews or meta-analyses) were identified. The majority of the  
4  
5 459 papers (n=41/65) focused on foreign workers, however, studies that included asylum seekers  
6  
7 460 and refugees have the highest mean quality (58.4%). Furthermore, only four out of five  
8  
9 461 BARHII health dimensions were included in the quality assessment. The living conditions  
10  
11 462 dimension has the highest average score (59.7%), followed by the risk behaviour dimension  
12  
13 463 (48.7%), mortality and morbidity dimension (47.9%), and the disease and injury dimension  
14  
15 464 (46.3%). Moreover, the descriptive research category represents the majority (70.8%) of the  
16  
17 465 evidence base with a mean quality of 47.7%. The qualitative research category has the  
18  
19 466 highest mean quality and is the only research category with a high-quality score (76%).  
20  
21  
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#### 25 467 **Associations between different variables**

26  
27  
28 468 Figure 7 presents the results of the multiple-correspondence analysis (MCA), showing  
29  
30 469 different associations between four dimensions: 1) type of study design; 2) quality of the  
31  
32 470 study; 3) type of migrant; and 4) main health dimension. Chi-square test results were utilised  
33  
34 471 to assess whether categorical variables were independent.  
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42 473 [INSERT FIGURE 7]  
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49 475 High-quality studies tend to include refugees and asylum seekers ( $X^2 = 17.005$ ,  $df = 4$ ,  $p$ -  
50  
51 476 value = 0.001928), focus on living conditions ( $X^2 = 131.94$ ,  $df = 6$ ,  $p$ -value =  $< 2.2e-16$ ), and  
52  
53 477 have a qualitative research design ( $X^2 = 656.35$ ,  $df = 12$ ,  $p$ -value =  $< 2.2e-16$ ). Moreover,  
54  
55 478 studies that included foreign workers tend to focus on diseases and injuries ( $X^2 = 374.52$ ,  $df =$   
56  
57 479 6,  $p$ -value =  $< 2.2e-16$ ) and contain a case report study design ( $X^2 = 576.87$ ,  $df = 12$ ,  $p$ -value  
58  
59  
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## Results

1  
2  
3 480 = < 2.2e-16). Furthermore, research that included the unclassified migrant population tend to  
4  
5 481 study the risk behaviour, and mortality and morbidity dimensions ( $X^2 = 374.52$ ,  $df = 6$ , p-  
6  
7 482 value = < 2.2e-16). Lastly, prevalence studies, and, to a lesser extent, analytical cross-  
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9  
10 483 sectional studies, tend to have a low-quality score ( $X^2 = 656.35$ ,  $df = 12$ , p-value = < 2.2e-  
11  
12 484 16).

For peer review only

Conclusion

## 485 **Discussion**

### 486 **Key findings**

487 This study mapped the existing academic literature on migrant health in Malaysia and  
488 assessed the quality and level of evidence of these scientific studies. Future research priorities  
489 based on the existing evidence and identified gaps are summarised in Table 7.

490

491 [INSERT TABLE 7]

492

493 Among the five BARHII health dimensions, institutional inequities, and mortality and  
494 morbidity were the least represented. Yet, studies concerning the influence of governance on  
495 migrant health are of utmost importance, as overarching governance can affect health  
496 outcomes of the other BARHII dimensions.<sup>99 100</sup> Similarly, epidemiological research on  
497 mortality and morbidity rates are necessary for population health statistics, to identify disease  
498 patterns, document changes over time, and inform plans of action to tackle these health  
499 issues.<sup>101</sup> Further research should focus on migrant health governance, as well as  
500 epidemiological research on morbidity and mortality among both migrants and non-migrants,  
501 to better understand the effects of policies on migrant health, which is particularly relevant in  
502 low- and middle-income countries (LMICs) where the evidence gap is so acute.<sup>102</sup>  
503 Furthermore, a recent systematic review on the effects of non-health-targeted policies on  
504 migrant health in high-income countries showed that non-health policies (e.g., restrictive  
505 immigration policies) were associated with poor health outcomes.<sup>103</sup> It is therefore important

## Conclusion

1  
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3 506 that policies in other sectors (potentially including, e.g., immigration, labour, education) are  
4  
5 507 also assessed for their potential consequences for migrant health.  
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8

9 508 Living conditions were represented in eleven studies and focused mainly (n=9/11) on the  
10  
11 509 service environment by addressing the healthcare setting. However, there is scarce  
12  
13 510 information on the social and economic environments that different categories of migrants  
14  
15 511 must navigate and no data on the physical environment at all. Research conducted in other  
16  
17 512 countries demonstrates the importance of these three subdimensions on migrant health.<sup>104-106</sup>  
18  
19 513 Shao et al<sup>104</sup> argued that inequalities regarding the level of income (economic environment)  
20  
21 514 influenced health outcomes among internal migrant workers in China. He & Wong<sup>105</sup> stated  
22  
23 515 that poor mental health among female migrant workers in China was related to gender-  
24  
25 516 specific stressors (social environment). Al-Khatib et al<sup>106</sup> demonstrated that poor housing  
26  
27 517 conditions (physical environment) in a refugee camp were directly associated with various  
28  
29 518 upper respiratory tract diseases. These studies underscore the importance of different  
30  
31 519 environments on migrant health, motivating a focus of future research on the health impact of  
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33 520 living conditions other than healthcare utilisation.  
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40 521 Ten studies were conducted on risk behaviour with different subdimensions, from hygiene  
41  
42 522 and sanitation to violent and abusive behaviour. However, all of these subdimensions were  
43  
44 523 under-researched, as only limited elements of each subdimension were discussed. For  
45  
46 524 instance, three studies focused on sexual behaviour by addressing HPV knowledge.<sup>61 62 90</sup>  
47  
48 525 Yet, no attention was given to other sexual behaviour-related topics, such as condom use,  
49  
50 526 HIV knowledge, and birth control. Although these studies have been conducted in Malaysia,  
51  
52 527 this research is lacking in the migration context.<sup>107-109</sup> Therefore, future research should focus  
53  
54 528 on broader aspects of each subdimension, as demonstrated in research elsewhere. For  
55  
56 529 example, Renzaho & Burns<sup>110</sup> addressed the poor nutrition subdimension by showing that  
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## Conclusion

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3 530 dietary patterns among African migrants changed negatively after arriving in Australia due to  
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5  
6 531 the increased intake of fast food and processed food. Ganle et al<sup>111</sup> concentrated on the sexual  
7  
8 532 risk behaviour subdimension and stated that 71% of the sampled refugees in Ghana had  
9  
10 533 transactional sex, and only 12% used contraceptives. Bosdriesz et al<sup>112</sup> compared smoking  
11  
12 534 between migrants and non-migrants in the United States (US) and showed that migrants  
13  
14 535 smoked less than US citizens. As a significant number of migrants in Malaysia come from  
15  
16 536 Indonesia, a population that smokes almost twice as much as Malaysians, smoking behaviour  
17  
18 537 among this migrant group may differ from locals.<sup>113</sup> Therefore, future research should further  
19  
20 538 explore the differences in other risk behaviours, such as smoking, between Malaysians and  
21  
22 539 migrants in Malaysia.

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26  
27 540 Disease and injury was the most researched dimension, representing more than two-thirds of  
28  
29 541 the evidence base on migrant health in Malaysia. Despite the strong representation, over half  
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31 542 the research papers concentrated on communicable diseases, while only a few examined non-  
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33 543 communicable diseases, consistent with global research output on international migrant  
34  
35 544 workers.<sup>114</sup> As the World Health Organization (WHO)<sup>115</sup> states that approximately 74% of all  
36  
37 545 deaths in Malaysia are attributable to non-communicable disease, in particular cardiovascular  
38  
39 546 disease, chronic respiratory disease, and diabetes, there is a need to expand research on non-  
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41 547 communicable disease trends and outcomes among the migrant population in Malaysia.

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47 548 We found that the majority of studies involved foreign workers (n=41/67), and only ten  
48  
49 549 studies examined asylum seekers and refugees as the primary population of interest. Our  
50  
51 550 findings, therefore, offer useful synthesis on migrant worker's health specifically, which is  
52  
53 551 lacking relative to studies on asylum seekers and refugees in global migration health  
54  
55 552 research.<sup>14</sup> Furthermore, eleven studies did not specify the included migrant population. This  
56  
57 553 issue could have occurred due to missing information on the type of migrant in the dataset  
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## Conclusion

1  
2  
3 554 that the researchers used for their studies. For example, the Ministry of Health (MOH) will  
4  
5 555 not report anything more detailed than 'non-Malaysian,' as no further information on non-  
6  
7 556 citizens are collected during patient registration at MOH facilities. Ideally, all research on  
8  
9 557 migrants should clearly specify the type of migrants being studied and not omit crucial  
10  
11 558 details, such as gender, visa status, and country of origin. Also, human trafficking could  
12  
13 559 significantly affect a person's health and vulnerability, yet, there is very little known about  
14  
15 560 the health issues experienced by trafficked persons in Malaysia.<sup>116</sup> While the vulnerabilities  
16  
17 561 experienced by trafficked persons intersect with other migration-related vulnerabilities like  
18  
19 562 gender, ethnicity or documentation status, victims of human trafficking should be categorised  
20  
21 563 separately, to reflect their own unique status and vulnerability. The travel routes or modes of  
22  
23 564 transportation used by migrants to come to Malaysia may influence migrant health in  
24  
25 565 different ways a well, as different routes or modes of transportation may be linked with  
26  
27 566 specific hazards. Related to this issue is the lack of evidence on migrant health with specific  
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29 567 stages of migration, including pre-departure, travel, destination interception, and return,  
30  
31 568 where health outcomes might differ between these stages.<sup>117</sup>  
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39 569 Lastly, this scoping review revealed that the average quality of studies on migrant health in  
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41 570 Malaysia is poor (49.2%) and that most of these studies have level 3 (n=27/65) or level 2  
42  
43 571 (n=25/65) evidence. Only qualitative studies with more rigour (level 2 evidence) and those  
44  
45 572 that focus on living conditions and include the refugee and asylum seeker populations, tend to  
46  
47 573 have a high-quality score. Therefore, there is a clear need to conduct research that will  
48  
49 574 provide strong evidence to support practices and policies that will positively impact migrant  
50  
51 575 health. Creating standard research design-specific guidelines, if not existing already, and,  
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53 576 subsequently, promoting these materials among academics and research institutions, could  
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55 577 increase the quality of future research work. Furthermore, researchers should follow study  
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## Conclusion

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3 578 design specific reporting guidelines, to ensure that all relevant information is captured in  
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5 579 publications for further evidence synthesis, such as this review.  
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580 **Limitations**

11 581 This study is the first systematic literature synthesis and scoping review on migrant health in  
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13 582 Malaysia and presents a comprehensive overview of all identified peer-reviewed articles that  
14  
15 583 met the inclusion criteria. Specific recommendations based on this research are provided to  
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17 584 improve the evidence base on migrant health in Malaysia. Furthermore, we utilised a self-  
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19 585 developed decision tree and modified JBI checklists to help identify the type of study design  
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21 586 and corresponding level of evidence of the included studies. We found this evidence  
22  
23 587 assessment framework to be useful for the quality assessment of migrant health-related  
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25 588 studies, and it might be useful for other research fields as well. Yet, our review has several  
26  
27 589 limitations. As this paper focuses exclusively on vulnerable migrants within the non-citizen  
28  
29 590 population in Malaysia, we excluded other non-citizen groups, such as expatriates and  
30  
31 591 international students, based on the assumption that these groups are less vulnerable (e.g.,  
32  
33 592 expatriates in Malaysia have more privileges in terms of recognition regarding their roles in  
34  
35 593 society, receive better financial compensation, and tend to have access to many other benefits  
36  
37 594 compared to foreign workers). However, we acknowledge that other non-citizen groups may  
38  
39 595 face challenges in obtaining proper healthcare in Malaysia as well, such as issues related to  
40  
41 596 cultural competency among foreign students and retirees.<sup>118 119</sup> In addition, papers including  
42  
43 597 non-citizens without further description were excluded, although these studies may have  
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45 598 included the vulnerable migrant population.  
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54 599 Only academic peer-reviewed studies were included, thus excluding grey literature,  
55  
56 600 editorials, and opinion papers. Also, only English language articles were included, resulting  
57  
58 601 in the exclusion of one paper in Bahasa Malaysia (the Malay language).<sup>120</sup> As a result, much  
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## Conclusion

1  
2  
3 602 relevant information that could potentially be used to inform both policies and practice could  
4  
5 603 have been excluded from this review.  
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8  
9 604 Inter-rater reliability was limited to a 20% sample of the records in the first screening stage,  
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11 605 and no data extraction nor quality assessment was verified by a second reviewer due to  
12  
13 606 resource constraints. Also, a decision tree or another selection format to objectively classify  
14  
15 607 the BARHII dimension and subdimension of each paper was not developed, and, therefore,  
16  
17 608 this paper might suffer from some selection bias. Yet, we anticipate low bias as the first  
18  
19 609 reviewer was the main researcher and was very familiar with the study design and included  
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21 610 frameworks.  
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24  
25  
26 611 Besides the BARHII framework, various conceptual public health models are available, and  
27  
28 612 using a different framework could lead to the identification of other gaps in the evidence base  
29  
30 613 related to specific dimensions of health. For instance, the WHO Commission on Social  
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32 614 Determinants of Health (CSDH) framework includes material circumstances, such as food  
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34 615 availability, whereas this dimension is not included in the BARHII framework.<sup>121</sup> Similarly,  
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36 616 critical appraisal tools other than the JBI toolkit are available and could affect the scores of  
37  
38 617 the quality assessment. Yet, the JBI toolkit offers a wider range of study design-specific tools  
39  
40 618 compared to others. Both the BARHII framework as well as the JBI toolkit were compared to  
41  
42 619 other public health models and critical appraisal tools, respectively, and seemed to be the best  
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44 620 fit for this study.  
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50 621 Likewise, a decision tree was developed by using the characteristics of the used definitions of  
51  
52 622 different research designs as well as the specific traits of Tomlin & Borgetto's<sup>29</sup> level of  
53  
54 623 evidence model. Using other definitions and level of evidence models could result in a  
55  
56 624 different level of evidence categorisation. However, we believe this review makes a strong  
57  
58 625 methodological contribution by combining study designs and level of evidence in a unified  
59  
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## Conclusion

1  
2  
3 626 decision tree, which can be used by researchers conducting systematic or scoping reviews  
4  
5 627 where accurate classification of the study design and associated evidence level, is important.  
6  
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9 628 In order to conduct the multiple-correspondence analysis (MCA), the dataset could only  
10  
11 629 include one unit per dimension for each paper. As some studies included multiple BARHII  
12  
13 630 dimensions, only the most prominent dimension was included in the analysis. As a result, the  
14  
15 631 analysis may suffer from some selection bias and present slightly different outcomes  
16  
17 632 compared to an analysis that includes the other BARHII dimensions.  
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19  
20  
21 633 Lastly, no adjustments were made for outliers in the quality assessment. Therefore, some  
22  
23 634 papers with extremely high or low scores could have influenced specific dimensions and  
24  
25 635 might not reflect the quality of those dimensions perfectly.  
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636 **Conclusion**

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33 637 Migrant health remains an issue in Malaysia, yet, the quality of the evidence needed to  
34  
35 638 inform policies is currently lacking. Research-specific reporting guidelines should be  
36  
37 639 followed to improve the credibility and quality of the evidence base. Furthermore, future  
38  
39 640 research should focus more on evidence gaps in the mortality and morbidity, and institutional  
40  
41 641 inequities dimensions, and certain subdimensions, such as non-communicable diseases,  
42  
43 642 housing conditions, and physical inactivity, to provide a comprehensive picture of migrant  
44  
45 643 health in Malaysia. Apart from demonstrating the research gaps, this paper also makes  
46  
47 644 methodological contributions to migrant health research by providing a modified JBI toolkit  
48  
49 645 and a decision tree that identifies the type of study design and corresponding level of  
50  
51 646 evidence, both of which can be utilised in other research fields as well.  
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698 **Figure legends:**

699 Figure 1. Bay Area Regional Health Inequities Initiative (BARHII) framework.

700 Figure 2. Decision tree to identify the type of study design and corresponding level of  
701 evidence.

702 Figure 3. Flowchart of the data selection process.

703 Figure 4. Number of studies disaggregated by health dimension.

704 Figure 5. Number of studies disaggregated by type of migrant.

705 Figure 6. Number of studies disaggregated by research design.

706 Figure 7. Results of the multiple-correspondence analysis (MCA).

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## Figure Legends

# Tables

Table 1. Definitions of migrant-related terms.

Term	Definition
Regular migrant worker (documented or legal migrant worker)	<i>“A migrant worker or members of his or her family authorised to enter, to stay and to engage in a remunerated activity in the State of employment pursuant to the law of that State and to international agreements to which that State is a party.”</i> <sup>6(p. 29)</sup>
Irregular migrant worker (undocumented or illegal migrant worker)	<i>“Migrant workers or members of their families, who are not authorised to enter, to stay or to engage in employment in a State.”</i> <sup>6(p. 102)</sup>
Refugee	<i>“A person who, owing to a well-founded fear of persecution for reasons of race, religion, nationality, membership of a particular social group or political opinions, is outside the country of his nationality and is unable or, owing to such fear, is unwilling avail himself of the protection of that country.”</i> <sup>6(p. 79)</sup>
Asylum seeker	<i>“A person who seeks safety from persecutions or serious harm in a country other than his or her own and awaits a decision on the application for refugee status under relevant international and national instruments. In case of a negative decision, the person must leave the country and may be expelled, as may any non-national in an irregular or unlawful situation, unless permission to stay is provided on humanitarian or other related grounds.”</i> <sup>6(p. 12)</sup>

## Figure Legends

Table 2. Definitions of included study designs.

Study design	Definition
<i>Analytical studies</i>	Studies that strive to quantify the relationship between a particular exposure or intervention and the outcome of interest, where these studies include a comparison group to compare the outcome rates. <sup>24</sup>
Systematic review	A study that is conducted systematically to collect all published evidence – that comply with the specified inclusion criteria – and provide a summary of the results to answer a specific research question. <sup>25</sup>
Randomised controlled trial (RCT)	An experimental study that includes at least two groups – treatment group and control group – to compare the outcomes between the group that received the intervention/drug and the group that received a placebo/no treatment. The participants of the group are randomly allocated to one of the groups. <sup>26</sup>
Quasi-experimental study/non-RCT	An experimental study that includes at least two groups – treatment group and control group – to compare the outcomes between the group that received the intervention/drug and the group that received a placebo. The participants of the group are <b>not</b> randomly allocated to one of the groups. <sup>27</sup>
Cohort study	A study that follows a group of people over time, where the participants are sampled based on the presence or absence of a particular exposure to compare the outcome of interest with a control group. <sup>26</sup>
Case-control study	A study that includes a group of people selected on the outcome of interest (cases) and a group without the outcome of interest (controls), followed by assessing previous exposure of both groups to determine if there is a relationship between the level of exposure and outcome of interest. <sup>26</sup>
Analytical cross-sectional	A study that looks at two groups – exposed and unexposed – and the outcome of interest at a particular point or period of time to compare the differences between the two groups. <sup>26</sup>
<i>Descriptive studies</i>	Studies that do not strive to quantify a relationship between variables, but simply describe the disease outcome and characteristics within a defined population. Note that descriptive studies can still include analytic components. <sup>24</sup>
Prevalence study	A study that looks at a population at a particular point or period of time to describe the prevalence of an outcome of interest. <sup>26</sup>
Case series	A study where only subjects are included with a particular outcome of interest to describe the shared and diverging characteristics of this study population. <sup>28</sup>
Case report	A study that describes an unfamiliar or extraordinary outcome of one individual. <sup>28</sup>

## Tables

Table 3. Level of evidence for each study design.

Research design	Level of evidence	Abbreviation
<b><i>Descriptive research</i></b>		
Systematic review of descriptive studies	1	Des-1
Prevalence study with analytical component	2	Des-2
Case series and prevalence study without analytical component	3	Des-3
Case report	4	Des-4
<b><i>Experimental research</i></b>		
Systematic review/meta-analysis of experimental studies	1	Exp-1
Randomised controlled trial	2	Exp-2
Group quasi-experimental study (a.k.a. non-RCT)	3	Exp-3
Quasi-experimental study with single subject	4	Exp-4
<b><i>Observational research</i></b>		
Systematic review/meta-analysis of observational studies	1	Obs-1
Cohort study	2	Obs-2
Case-control	3	Obs-3
Analytical cross-sectional study	4	Obs-4
<b><i>Qualitative research</i></b>		
Systematic review/meta-synthesis of qualitative studies	1	Qual-1
Group qualitative studies with more rigor <sup>1</sup>	2	Qual-2
Group qualitative studies with less rigor	3	Qual-3
Qualitative study with a single informant	4	Qual-4

1 = Highest level of evidence; 4 = lowest level of evidence. Modifications have been made in the terminology to make this model more align with the included research designs in this study and are shown in the footnote below.<sup>2</sup>

<sup>1</sup> Rigor was subjectively assessed and based on the number of included participants, amount of collected data, and detailed explanation how the study was conducted.

<sup>2</sup> The following terminology of Tomlin & Borgetto's model have been modified: association/correlation studies = prevalence studies with analytical component; normative/descriptive studies = prevalence studies without analytical component; individual case studies = case report; controlled-clinical trials = group quasi- experimental study; single-subject studies = quasi-experimental study with single subject; pre-existing groups comparisons with covariate analysis = cohort study; one-group pre-post studies = analytical cross-sectional study.

## Tables

Table 4. Summary table of included articles.

Reference	Study design	Study period	Type of migrant	Sample population	Main category	Subcategory	Quality score	Summary
Scheutz et al <sup>33</sup>	Prevalence (Des-3)	January to May 1982	Asylum seekers & refugees	361 Vietnamese refugees	Disease & injury	Non-communicable disease (Oral health)	Moderate (55.6)	ental health of refugees was examined, and the study showed a positive relationship between the average number of tooth decay and missing teeth and increase in age among younger refugees.
Levy <sup>34</sup>	Prevalence (Des-2)	July to August 1984	Asylum seekers & refugees	297 children (94 Filipino, 104 Muruts, 99 Kadazan)	Disease & injury	Communicable disease (Parasite)	Low (44.4)	Three groups of children – one refugee group and two indigenous groups – were examined for six types of intestinal parasites. Among the three groups, Filipino refugee children presented significant higher rates of trichuris trichiura and ascaris lumbricoides compared to both groups.
Kassim et al <sup>35</sup>	Case series (Des-3)	1985 to 1986	Unclassified migrants <sup>1</sup>	86 children (7 migrants, <sup>2</sup> 34 Malays, 16 Chinese, 3 mixed origin)	Risk behaviour	Violence & abuse (Neglect)	Moderate (60.0)	In total, 86 children were identified as cases suffering from different types of abuse. Among this group were 7 regular migrant children, where they were identified as neglected, due to lacking nutritional and physical needs.
Zulkifli et al <sup>36</sup>	Analytical cross-sectional (Obs-4)	N/A <sup>2</sup>	Unclassified migrants	1,515 people (336 migrants, <sup>2</sup> 1,075 citizens)	Living conditions	Service environment (Healthcare utilisation)	Low (33.3)	A comparison between migrants and locals regarding maternal and child health outcomes were studied. Migrant women had a lower usage of contraceptives and antenatal care, but used the services of traditional birth attendants more compared to local women. In addition, migrant women had statistically significantly higher rates regarding infant mortality compared to locals.
Rajeswari et al <sup>37</sup>	Prevalence (Des-3)	N/A <sup>2</sup>	Foreign workers <sup>3</sup>	456 children (10 Indonesians, 357 Malays, 78 Orang Asli, 11 Indian)	Disease & injury	Communicable disease (Parasite)	Low (22.2)	School children were examined for different types of helminths and protozoa, and the study showed that children from migrant workers had the highest prevalence.



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Tables

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2	Jeyakumar <sup>38</sup>	Case series	10 May	Unclassified	27 migrants	Risk	Poor nutrition	Low	<p>Twenty-seven detained irregular migrants were sent to the hospital to treat ankle oedema, where they showed a positive response to thiamine treatment.</p> <p>A total of 134 malaria cases were admitted to University Hospital Kuala Lumpur between 1983 and 1992, including 22 irregular Indonesian migrants (16.4%) and (16.4%) other foreigners (such as other irregular migrants from Bangladesh, India, and Thailand, as well as Vietnamese refugees. In addition, chloroquine-resistance was found in 9 irregular Indonesian migrants and 6 other foreigners.</p> <p>Within a two-year period, 39 foreigners were admitted to the psychiatric wards of UHKL., including 30 migrant workers that suffered from a psychiatric disorder. Domestic workers represented with 23 cases the largest group among these foreign workers.</p> <p>Among the 37 suspected solvent abusers (glue sniffers) that were admitted to Bukit Padang Psychiatric Hospital, 17 children admitted using these inhalants. Almost two-third of the cases were Filipino immigrants.</p> <p>An epidemiological study aimed to present the tuberculosis and leprosy trends in Sabah. Since 1990, at least 24% of the annual tuberculosis cases were among Indonesian and Filipino migrants, where the annual rate differed between 100 to 200 cases per 100,000 population between 1990 and 2000. Furthermore, leprosy rates among migrants differed from 4.39 cases to 6.19 cases per 100,000 population between 1996 and 2001.</p> <p>Jabouley procedure was carried out to treat a 30-year-old Myanmar worker that suffered from a filarial</p>
3		(Des-3)	1993 to 08	migrants <sup>1,4</sup>	(23 Bangladeshi, 4	behaviour	(Nutrition deficiency)	(40.0)	
4			July 1993		Indonesians)				
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6	Jamaiah et al <sup>39</sup>	Case series	1983 to	Unclassified	134 people	Disease &	Communicable	Low	
7		(Des-3)	1992	migrants <sup>1</sup>	(22 Indonesian, 22	injury	disease	(40.0)	
8					Others, <sup>2,5</sup> 40 Chinese,		(Parasite)		
9					37 Malays, 13 Indians)				
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17	Krahl &	Prevalence	January	Foreign	39 people	Disease &	Mental health	High	
18	Hashim <sup>40</sup>	(Des-3)	1994 to	workers <sup>6,7</sup>	(20 Indonesians, 16	Injury	(Psychiatric disorders)	(77.8)	
19			June 1996		Filipinos, 1 Bruneian, 1				
20					Singaporean, 1 Thai)				
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23	Zabedah et	Prevalence	N/A <sup>2</sup>	Unclassified	37 people identified;	Risk	Alcohol & other drugs	Low	
24	al <sup>41</sup>	(Des-2)		migrants	27 people included	behaviour	(Inhalant)	(22.2)	
25					(17 Filipinos, 10 locals)				
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28	Dony et al <sup>42</sup>	Prevalence	N/A <sup>2</sup>	Unclassified	3,908 people	Mortality &	Morbidity rates	Moderate	
29		(Des-3)		migrants	(943 foreigners, <sup>2</sup> 2,965	Morbidity	(Tuberculosis &	(62.5)	
30					nationals)		leprosy)		
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39	Chandran et	Case report	N/A <sup>2</sup>	Foreign workers	1 Myanmar	Disease &	Communicable	High	
40	al <sup>43</sup>	(Des-4)				injury	disease	(83.3)	
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## Tables

						(Parasite)			infection. After the procedure, the patient was discharged, but did not show for the follow-up.
Nissapatorn et al <sup>44</sup>	Prevalence (Des-3)	January 2000 to April 2004	Foreign workers	1,885 patients <sup>2</sup>	Disease & injury	Communicable disease (Parasite)	Low (50.0)		Within a four-year period, 1,885 medical records of the University of Malaya Medical Centre were reviewed to identify the prevalence of four common protozoan infections. In total, 28 malaria cases were identified, where 60.7% was among foreigners. The majority of this group consisted of foreign workers.
Sobri et al <sup>45</sup>	Case series (Des-3)	January 1995 to December 2001	Unclassified migrants	42 people (7 Indonesians, 1 Burmese, 1 Siamese (Thai), 1 Bangladeshi, 1 Nepalese, 23 Malays, 6 Chinese, 2 Indians)	Disease & injury	Communicable disease (Bacteria)	Low (50.0)		In total, 42 patients were diagnosed with tuberculosis meningitis at the Kuala Lumpur Hospital during a 7-year period. Eleven (9.5%) out of the 42 tuberculosis meningitis patients were among immigrants.
Leong <sup>46</sup>	Prevalence (Des-3)	1 January 1997 to 31 December 2004	Foreign workers	3,117 Indonesians	Disease & injury	Various diseases (various diseases)	Low (44.4)		During an 8-year-period, 3,117 female migrant (domestic) workers were screened at a private clinic in Johor Bahru, where 223 (7.2%) of them presented medical problems. Hypertension, pulmonary tuberculosis and hepatitis B were the top three major issues.
Sasidharan et al <sup>47</sup>	Prevalence (Des-2)	June 1999 to September 2001	Foreign workers	697 people (26 Bangladeshi, 276 Malays, 229 Chinese, 166 Indians)	Disease & injury	Communicable disease (Bacteria)	High (77.8)		From 1999 to 2002, a total of 697 patients were examined for <i>Helicobacter pylori</i> infection. Twenty-six Bangladeshi foreign workers were among this group, and the infection was present in 6 of them.
Masitah et al <sup>48</sup>	Case series (Des-3)	N/A <sup>2</sup>	Foreign workers	N/A <sup>2</sup>	Disease & injury	Communicable disease (Parasite)	Low (22.2)		During a 6-year period, different malaria registries were reviewed to identify the number of cases in Selangor. The number of annual malaria cases decreased from 172 people in 2001 to 90 people in 2006, while the proportion cases among migrant workers increased from 57% to 85%, respectively.

## Tables

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2	Shailendra & Prepageran <sup>49</sup>	Case report (Des-4)	N/A <sup>2</sup>	Foreign workers	1 Myanmar	Disease & injury	Communicable disease (Parasite)	High (75.0)	38-year-old Myanmar migrant worker presented a case of oropharyngeal rhinosporidiosis. The abnormal growths were removed, and the patient did not show any recurrence of the disease after a 3-month follow-up.
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8	Chan et al <sup>50</sup>	Analytical cross-sectional (Obs-4)	N/A <sup>2</sup>	Foreign workers <sup>1</sup>	699 people (336 Indonesians, 45 Bangladeshi, 45 Indians, 26 Nepalese, 22 Myanmar, 17 Pakistani, 3 Africans, <sup>2</sup> 3 Sri Lankans, 3 Thai, 1 Chinese, 198 Malaysians)	Disease & injury	Communicable disease (Parasite)	Low (0.0)	A sample of 699 people were screened for toxoplasmosis, including 501 migrant workers. Among the migrant workers, 171 (34.1%) cases tested positive for the IgG antibodies test and 26 (5.2%) cases tested positive for the M antibodies test. The statistical analysis showed that the infection rate – using the IgG test – was significantly higher among local residents compared to the foreign workers.
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19	Farhana et al <sup>51</sup>	Case series (Des-3)	1999 to 2008	Foreign workers	34 people (3 Myanmar, 1 Indonesian, 1 Pakistani, 14 Chinese, 9 Malays, 6 Indians)	Disease & injury	Communicable disease (Parasite)	Low (60.0)	A total of 34 amoebiasis cases were admitted to university Malaya Medical Centre during a 10-year-period, including five foreign workers.
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26	Chan et al <sup>52</sup>	Analytical cross-sectional (Obs-4)	N/A <sup>2</sup>	Foreign workers <sup>1</sup>	699 people (336 Indonesians, 45 Bangladeshi, 45 Indians, 26 Nepalese, 22 Myanmar, 17 Pakistani, 3 Africans, <sup>2</sup> 3 Sri Lankans, 3 Thai, 1 Chinese, 198 Malaysians)	Disease & injury	Communicable disease (Parasite)	Low (0.0)	A sample of 699 people were screened for toxoplasmosis, including 501 migrant workers. Among the migrant workers, 171 (34.1%) cases tested positive for the IgG antibodies test and 26 (5.2%) cases tested positive for the M antibodies test. The statistical analysis showed that the infection rate – using the IgG test – was significantly higher among local residents compared to the foreign workers.
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37	Murty <sup>53</sup>	Case report (Des-4)	N/A <sup>2</sup>	Foreign workers	1 Myanmar	Disease & injury	Non-communicable disease (Benign)	High (80.0)	A 37-year-old foreign worker was found dead, and the post-mortem examination showed that the case suffered from a cystic tumour in the heart.
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Murty et al <sup>54</sup>	Case series (Des-3)	1996 to 2005	Foreign workers	27 people (16 Indonesians, 1 Bangladeshi, 1 Punjabi, <sup>2</sup> 1 Bajau, <sup>2</sup> 5 Malays, 2 Indians, 1 Chinese)	Disease & injury	Injury (Physical trauma)	Low (44.4)	During a 10-year study period, 27 cases of fatal lightning strikes were identified. The majority of the cases were among foreign workers, where Indonesians had with 16 people (59.3%) the highest prevalence.
Mustafa et al <sup>55</sup>	Prevalence (Des-2)	August 2006 to March 2009	Foreign workers	558 patients (34 foreign labour; <sup>2</sup> 347 Malays, 97 Indians; 80 Chinese)	Disease & injury	Communicable disease (Virus)	Low (44.4)	A total of 558 suspected dengue cases were identified, including 34 migrant workers. Among the foreign labour group, 20 patients presented acute dengue, 4 patients presented recent dengue, and 10 patients tested negative for dengue.
Su et al <sup>56</sup>	Analytical cross- sectional (Obs-4)	3 January 2007 to 24 April 2007	Foreign workers	194 people <sup>8</sup> (95% Indonesians, 5% Bangladeshi)	Disease & injury	Injury (Physical syndrome)	Moderate (57.1)	During a 4-month cross-sectional study, 234 migrant workers were examined for level of occupational vibration exposure and health outcomes. In total, 18% of the migrant workers suffered from hand-arm vibration syndrome (HAVS). In addition, different HAVS-related symptoms were significantly higher among workers with high levels of exposure compared to migrant workers with low levels of exposure.
Daher et al <sup>57</sup>	Prevalence (Des-2)	September 2009 to April 2010	Unclassified migrants	253 Iraqi	Disease & injury	Mental health (Quality of life)	High (75.0)	Health-related quality of life of 253 Iraqi migrants was examined, showing that their quality of life was moderate and statically significant higher levels were found among males and married people.
Ratnasingam et al <sup>58</sup>	Prevalence (Des-2)	January 2010 to November 2010	Foreign workers	5,340 people (1,348 Bangladeshi, 843 Myanmar, 743 Nepalese, 217 Indonesians, 2,190 Malaysians)	Disease & injury	Injury (Physical trauma)	Low (11.1)	A total of 5,340 workers in the furniture industry were examined, where 59% of this population was foreign labour. Compared to local workers, migrant workers had less occupational accidents and a more positive work-oriented mentality.

## Tables

Ab Rahman & Abdullah <sup>59</sup>	Case report (Des-4)	N/A <sup>2</sup>	Foreign workers	1 Nepalese	Disease & injury	Communicable disease (Parasite)	High (87.5)	A 24-year-old Nepalese migrant worker presented a long medical history of different symptoms, including fever, abdominal pain, and poor appetite. Clinical examination showed that the patient suffered from a visceral leishmaniasis and malaria co-infection, and he was treated with chloroquine and amphotericin B. A follow-up was carried out after 6 months and the man remained well.
Taib & Baba <sup>60</sup>	Case series (Des-3)	2006 to 2009	Foreign workers	75 patients (38 foreigners, <sup>8</sup> 37 locals)	Disease & injury	Communicable disease (Bacteria)	Low (30.0)	A total of 75 leprosy cases were detected at the Hospital Kuala Lumpur Hansen's Clinic during a 4-year period. With 38 patients, foreign workers represented more than half of the cases.
Osman et al <sup>61</sup>	Prevalence (Des-3)	June 2012 to September 2012	Unclassified migrants	108 Iraqi	Risk behaviour	Sexual behaviour (HPV knowledge)	Low (50.0)	Knowledge and awareness regarding cervical cancer and Pap smear tests were assessed among 108 Iraqi migrant women. In general, this population lacks understanding regarding cervical cancer and the importance of Pap smear tests.
Minhat et al <sup>62</sup>	Prevalence (Des-2)	April 2010 to June 2010	Unclassified migrants	271 Iranians	Risk behaviour	Sexual behaviour (HPV knowledge)	Low (25.0)	The knowledge regarding HPV vaccination of 271 Iranian male migrants was evaluated and showed that the majority of the study population has poor knowledge regarding this matter. Marital status was the only predictive factor that was statistically significant, where married women were 3.6 times more likely to have good HPV knowledge.
Mendelsohn et al <sup>63</sup>	Qualitative (Qual-2)	July 2010 to September 2010	Asylum seekers & refugees	14 Myanmar <sup>9</sup>	Living conditions	Service environment (Healthcare utilisation)	High (90.0)	Fourteen Myanmar refugees were interviewed to explore the difficulties that this group has in accessing antiretroviral therapy (ART). Barriers to comply to ART include lack of an UNHCR identity card, fear of arrest during travelling to the hospital, corruption, financial issues, and receiving small quantities of ART medication per refill.

## Tables

Mendelsohn et al <sup>64</sup>	Analytical cross-sectional (Obs-4)	April 2010 to July 2010	Asylum seekers & refugees	299 people (146 Myanmar, 5 Others, <sup>2</sup> 148 Malaysians)	Living conditions	Service environment (Healthcare utilisation)	High (83.3)	ART compliance and virological outcomes were compared between HIV-infected refugees and locals, where the study showed that both groups had similar rates of compliance and unsuppressed viral loads.
Kwan et al <sup>65</sup>	Case series (Des-3)	2008 to 2013	Unclassified migrants	27 people (3 Indonesians, 2 Indians, 2 Nepalese, 2 Myanmar, 1 Sri Lankan, 17 Malaysians)	Disease & injury	Communicable disease (Bacteria)	Low (40.0)	Between 2008 and 2013, 27 leprosy cases were identified by reviewing the Dermatology Clinic census. Out of the identified leprosy cases, 37% of them were among immigrants.
Santos et al <sup>66</sup>	Prevalence (Des-3)	February 2013 to June 2013	Foreign workers	317 people (110 Sri Lankans, 85 Indonesians, 71 Indians, <sup>8</sup> 22 Nepalese, 20 Indians, <sup>8</sup> 9 Myanmar)	Disease & injury	Injury (Physical syndrome)	Moderate (55.6)	A sample of 317 migrant workers were examined to explore the prevalence of musculoskeletal pain among this group. Almost two-third (203 people) of the surveyed migrant workers suffered from work-related musculoskeletal complaints. Pain in the knee/leg/foot/neck was the most common, as 85 migrant workers reported this outcome.
Razali et al <sup>67</sup>	Case series (Des-3)	2000 to 2012	Unclassified migrants	18 females (2 Indonesians, 1 Myanmar, 6 Malays, 5 Chinese, 3 Indians, 1 Punjabi)	Risk behaviour	Violence & abuse (Murder)	High (80.0)	Clinical records of two forensic psychiatric institutions were reviewed during 2000 and 2012. A total of 18 cases that committed maternal filicide were detected, including 3 immigrant women that suffered from adverse life events.
Elmi et al <sup>68</sup>	Case control (Obs-3)	January 2010 to April 2014	Unclassified migrants	209 cases (49 migrants, <sup>2</sup> 265 locals)	Disease & injury	Communicable disease (Bacteria)	Low (50.0)	A case control study was conducted to identify risk factors regarding multidrug-resistant tuberculosis (MDR-TB) development. The study showed that MDR-TB was more prevalent than non-MDR-TB among foreign patients, and that MDR-TB was significantly higher among migrants compared to locals.
Santos et al <sup>69</sup>	Prevalence (Des-2)	March 2013 to April 2013	Foreign workers	317 people (110 Sri Lankans, 85 Indonesians, 71	Living conditions	Economic & work environment	Low (44.4)	The study assessed overall levels of pain and identified perceived environmental hazards among a group of foreign workers. In total, 204 out of 317 migrant workers

## Tables

					<i>Indians,<sup>8</sup> 22 Nepalese, 20 Indians,<sup>8</sup> 9 Myanmar)</i>	Disease & injury	(Occupational hazards)  Injury (Physical syndrome)		ffered from musculoskeletal pain, and noise (37.5%) and dust (37.2%) were perceived as the main environmental hazards among this group.
William et al <sup>70</sup>	Prevalence (Des-2)	4 July 2012 to 3 July 2014	Unclassified migrants	176 people <i>(53 Filipinos, 6 Indonesians, 106 Indigenous, 10 Chinese, 1 Indian)</i>	Disease & injury	Communicable disease (Bacteria & Virus)	High (77.8)		uring a 2-year study, 176 participants that tested positive for pulmonary tuberculosis at the Luyang Clinic in Kota Kinabalu were enrolled in the study. More than one-third of the patients (33.5%) were migrants. In addition, out of the three patients with a HIV co-infection, one was a migrant.
Siah et al <sup>71</sup>	Prevalence (Des-2)	N/A <sup>2</sup>	Asylum seekers & refugees	<i>89 children (39.3% Myanmar, 21.3% Somali, 22.5% Sudanese, 16.9% Others<sup>2</sup>)</i>	Disease & injury	Mental health (Quality of life)	Low (11.1)		total of 89 refugee children were surveyed to investigate factors that influence their quality of life. Experiencing deportation, lower levels of education and unemployment of their fathers were significantly associated with a lower quality of life.
Guinto et al <sup>72</sup>	Scoping review <sup>10</sup>	2000 to 2014	Foreign workers	N/A	Institutional inequities	Laws & regulations (Universal Health Coverage)	N/A		he study presented implementation challenges of universal health coverage (UHC) in Southeast Asian countries. Malaysia implemented some measures regarding healthcare for migrant workers, however, government-run UHC is still lacking.
Vijian et al <sup>73</sup>	Analytical cross- sectional (Obs-4)	2010 to 2015	Foreign workers	50 people <i>(8 Bangladeshi, 6 Nepalese, 3 Myanmar, 1 African,<sup>2,11</sup> 1 Pakistani, 1 Vietnamese, 14 Malays, 12 Chinese, 4 Indians)</i>	Disease & injury	Non-communicable disease (Perforation)	Low (16.7)		twenty foreign workers and 30 local patients that suffered from perforated peptic ulcers were compared to each other to assess the difference in characteristics between these two groups. Several characteristics were significantly different, where foreign workers were on average 18 years younger (mean age = 30.4), suffered from smaller-sized ulcers, and experienced lower levels of post-operative complications.

## Tables

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2	Azian et al <sup>74</sup>	Prevalence (Des-2)	N/A <sup>2</sup>	Foreign workers	2,153 samples <sup>12</sup> (1,422 Bangladeshi, 349 Indians, 201 Nepalese, 78 Indonesians, 58 Vietnamese, 45 Myanmar)	Disease & injury	Communicable disease (Parasite)	Low (11.1)	A total of 2,153 blood samples were taken from migrant workers that were located in seven states of Peninsular Malaysia and were tested for leishmaniasis infection. More than half (55.3%) of the collected blood samples were found positive.
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11	Sahimin et al <sup>75</sup>	Prevalence (Des-2)	September 2014 to August 2015	Foreign workers	388 people (167 Indonesians, 81 Nepalese, 70 Bangladeshi, 47 Indians, 23 Myanmar)	Disease & injury	Communicable disease (Parasite)	Low (33.3)	A cross-sectional study was conducted to examine the prevalence of different intestinal parasitic infections among foreign labour. Out of the 388 migrant workers, infection rates were between 52.1% and 84%. Higher infection rates significantly associated with migrants from Nepal and India, recently arrived in the country, and less than 1-year work experience in Malaysia.
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21	Noh et al <sup>76</sup>	Prevalence (Des-2)	N/A <sup>2</sup>	Foreign workers	600 foreign workers <sup>2</sup>	Living conditions	Service environment (Healthcare utilisation)	Low (22.2)	Data of 600 foreign workers was obtained to explore their healthcare utilisation. Most of them utilise health services occasionally (88.5%) and the majority (61.4%) goes to government hospitals.
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26	Kamaludin & How <sup>77</sup>	Analytical cross- sectional (Obs-4)	February 2016 to April 2016	Foreign workers	120 people <sup>2</sup> (60 foreign workers, 60 local workers)	Risk behaviour	Hazard & safety awareness (environmental risk)	Low (50.0)	The study compared environmental health awareness between 60 local workers and 60 migrant workers, where the latter group showed significant lower levels of awareness.
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31	Min et al <sup>78</sup>	Prevalence (Des-3)	January 2011 to December 2013	Foreign workers	440 people (46 Indonesians, 37 Bangladeshi, 33 Nepalese, 17 Myanmar, 11 Pakistani, 8 Others, <sup>2</sup> 226 Malays, 32 Chinese, 20 Others, <sup>2</sup> 10 Indians)	Disease & injury	Injury (Physical trauma)	Moderate (62.5)	Medical records of the Hospital Sultan Ismail in Johor Bahru were reviewed between January 2011 and December 2013 to describe the prevalence of work-related ocular traumas. More than one-third of the ocular injuries were among foreign workers and contributed to two-third of the open eye traumas.
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Tables

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Woh et al <sup>79</sup>	Prevalence (Des-3)	N/A <sup>2</sup>	Foreign workers	317 people (140 Indians, 80 Nepalese, 36 Indonesians, 29 Bangladeshi, 18 Myanmar, 7 Pakistani, 4 Sri Lankans, 2 Vietnamese, 1 Thai)	Disease & injury	Communicable disease (Bacteria)	Low (44.4)	cross-sectional study was conducted among 317 migrant food handlers from Ipoh, Kuala Terengganu, and Shah Alam to assess the Salmonella prevalence of this group, resulting in nine (2.8%) people testing positive. Even out of these 9 cases presented multidrug resistance towards trimethoprim-sulfamethoxazole (6 cases), streptomycin (7 cases), ampicillin (4 cases), chloramphenicol (4 cases), sulphonamides (6 cases), and tetracycline (7 cases).																																					
Tanabe et al <sup>80</sup>	Mixed-method <sup>10</sup>	N/A <sup>2</sup>	Asylum seekers & refugees	Participants per method <sup>9</sup> (422 Myanmar - survey; 66 Myanmar - focus group; 6 people <sup>2</sup> - interviews; 4 facility assessments)	Living conditions	Service environment (Healthcare utilisation)	N/A	multiple-country study was conducted to explore barriers regarding family planning services among refugees, where the main challenges included lack of understanding and misinformation concerning contraceptives, language barriers, financial issues, retention concerns, and distance of service delivery points.																																					
Ratnalingam et al <sup>81</sup>	Prevalence (Des-2)	N/A <sup>2</sup>	Foreign workers	207 patients <sup>2</sup>	Disease & injury	Communicable disease (Bacteria)	Low (33.3)	total of 207 patients from four different hospitals in Malaysia were enrolled in the study to describe the characteristics and risk factors of microbial keratitis. More than one-fourth of the cases were due to work-related traumas, where 34.2% of these cases were among male migrant workers.																																					
Woh et al <sup>82</sup>	Prevalence (Des-2)	N/A <sup>2</sup>	Foreign workers	383 swab samples <sup>12</sup> (Indians, Nepalese, Indonesians, Bangladeshi, Myanmar, Pakistani, Sri Lankans, Thai, Vietnamese)	Risk behaviour	Hygiene & sanitation (Food preparation)	Low (22.2)	total of 383 hand swabs were obtained from migrant food handlers to investigate the prevalence of aerobic plate counts (APC), Staphylococcus aureus, and Escherichia coli, resulting in 99.5%, 64.4%, and 20.8% testing positive, respectively. In general, levels of the first two did not exceed the acceptable standard. Infection rates were significantly higher among food handles from India compared food handlers from Nepal. In addition,																																					

Tables

									significant higher rates were found among cooks, followed by waiters, compared to managers.
Noor & Shaker <sup>83</sup>	Analytical cross-sectional (Obs-4) <sup>13</sup>	N/A <sup>2</sup>	Foreign workers	119 Indonesians	Disease & injury	Mental health (Stress)	High (85.7)		On a sample of 119 migrant workers were examined to explore the relationship between psychological distress and workplace discrimination, and the effect of coping strategy on stress levels. The study showed that workplace discrimination increased levels of stress. In addition, problem-oriented coping strategies were related to lower stress levels, while the emotional and avoidance coping strategy was associated to higher levels of stress.
Noordin et al <sup>84</sup>	Prevalence (Des-3)	September 2014 to August 2015	Foreign workers	484 foreign labour (246 Indonesians, 103 Nepalese, 69 Bangladeshi, 51 Indians, 14 Myanmar, 1 Vietnamese)	Disease & injury	Communicable disease (Parasite)	Low (33.3)		lymphatic filariasis prevalence among foreign labour was determined by screening 484 migrant workers, showing that 6.8% and 2.1% suffered from bancroftian filariasis and brugian filariasis, respectively.
Sahimin et al <sup>85</sup>	Prevalence (Des-2)	September 2014 to August 2015	Foreign workers	484 people (247 Indonesians, 99 Nepalese, 72 Bangladeshi, 52 Indians, 14 Myanmar)	Disease & injury	Communicable disease (Parasite)	Low (44.4)		total of 484 foreign workers were sampled to describe the prevalence of Toxoplasma gondii and factors related higher infection rates. In total, 278 migrant workers (7.4%) tested positive for T gondii, where significant higher levels of infection were associated with Nepalese origin, newly arrived in Malaysia, and working in manufacturing.
Labao et al <sup>86</sup>	Prevalence (Des-3)	N/A <sup>2</sup>	Foreign workers	60 Filipinos	Disease & injury	Injury (Physical syndrome)	Moderate (55.6)		cross-sectional study was conducted to investigate which body regions were presenting the most work-related musculoskeletal complaints among migrant workers. The major affected areas included the shoulder (60%), lower back (60%), upper back (48.3%), and neck (55%) regions.

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## Tables

Shaw et al <sup>87</sup>	Randomised controlled trial (Exp-2)	N/A <sup>2</sup>	Asylum seekers & refugees	39 <i>Afghans</i>	Disease & injury	Mental health (Stress)	Low (30.8)	In order to assess the impact of cognitive behavioural therapy (CBT) on emotional distress, an 8-week intervention was conducted among 39 female refugees. As a result, the intervention significantly lowered levels of posttraumatic stress, anxiety, emotional distress, and depression.
Rahman et al <sup>88</sup>	Case control (Obs-3)	N/A <sup>2</sup>	Unclassified migrants <sup>4</sup>	61 <i>people</i> (52 <i>Myanmar</i> , 9 <i>Others</i> <sup>2</sup> )	Risk behaviour	Poor nutrition (Nutrition deficiency)	Moderate (60.0)	A case control study was conducted to determine the factors that were related to bilateral leg swelling among detained irregular migrants. Out of the 226 inmates, 21 Myanmar were identified as cases and were compared to controls from Myanmar, Indonesia, Nepal, and Vietnam. The study showed that the illness was caused by a thiamine deficiency, as the patients lacked the consumption of meat. Intravenous and oral thiamine treatment was provided, and the patients responded well to it.
Sahimin et al <sup>89</sup>	Prevalence (Des-2)	September 2014 to August 2015	Foreign workers	388 <i>people</i> (167 <i>Indonesians</i> , 81 <i>Nepalese</i> , 70 <i>Bangladeshi</i> , 47 <i>Indians</i> , 23 <i>Myanmar</i> )	Disease & injury	Communicable disease (Parasite)	Low (44.4)	A sample of 388 foreign workers were examined to describe the prevalence of <i>Giardia duodenalis</i> and <i>Cryptosporidium parvum</i> , showing that 42 people (10.8%) and 12 people (3.1%) tested positive, respectively. Indonesian nationality, work in the manufacturing and service sector, and newly arrived in Malaysia were significantly associated with <i>G. duodenalis</i> , while <i>C. parvum</i> was only significantly associated with employment in the food industry.
Nwabichie et al <sup>90</sup>	Prevalence (Des-2)	N/A <sup>2</sup>	Unclassified migrants	320 <i>people</i> <sup>2</sup> (50% <i>Nigerians</i> , 15% <i>Ghanaians</i> , 35% <i>Others</i> [from <i>Sudan</i> , <i>Tanzania</i> , <i>Kenya</i> and <i>South Africa</i> ])	Risk behaviour	Sexual behaviour (HPV knowledge)	High (77.8)	In total, 320 African female migrants were surveyed to investigate risk factors that are related to higher HPV risk behaviour. Only 27.2% of the sample obtained cervical cancer screening, where higher levels of screening were significantly associated with having knowledge regarding cervical cancer, being married, having a standard health

## Tables

								are provider, and no perceived barriers when obtaining the check-up.
Jeffree et al <sup>91</sup>	Case control (Obs-3)	N/A <sup>2</sup>	Foreign workers	470 people <sup>2</sup>	Disease & injury	Communicable disease (Parasite)	Moderate (60.0)	A case-control study was conducted to determine the risk factors related to a malaria outbreak, where rubber tappers including one migrant worker – presented a higher infection rate.
Zerguine et al <sup>92</sup>	Analytical cross-sectional (Obs-4)	June 2016 to September 2016	Foreign workers	323 people (155 Bangladeshi, 126 Indonesians, 25 Pakistani, 11 Nepalese, 6 Chinese)	Disease & injury	Injury (Physical trauma)	Moderate (57.1)	A total of 323 migrant workers were sampled to investigate the prevalence and causes of workplace injuries, and examine the relationship between these outcomes and safety commitment variables. The study showed that 22.6% of the foreign workers suffered from work-related injury, mostly due to falls from heights (1.5%), and that there was a significant association between various injuries and different safety commitment-related variables, such as safe equipment and safety training.
Ya'acob et al <sup>93</sup>	Randomised controlled Trial (Exp-2)	N/A <sup>2</sup>	Foreign workers	54 Indonesians	Disease & injury	Injury (Physical syndrome)	Low (38.5)	A workplace intervention was conducted to assess the effect of Kiken Yochi training on musculoskeletal symptoms among foreign workers, where the study showed that the intervention significantly decreased musculoskeletal symptoms in feet and ankle areas compared to the control group.
Chuah et al <sup>9</sup>	Qualitative (Qual-2)	July 2016 to November 2017	Asylum seekers & refugees	20 stakeholders <sup>14</sup>	Living conditions	Service environment (Healthcare utilisation)	High (80.0)	Twenty stakeholders were interviewed to explore the barriers that refugees and asylum seekers encounter during healthcare utilisation, showing that cultural competency, insufficient health literacy, healthcare expenses, and not being aware of their rights were the main challenges.

## Tables

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2	Loganathan et al <sup>94</sup>	Qualitative (Qual-2)	July 2018 to September 2018	Foreign workers	18 stakeholders <sup>14</sup>	Living conditions	Service environment (Healthcare utilisation)	High (80.0)	qualitative study with 18 stakeholders demonstrated that migrant workers face several complications with respect to utilising healthcare, including financial issues, discrimination, lack of valid passports and work permits, cultural competency, and physical barriers.
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9	Rahman et al <sup>95</sup>	Prevalence (Des-3)	N/A <sup>2</sup>	Foreign workers	<i>314 Bangladeshi</i>	Living conditions	Service environment (Healthcare utilisation)	Low (33.3)	group of 314 migrant workers were sampled to present the distribution of diseases and healthcare utilisation pattern. Fever and sprains were the most reported diseases among the group that suffered from an illness in the last two weeks, while fever and gastrointestinal diseases were the most prevalent among the group that suffered from an illness in the last month. In addition, the majority (approx. 80%) visited hospitals to seek treatment.
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14						Disease & injury	Various diseases (various diseases)		
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21	Siah et al <sup>96</sup>	Qualitative (Qual-3)	N/A <sup>2</sup>	Asylum seekers & refugees	8 stakeholders ( <i>5 refugees,<sup>2</sup> 3 locals</i> )	Living conditions	Social environment (Prejudice)	Low (50.0)	eight people stakeholders were interviewed to explore the forms of discrimination that refugee children experience. The study shows that refugee children suffer from denied access to health care, not receiving proper education, and being judged by their social environment.
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27	Sahimin et al <sup>97</sup>	Prevalence (Des-2)	September 2014 and August 2015	Foreign workers	<i>610 people (246 Indonesians, 99 Nepalese, 72 Bangladeshi, 52 Indians, 14 Myanmar)</i>	Disease & injury	Communicable disease (Parasite)	Low (33.3)	four different diagnostic tests were applied to identify <i>Strongyloides stercoralis</i> among migrant workers, where prevalence rates differed between 0.8% and 35.8%
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34	Chuah et al <sup>98</sup>	Qualitative (Qual-2)	July 2016 to January 2018	Asylum seekers & refugees	20 stakeholders <sup>14</sup>	Living conditions	Service environment (Healthcare utilisation)	High (80.0)	twenty stakeholders were interviewed to identify the challenges with respect to accessing healthcare among refugees, showing that out of pocket healthcare spending, language and cultural competency barriers, and access to medication are the top healthcare challenges.
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\*Sample population in *italic* represents the migrant population;

## Tables

\*\*The following abbreviations are used in the table: N/A = Data not available; HPV = Human Papilloma Virus

<sup>1</sup>Includes irregular migrants.

<sup>2</sup>Data to present detailed information is lacking.

<sup>3</sup>Includes children of migrant workers, which is according to the IOM (2011) definition still classified as migrant workers

<sup>4</sup>Includes detained migrants.

<sup>5</sup>Includes refugees, international students, expats, and unclassified migrants.

<sup>6</sup>Includes 3 expats; <sup>7</sup>Includes 6 transnational marriage migrants.

<sup>8</sup>Ambiguous reporting of the data.

<sup>9</sup>Includes a multiple-country study, and, therefore, subjects that were included in countries other than Malaysia are not reported in this table.

<sup>10</sup>Level of evidence and quality appraisal is not available for this study design.

<sup>11</sup>Includes an international student.

<sup>12</sup>Number of samples might not be similar to the number of study participants.

<sup>13</sup>Despite of lacking a comparison group, this study was identified as an analytical cross-sectional study due to the aim – testing two hypotheses – and comprehensive statistical analysis.

<sup>14</sup>Representing the population of interest (as shown in the ‘type of migrant’ category).

## Tables

Table 5. Number and average quality of included articles disaggregated by type of migrant and BARHII dimensions

Category	Number of studies per study design with level of evidence									Total # studies	Mean quality	References
	CR-4	AC-4	QL-3	CS-3	PR-3	CC-3	QL-2	PR-2	RC-2			
<i>Type of migrant</i>												
Asylum seekers & refugees	-	1	1	-	1	-	3	2	1	10 <sup>1</sup>	58.4%	33 34 63 64 71 80 87 96 98
Foreign workers	4	7	-	4	10	1	1	12	1	41 <sup>2</sup>	45.7%	40 43 44 46-56 58-60 66 69 72-79 81-86 89 91-95 97
Unclassified migrants	-	1	-	6	2	2	-	5	-	16	52.7%	35 36 38 39 41 42 45 57 61 62 65 67 68 70 88 90
<i>Dimension of BARHII framework</i>												
Institutional inequities	-	-	-	-	-	-	-	-	-	1 <sup>2</sup>	-	36 63 64 69 76 80 94-96 98
Living conditions	-	2	1	-	1	-	4	2	-	11 <sup>1</sup>	59.7%	38 41 61 62 67 77 82 88 90
Risk behaviour	-	1	-	3	1	1	-	4	-	10	48.7%	34 37 39 40 43-60 65 66 68-71 73-75 78 79 81 83-87 89 91-93 95 97
Disease & injury	4	6	-	7	11	2	-	14	2	46	46.3%	42
Mortality & morbidity	-	1	-	-	1	-	-	-	-	2	47.9%	
<i>Subdimensions of institutional inequities</i>												
Laws & regulations	-	-	-	-	-	-	-	-	-	1 <sup>2</sup>	-	
<i>Subdimensions of living conditions</i>												
Social environment	-	-	1	-	-	-	-	-	-	1	50.0%	
Economic and work environment	-	-	-	-	-	-	-	1	-	1	44.4%	
Service environment	-	2	-	-	1	-	4	1	-	9 <sup>1</sup>	62.8%	66 63 64 76 80 94 95 98
<i>Subdimensions of risk behaviour</i>												
Poor nutrition	-	-	-	1	-	1	-	-	-	2	50.0%	88
Violence & abuse	-	-	-	2	-	-	-	-	-	2	70.0%	67
Alcohol & other drugs	-	-	-	-	-	-	-	1	-	1	22.2%	
Sexual behaviour	-	-	-	-	1	-	-	2	-	3	50.9%	62 90
Hygiene & sanitation	-	-	-	-	-	-	-	1	-	1	22.2%	
Hazard & safety awareness	-	1	-	-	-	-	-	-	-	1	50.0%	
<i>Subdimensions of disease &amp; injury</i>												
Communicable disease	3	2	-	6	4	2	-	10	-	27	44.2%	37 39 43-45 47-52 55 59 60 65 68 70 74 75 79 81 84 85 89 91 97
Non-communicable disease	1	1	-	-	1	-	-	-	-	3	50.8%	53 73

Tables

Injury	-	2	-	1	3	-	-	2	1	9	47.4%	56 58 66 69 78 86 92 93
Mental health	-	1	-	-	1	-	-	2	1	5	56.1%	57 71 83 87
Various diseases	-	-	-	-	2	-	-	-	-	2	38.9%	95
<i>Subdimensions of mortality &amp; morbidity</i>												
Mortality rates	-	1	-	-	-	-	-	-	-	1	33.3%	
Morbidity rates	-	-	-	-	1	-	-	-	-	1	62.5%	
<b>Total</b>	<b>4</b>	<b>9</b>	<b>1</b>	<b>10</b>	<b>13</b>	<b>3</b>	<b>4</b>	<b>19</b>	<b>2</b>	<b>67<sup>1,2</sup></b>	<b>49.2%</b>	33-98

\*Abbreviations for the type of study with the related level of evidence (the number after the dash) are used to describe the included studies: CR-4 = case report; AC-4 = analytical cross-sectional study; QL-3 = qualitative study with less rigour; CS-3 = case series; PR-3 = prevalence study without analytical component; CC-3 = case control; QL-2 = qualitative study with more rigor; PR-2 = prevalence study with analytical component; RC-2 = randomised controlled trial.

\*\*Level of evidence ranks from 1 to 4, where 1 is the highest level of evidence and 4 is the lowest level.

<sup>1</sup>Includes a mixed-method design, which was not appraised for level of evidence nor quality of the study;

<sup>2</sup>Includes a scoping review design, which was not appraised for level of evidence nor quality of the study.



## Tables

Table 6. Number and average quality of included articles disaggregated by research design category.

Research design	Level of evidence	Included studies	Mean quality	References
<i>Descriptive research</i>				
Systematic review of descriptive studies	1	-	-	-
Prevalence study with analytical component	2	19	39.7%	34 41 47 55 57 58 62 69-71 74-76 81 82 89 90 97
Case series	3	10	46.7%	35 38 39 45 48 51 54 60 65 67
Prevalence study without analytical component	3	13	49.8%	33 37 40 42 44 46 61 66 78 79 84 86 95
Case report	4	4	81.5%	43 49 53 59
Total		46	47.7%	33-35 37-49 51 53-55 57-62 65-67 69-71 74-76 78 79 81 82 84-86 89 90 95 97
<i>Experimental research</i>				
Systematic review/meta-analysis of experimental studies	1	-	-	-
Randomised controlled trial	2	2	34.7%	87 93
Group quasi-experimental study (non-randomised)	3	-	-	-
Quasi-experimental study with single subject	4	-	-	-
Total		2	34.7%	87 93
<i>Observational research</i>				
Systematic review/meta-analysis of observational studies	1	-	-	-
Cohort study	2	-	-	-
Case-control	3	3	56.7%	68 88 91
Analytical cross-sectional study	4	9	42.6%	36 50 52 56 64 73 77 83 92
Total		12	46.1%	36 50 52 56 64 68 73 77 83 88 91 92
<i>Qualitative research</i>				
Systematic review/meta-synthesis of qualitative studies	1	-	-	-
Group qualitative studies with more rigor	2	4	82.5%	9 63 94 98
Group qualitative studies with less rigor	3	1	50.0%	96
Qualitative study with a single informant	4	-	-	-
Total		5	76.0%	9 63 94 96 98
<b>Total</b>		<b>67<sup>1</sup></b>	<b>49.2%</b>	<b>9 33-98</b>

<sup>1</sup>Includes a mixed-method design and a scoping review, which were both not assessed for the level of evidence nor quality appraisal.

## Tables

Table 7. Main recommendations to improve future research on migrant health.

Recommendation
Improve the description of the target migrant population by including information regarding the type of migrant (e.g., foreign worker, refugee), visa status (e.g., regular, irregular), country of origin, socioeconomic variables (e.g., level of education, income), mode of transport during migration journey (e.g., boat, car), and the existence of forced entry (e.g., human trafficking, forced marriage).
Create associations between different stages of migration (pre-departure, travel, destination, interception, and return phase) and health outcomes.
More research output concerning governance and institutional inequities and mortality and morbidity, and, consequently, conduct a time series analysis between these two dimensions to identify and possible relationships.
More research output regarding non-communicable diseases, especially on the main causes of death in Malaysia; cardiovascular diseases, chronic respiratory diseases, and diabetes.
More research output concerning several subdimension of risk behaviour, especially on smoking, physical inactivity, and alcohol abuse.
Evaluate the impact of health and non-health policies on migrant health.
Explore living conditions regarding the physical environment, such as housing and environmental conditions, and the impact on migrant health outcomes.
Promotion of guidelines on study conduct and reporting among researchers.

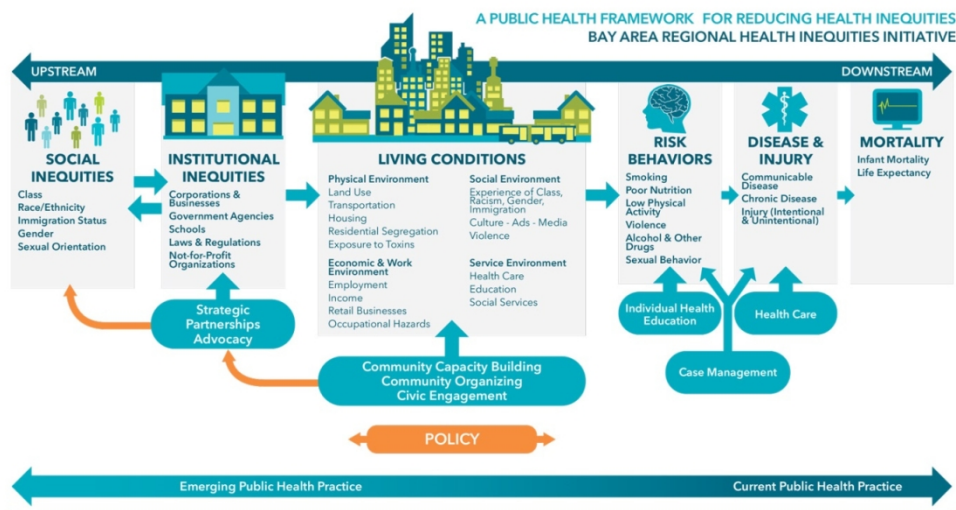


Figure 1. Bay Area Regional Health Inequities Initiative (BARHII) framework.

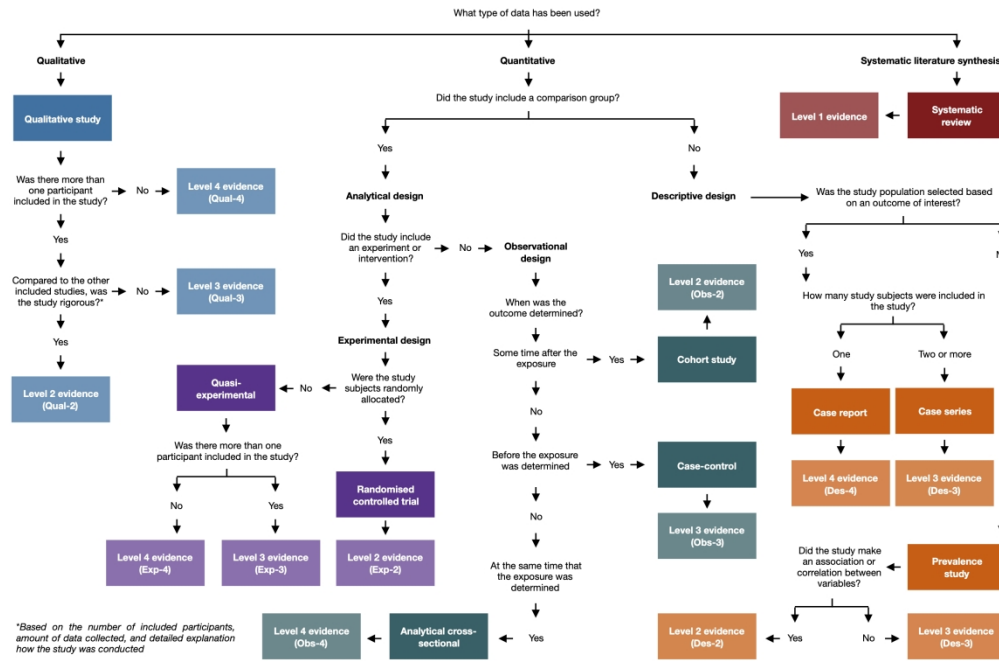


Figure 2. Decision tree to identify the type of study design and corresponding level of evidence.

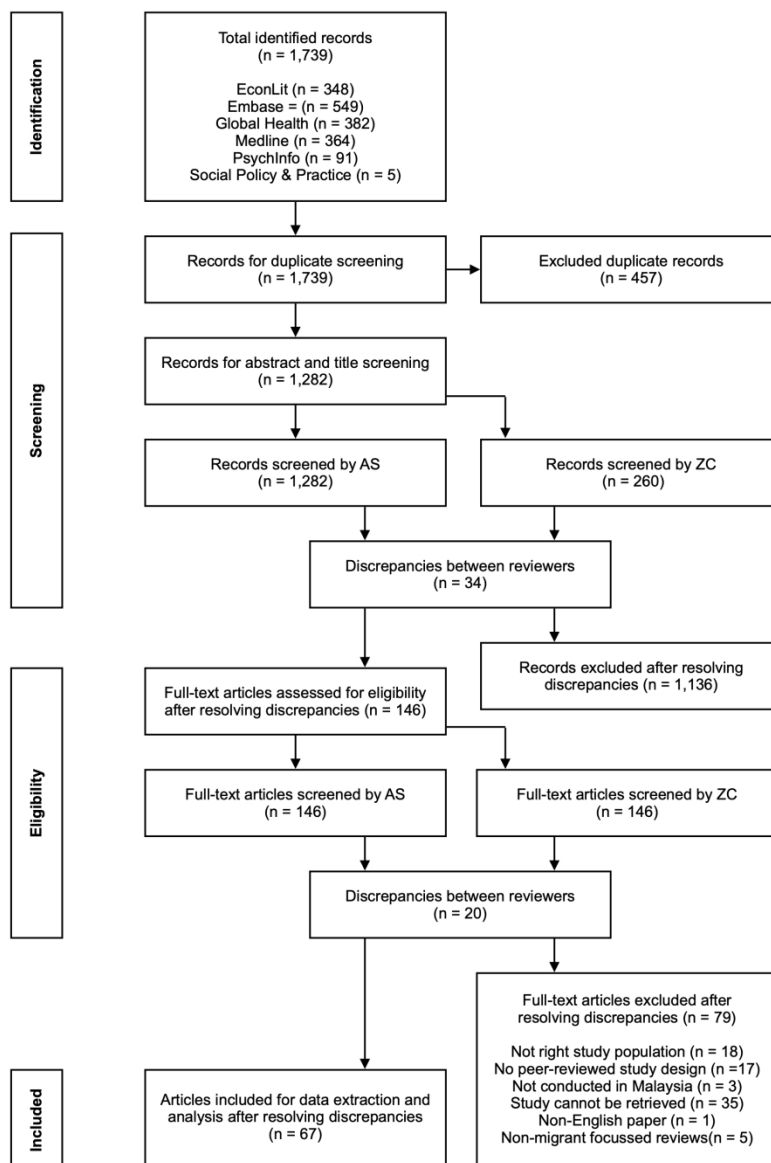


Figure 3. Flowchart of the data selection process.

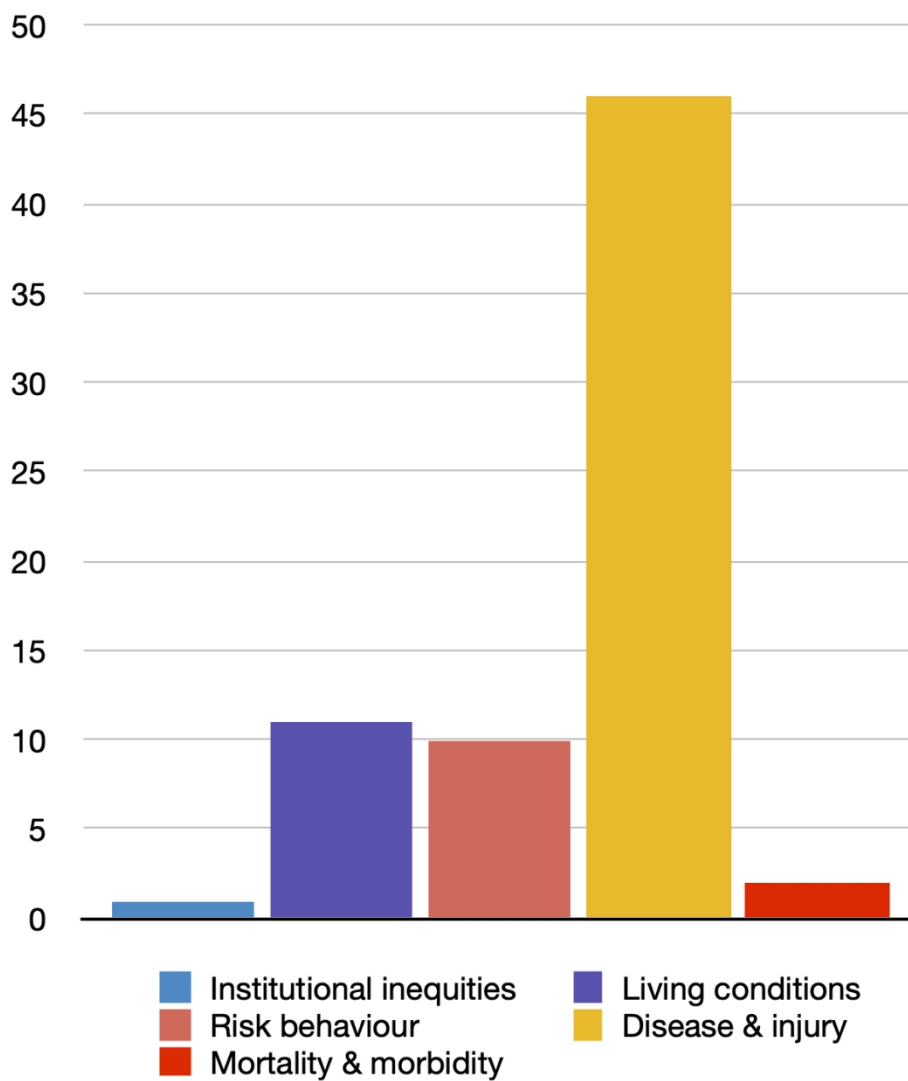


Figure 4. Number of studies disaggregated by health dimension.

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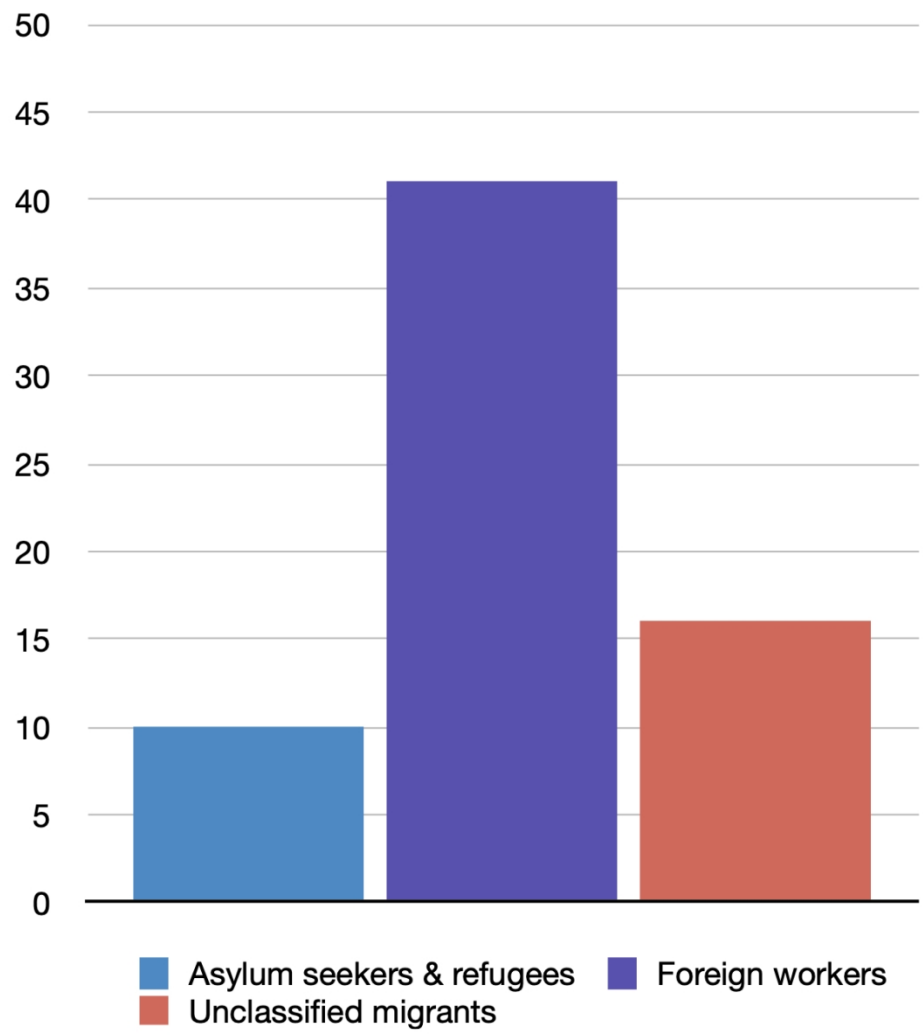


Figure 5. Number of studies disaggregated by type of migrant.

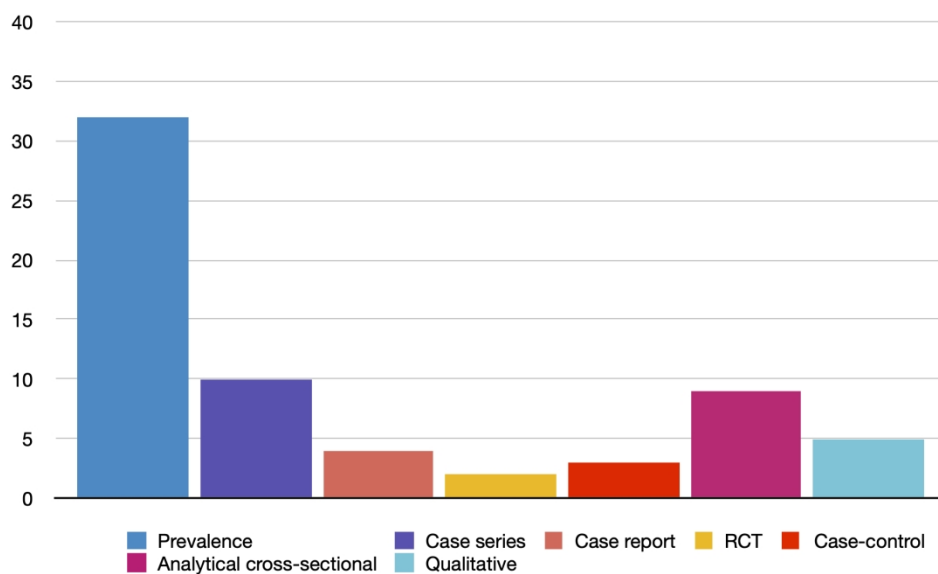


Figure 6. Number of studies disaggregated by research design.

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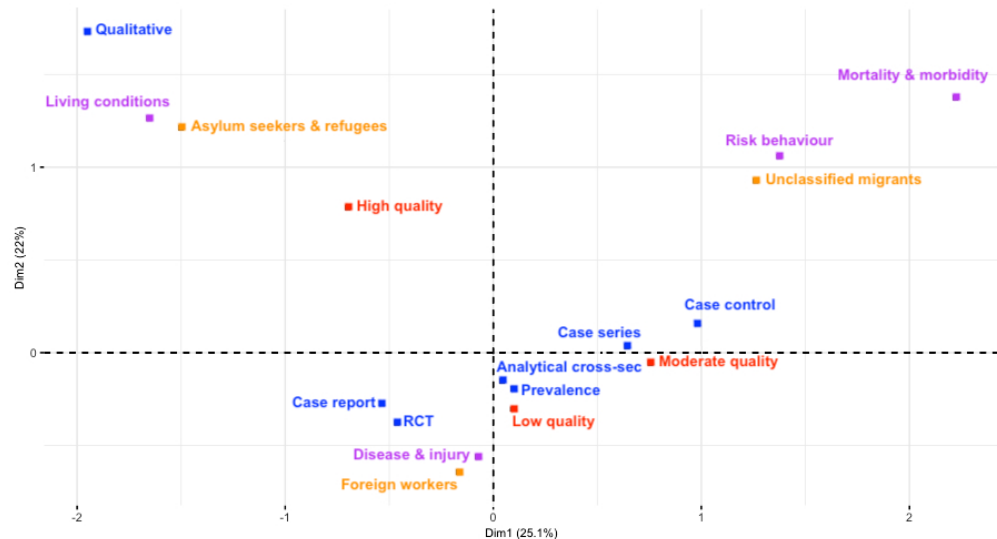


Figure 7. Results of the multiple-correspondence analysis (MCA).  
317x173mm (72 x 72 DPI)

## Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
<b>TITLE</b>			
Title	1	Identify the report as a scoping review.	
<b>ABSTRACT</b>			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	
<b>INTRODUCTION</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	
<b>METHODS</b>			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	



SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
<b>RESULTS</b>			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	
<b>DISCUSSION</b>			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	
Limitations	20	Discuss the limitations of the scoping review process.	
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	
<b>FUNDING</b>			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

\* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med.* 2018;169:467–473. doi: [10.7326/M18-0850](https://doi.org/10.7326/M18-0850).



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## Supplementary file 2. Detailed search strategy

### I.1. EconLit

Database name	EconLit
Database search engine	OvidSP
Dates of database coverage	1886 to September 12, 2019
Date search conducted	17 September 2019
Total number of hits	348

#	Searches	Results
1	asylum* OR displaced OR emigra* OR emigre* OR foreign born OR foreign labor OR foreign labour OR foreign work* OR foreign-born OR foreign-work* OR foreigner* OR immigra* OR migra* OR people of concern OR person of concern OR persons of concern OR refugee* OR smuggl* OR traffick* OR transient* OR transmigrant*	120,090
2	abnormalit* OR abortion* OR abscess* OR accident* OR ache* OR aids OR ailment* OR alcohol* OR allerg* OR anorexia OR AMR OR antibiotic resistan* OR antimicrobial resistan* OR anxiet* OR allerg* OR apnoea OR arthritis OR ascariasis OR assault* OR asthma OR attack* OR bacteri* OR bipolar OR bite* OR blastoma* OR bleed* OR blind OR blood OR burn* OR cancer* OR cardio* OR Chagas OR chlamydia OR cholesterol OR coma OR complication* OR condition* OR condom* OR contraception OR cyst* OR dead OR deaf OR death* OR decay OR deform* OR dehydrat* OR dementia OR dengue OR depress* OR diabetes OR diarrhoea OR disabilit* OR disease* OR disorder* OR dracunculiasis OR drug* OR dysfunction* OR eczema OR enlargement* OR epilep* OR exhaust* OR failure OR fatal* OR fatigue OR fever* OR filariasis OR flu OR gall stone* gallstone* OR gonorrhoea OR headache* OR health OR healthcare OR hearing loss OR helminth* OR hepatitis OR hernia* OR herpe* OR HIV OR hookworm* OR HPV OR hypertension OR illness* OR indigestion* OR infect* OR inflame* OR injur* OR leishmaniasis OR leprosy OR leukaemia OR leukemia OR lice OR life expectancy OR malaria OR malformat* OR malnutrition OR measles OR medical OR melanoma* OR mental* OR migraine OR miscarriage* OR morbidit* OR mortalit* OR muscl* OR myeloma OR nausea OR neuro* OR nutrition* OR onchocerciasis OR osteoarthritis OR osteoporosis OR pain* OR parasite* OR patient care OR physical activ* OR pneumonia OR poison* OR	373,019

	psoriasis OR psychiatric OR psychos* OR rabies OR rape* OR reproductiv* OR rheuma* OR ringworm* OR sarcoma* OR scabies OR schistosomiasis OR schizophren* OR seizure* OR sepsis* OR sexual* OR shock* OR sick* OR smoking OR sore* OR STD* OR stillbirth* OR stress* OR stroke* OR suicid* OR sunburn* OR syndrome* OR syphilis OR TB OR thrombosis OR tobacco OR STI* OR toothache* OR trachoma OR trauma* OR trichuriasis OR trichomoniasis OR trypanosomiasis OR tuberculosis OR tumor* OR tumour* OR ulcer* OR violence OR virus* OR vomit* OR wart* OR well-being OR wellbeing OR worm* OR wound*	
3	Malaysia OR Johor OR Kedah OR Kelantan OR Kuala Lumpur OR Labuan OR Malacca OR Melaka OR Malaya OR Negeri Sembilan OR Pahang OR Penang OR Perak OR Perlis OR Putrajaya OR Sabah OR Sarawak OR Selangor OR Terengganu	6,883
4	Malaysian	1,654
5	area* OR Borneo OR city OR cities OR district* OR island* OR isle* OR province* OR region* OR state* OR territor* OR village*	367,269
6	4 AND 5	361
7	3 OR 6	6,925
8	1 AND 2 AND 7	348
9	Animal migration OR bird migration OR cell* OR membrane* OR molecu*	2,622
10	8 NOT 9	348

## I.2. Embase

Database name	Embase
Database search engine	OvidSP
Dates of database coverage	1947 to 2019 September 13
Date search conducted	17 September 2019
Total number of hits	549

#	Searches	Results
1	asylum* OR displaced OR emigra* OR emigre* OR foreign born OR foreign labor OR foreign labour OR foreign work* OR foreign-born OR foreign-work* OR foreigner* OR immigra* OR migra* OR people of concern OR person of concern OR persons of concern OR refugee* OR smuggl* OR traffick* OR transient* OR transmigrant*	1,124,805
2	asylum seeker [MeSH]	793
3	emigrant [MeSH]	293
4	foreign worker [MeSH]	5,306
5	human trafficking [MeSH]	697
6	migrant worker [MeSH]	1,548
7	migrant [MeSH]	35,567
8	migration [MeSH]	45,436
9	immigrant [MeSH]	16,376
10	refugee [MeSH]	12,425
11	refugee camp [MeSH]	553
12	undocumented immigrant [MeSH]	350
13	1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12	1,125,119
14	abnormalit* OR abortion* OR abscess* OR accident* OR ache* OR aids OR ailment* OR alcohol* OR allerg* OR anorexia OR AMR OR antibiotic resistan* OR antimicrobial resistan* OR anxiet* OR allerg* OR apnoea OR arthritis OR ascariasis OR assault* OR asthma OR attack* OR bacteri* OR bipolar OR bite* OR blastoma*	31,271,711

	OR bleed* OR blind OR blood OR burn* OR cancer* OR cardio* OR Chagas OR chlamydia OR cholesterol OR coma OR complication* OR condition* OR condom* OR contraception OR cyst* OR dead OR deaf OR death* OR decay OR deform* OR dehydrat* OR dementia OR dengue OR depress* OR diabetes OR diarrhoea OR disabilit* OR disease* OR disorder* OR dracunculiasis OR drug* OR dysfunction* OR eczema OR enlargement* OR epilep* OR exhaust* OR failure OR fatal* OR fatigue OR fever* OR filariasis OR flu OR gall stone* gallstone* OR gonorrhoea OR headache* OR health OR healthcare OR hearing loss OR helminth* OR hepatitis OR hernia* OR herpe* OR HIV OR hookworm* OR HPV OR hypertension OR illness* OR indigestion* OR infect* OR inflame* OR injur* OR leishmaniasis OR leprosy OR leukaemia OR leukemia OR lice OR life expectancy OR malaria OR malformat* malnutrition OR measles OR medical OR melanoma* OR mental* OR migraine OR miscarriage* OR morbidit* OR mortalit* OR muscl* OR myeloma OR nausea OR neuro* OR nutrition* OR onchocerciasis OR osteoarthritis OR osteoporosis OR pain* OR parasite* OR patient care OR physical activ* OR pneumonia OR poison* OR psoriasis OR psychiatric OR psychos* OR rabies OR rape* OR reproductiv* OR rheuma* OR ringworm* OR sarcoma* OR scabies OR schistosomiasis OR schizophren* OR seizure* OR sepsis* OR sexual* OR shock* OR sick* OR smoking OR sore* OR STD* OR stillbirth* OR stress* OR stroke* OR suicid* OR sunburn* OR syndrome* OR syphilis OR TB OR thrombosis OR tobacco OR STI* OR toothache* OR trachoma OR trauma* OR trichuriasis OR trichomoniasis OR trypanosomiasis OR tuberculosis OR tumor* OR tumour* OR ulcer* OR violence OR virus* OR vomit* OR wart* OR well-being OR wellbeing OR worm* OR wound*	
15	accident [MeSH]	209,815
16	diseases [MeSH]	23,553,673
17	health [MeSH]	688,819
18	health behavior [MeSH]	396,908
19	health care [MeSH]	5,107,719
20	health care facility [MeSH]	1,641,961
21	health care policy [MeSH]	188,812
22	health service [MeSH]	5,405,209
23	infection [MeSH]	3,626,633
24	injury [MeSH]	2,303,491
25	malnutrition [MeSH]	178,039

26	morbidity [MeSH]	361,003
27	mortality [MeSH]	1,081,969
28	neoplasm [MeSH]	4,683,051
29	parasite [MeSH]	36,154
30	virus [MeSH]	907,130
31	14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 21 OR 22 OR 23 OR 24 OR 25 OR 26 OR 27 OR 28 OR 29 OR 30	32,849,152
32	Malaysia OR Johor OR Kedah OR Kelantan OR Kuala Lumpur OR Labuan OR Malacca OR Melaka OR Malaya OR Negeri Sembilan OR Pahang OR Penang OR Perak OR Perlis OR Putrajaya OR Sabah OR Sarawak OR Selangor OR Terengganu	28,901
33	Malaysian	1,611
34	area* OR Borneo OR city OR cities OR district* OR island* OR isle* OR province* OR region* OR state* OR territor* OR village*	7,357,992
35	33 AND 34	395
36	32 OR 35	29,057
37	13 AND 31 AND 36	651
38	Animal migration OR bird migration OR cell* OR membrane* OR molecu*	10,280,170
39	37 NOT 38	549



### I.3. Global Health

Database name	Global Health
Database search engine	OvidSP
Dates of database coverage	1910 to 2019 Week 36
Date search conducted	17 September 2019
Total number of hits	382

#	Searches	Results
1	asylum* OR displaced OR emigra* OR emigre* OR foreign born OR foreign labor OR foreign labour OR foreign work* OR foreign-born OR foreign-work* OR foreigner* OR immigra* OR migra* OR people of concern OR person of concern OR persons of concern OR refugee* OR smuggl* OR traffick* OR transient* OR transmigrant*	89,712
2	immigrants [MeSH]	7,830
3	migrant labour [MeSH]	1,006
4	migrants [MeSH]	3,576
5	migration [MeSH]	3,819
6	refugees [MeSH]	3,687
7	1 OR 2 OR 3 OR 4 OR 5 OR 6	89,712
8	abnormalit* OR abortion* OR abscess* OR accident* OR ache* OR aids OR ailment* OR alcohol* OR allerg* OR anorexia OR AMR OR antibiotic resistan* OR antimicrobial resistan* OR anxiet* OR allerg* OR apnoea OR arthritis OR ascariasis OR assault* OR asthma OR attack* OR bacteri* OR bipolar OR bite* OR blastoma* OR bleed* OR blind OR blood OR burn* OR cancer* OR cardio* OR Chagas OR chlamydia OR cholesterol OR coma OR complication* OR condition* OR condom* OR contraception OR cyst* OR dead OR deaf OR death* OR decay OR deform* OR dehydrat* OR dementia OR dengue OR depress* OR diabetes OR diarrhoea OR disabilit* OR disease* OR disorder* OR dracunculiasis OR drug* OR dysfunction* OR eczema OR enlargement* OR epilep* OR exhaust* OR failure OR fatal* OR fatigue OR fever* OR filariasis OR flu OR gall stone* gallstone* OR gonorrhoea OR headache* OR health OR healthcare OR hearing loss OR helminth* OR hepatitis OR hernia* OR herpe* OR HIV OR hookworm* OR HPV OR hypertension OR illness* OR	3,675,317

	indigestion* OR infect* OR inflame* OR injur* OR leishmaniasis OR leprosy OR leukaemia OR leukemia OR lice OR life expectancy OR malaria OR malformat* OR malnutrition OR measles OR medical OR melanoma* OR mental* OR migraine OR miscarriage* OR morbidit* OR mortalit* OR muscl* OR myeloma OR nausea OR neuro* OR nutrition* OR onchocerciasis OR osteoarthritis OR osteoporosis OR pain* OR parasite* OR patient care OR physical activ* OR pneumonia OR poison* OR psoriasis OR psychiatric OR psychos* OR rabies OR rape* OR reproductiv* OR rheuma* OR ringworm* OR sarcoma* OR scabies OR schistosomiasis OR schizophren* OR seizure* OR sepsis* OR sexual* OR shock* OR sick* OR smoking OR sore* OR STD* OR stillbirth* OR stress* OR stroke* OR suicid* OR sunburn* OR syndrome* OR syphilis OR TB OR thrombosis OR tobacco OR STI* OR toothache* OR trachoma OR trauma* OR trichuriasis OR trichomoniasis OR trypanosomiasis OR tuberculosis OR tumor* OR tumour* OR ulcer* OR violence OR virus* OR vomit* OR wart* OR well-being OR wellbeing OR worm* OR wound*	
9	accidents [MeSH]	14,359
10	diseases [MeSH]	2,302,791
11	health [MeSH]	283,009
12	health behaviour [MeSH]	11,560
13	health care [MeSH]	91,876
14	health policy [MeSH]	20,150
15	health services [MeSH]	88,605
16	infection [MeSH]	100,189
17	injuries [MeSH]	3,171
18	malnutrition [MeSH]	28,215
19	morbidity [MeSH]	28,845
20	mortality [MeSH]	135,836
21	neoplasm [MeSH]	225,495
22	parasites [MeSH]	488,622
23	viruses [MeSH]	496,168
24	8 OR 9 OR 10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23	3,688,190

25	Malaysia OR Johor OR Kedah OR Kelantan OR Kuala Lumpur OR Labuan OR Malacca OR Melaka OR Malaya OR Negeri Sembilan OR Pahang OR Penang OR Perak OR Perlis OR Putrajaya OR Sabah OR Sarawak OR Selangor OR Terengganu	17,417
26	Malaysian	3,366
27	area* OR Borneo OR city OR cities OR district* OR island* OR isle* OR province* OR region* OR state* OR territor* OR village*	1,392,874
28	26 AND 27	1,138
29	25 OR 28	17,513
30	7 AND 24 AND 29	429
31	Animal migration OR bird migration OR cell* OR membrane* OR molercul*	833,650
32	30 NOT 31	382

#### I.4. Medline

Database name	Medline
Database search engine	OvidSP
Dates of database coverage	1946 to September Week 1 2019
Date search conducted	17 September 2019
Total number of hits	364

#	Searches	Results
1	asylum* OR displaced OR emigra* OR emigre* OR foreign born OR foreign labor OR foreign labour OR foreign work* OR foreign-born OR foreign-work* OR foreigner* OR immigra* OR migra* OR people of concern OR person of concern OR persons of concern OR refugee* OR smuggl* OR traffick* OR transient* OR transmigrant*	720,051
2	“Emigrants and Immigrants” [MeSH]	11,337
3	“Emigration and Immigration” [MeSH]	24,805
4	Human Trafficking [MeSH]	347
5	Refugees [MeSH]	9,508
6	“Transients and Migrants”	10,955
7	1 OR 2 OR 3 OR 4 OR 5 OR 6	720,051
8	abnormalit* OR abortion* OR abscess* OR accident* OR ache* OR aids OR ailment* OR alcohol* OR allerg* OR anorexia OR AMR OR antibiotic resistan* OR antimicrobial resistan* OR anxiet* OR allerg* OR apnoea OR arthritis OR ascariasis OR assault* OR asthma OR attack* OR bacteri* OR bipolar OR bite* OR blastoma* OR bleed* OR blind OR blood OR burn* OR cancer* OR cardio* OR Chagas OR chlamydia OR cholesterol OR coma OR complication* OR condition* OR condom* OR contraception OR cyst* OR dead OR deaf OR death* OR decay OR deform* OR dehydrat* OR dementia OR dengue OR depress* OR diabetes OR diarrhoea OR disabilit* OR disease* OR disorder* OR dracunculiasis OR drug* OR dysfunction* OR eczema OR enlargement* OR epilep* OR exhaust* OR failure OR fatal* OR fatigue OR fever* OR filariasis OR flu OR gall stone* gallstone* OR gonorrhoea OR headache* OR health OR healthcare OR hearing loss OR helminth* OR hepatitis OR hernia* OR herpe* OR HIV OR hookworm* OR HPV OR hypertension OR illness* OR	21,089,958

	indigestion* OR infect* OR inflame* OR injur* OR leishmaniasis OR leprosy OR leukaemia OR leukemia OR lice OR life expectancy OR malaria OR malformat* OR malnutrition OR measles OR medical OR melanoma* OR mental* OR migraine OR miscarriage* OR morbidit* OR mortalit* OR muscl* OR myeloma OR nausea OR neuro* OR nutrition* OR onchocerciasis OR osteoarthritis OR osteoporosis OR pain* OR parasite* OR patient care OR physical activ* OR pneumonia OR poison* OR psoriasis OR psychiatric OR psychos* OR rabies OR rape* OR reproductiv* OR rheuma* OR ringworm* OR sarcoma* OR scabies OR schistosomiasis OR schizophren* OR seizure* OR sepsis* OR sexual* OR shock* OR sick* OR smoking OR sore* OR STD* OR stillbirth* OR stress* OR stroke* OR suicid* OR sunburn* OR syndrome* OR syphilis OR TB OR thrombosis OR tobacco OR STI* OR toothache* OR trachoma OR trauma* OR trichuriasis OR trichomoniasis OR trypanosomiasis OR tuberculosis OR tumor* OR tumour* OR ulcer* OR violence OR virus* OR vomit* OR wart* OR well-being OR wellbeing OR worm* OR wound*	
9	Accidents [MeSH]	182,330
10	“Delivery of Health Care” [MeSH]	1,028,923
11	Disease [MeSH]	181,324
12	Health [MeSH]	344,725
13	Health Behavior [MeSH]	301,243
14	Health Facilities [MeSH]	756,386
15	Health Policy [MeSH]	102,614
16	Health Services [MeSH]	2,044,089
17	Infection [MeSH]	765,299
18	Malnutrition [MeSH]	118,335
19	Morbidity [MeSH]	524,764
20	Mortality [MeSH]	364,390
21	Neoplasms [MeSH]	3,212,183
22	Parasites [ MeSH]	6,776
23	Viruses [MeSH]	754,871
24	“Wounds and Injuries” [MeSH]	873,897

25	8 OR 9 OR 10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23 OR 24	21,770,503
26	Malaysia OR Johor OR Kedah OR Kelantan OR Kuala Lumpur OR Labuan OR Malacca OR Melaka OR Malaya OR Negeri Sembilan OR Pahang OR Penang OR Perak OR Perlis OR Putrajaya OR Sabah OR Sarawak OR Selangor OR Terengganu	17,824
27	Malaysian	4,673
28	area* OR Borneo OR city OR cities OR district* OR island* OR isle* OR province* OR region* OR state* OR territor* OR village*	4,572,673
29	27 AND 28	1,297
30	26 OR 29	18,038
31	7 AND 25 AND 30	404
32	Animal migration OR bird migration OR cell* OR membrane* OR molecu*	6,952,122
33	31 NOT 32	364

### I.5. PsychInfo

Database name	PsychInfo
Database search engine	OvidSP
Dates of database coverage	1806 to September Week 2 2019
Date search conducted	17 September 2019
Total number of hits	91

#	Searches	Results
1	asylum* OR displaced OR emigra* OR emigre* OR foreign born OR foreign labor OR foreign labour OR foreign work* OR foreign-born OR foreign-work* OR foreigner* OR immigra* OR migra* OR people of concern OR person of concern OR persons of concern OR refugee* OR smuggl* OR traffick* OR transient* OR transmigrant*	112,729
2	Asylum seeking [MeSH]	487
3	Foreign workers [MeSH]	530
4	Human migration [MeSH]	12,788
5	Human trafficking [MeSH]	844
6	Immigration [MeSH]	21,250
7	Refugees [MeSH]	5,580
8	1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7	113,572
9	abnormalit* OR abortion* OR abscess* OR accident* OR ache* OR aids OR ailment* OR alcohol* OR allerg* OR anorexia OR AMR OR antibiotic resistan* OR antimicrobial resistan* OR anxiet* OR allerg* OR apnoea OR arthritis OR ascariasis OR assault* OR asthma OR attack* OR bacteri* OR bipolar OR bite* OR blastoma* OR bleed* OR blind OR blood OR burn* OR cancer* OR cardio* OR Chagas OR chlamydia OR cholesterol OR coma OR complication* OR condition* OR condom* OR contraception OR cyst* OR dead OR deaf OR death* OR decay OR deform* OR dehydrat* OR dementia OR dengue OR depress* OR diabetes OR diarrhoea OR disabilit* OR disease* OR disorder* OR dracunculiasis OR drug* OR dysfunction* OR eczema OR enlargement* OR epilep* OR exhaust* OR failure OR fatal* OR fatigue OR fever* OR filariasis OR flu OR gall stone* gallstone* OR gonorrhoea OR headache*	3,197,191

	OR health OR healthcare OR hearing loss OR helminth* OR hepatitis OR hernia* OR herpe* OR HIV OR hookworm* OR HPV OR hypertension OR illness* OR indigestion* OR infect* OR inflame* OR injur* OR leishmaniasis OR leprosy OR leukaemia OR leukemia OR lice OR life expectancy OR malaria OR malformat* OR malnutrition OR measles OR medical OR melanoma* OR mental* OR migraine OR miscarriage* OR morbidit* OR mortalit* OR muscl* OR myeloma OR nausea OR neuro* OR nutrition* OR onchocerciasis OR osteoarthritis OR osteoporosis OR pain* OR parasite* OR patient care OR physical activ* OR pneumonia OR poison* OR psoriasis OR psychiatric OR psychos* OR rabies OR rape* OR reproductiv* OR rheuma* OR ringworm* OR sarcoma* OR scabies OR schistosomiasis OR schizophren* OR seizure* OR sepsis* OR sexual* OR shock* OR sick* OR smoking OR sore* OR STD* OR stillbirth* OR stress* OR stroke* OR suicid* OR sunburn* OR syndrome* OR syphilis OR TB OR thrombosis OR tobacco OR STI* OR toothache* OR trachoma OR trauma* OR trichuriasis OR trichomoniasis OR trypanosomiasis OR tuberculosis OR tumor* OR tumour* OR ulcer* OR violence OR virus* OR vomit* OR wart* OR well-being OR wellbeing OR worm* OR wound*	
10	Accidents [MeSH]	13,047
11	Chronic illness [MeSH]	27,898
12	“Death and Dying” [MeSH]	37,732
13	Health [MeSH]	239,359
14	Health Behavior [MeSH]	29,441
15	Health Care Delivery [MeSH]	93,926
16	Health Care Policy [MeSH]	11,882
17	Health Care Services [MeSH]	199,129
18	Health Care Utilization [MeSH]	15,311
19	Infectious disorders [MeSH]	60,085
20	Injuries [MeSH]	25,738
21	Morbidity [MeSH]	7,010
22	Neoplasms [MeSH]	49,460
23	Nutritional deficiencies [MeSH]	3,952
24	Parasitic disorders [MeSH]	1,068
25	Viral disorders [MeSH]	50,123



26	9 OR 10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23 OR 24 OR 25	3,211,923
27	Malaysia OR Johor OR Kedah OR Kelantan OR Kuala Lumpur OR Labuan OR Malacca OR Melaka OR Malaya OR Negeri Sembilan OR Pahang OR Penang OR Perak OR Perlis OR Putrajaya OR Sabah OR Sarawak OR Selangor OR Terengganu	3,636
28	Malaysian	1,676
29	area* OR Borneo OR city OR cities OR district* OR island* OR isle* OR province* OR region* OR state* OR territor* OR village*	1,025,257
30	28 AND 29	391
31	27 OR 30	3,727
32	8 AND 26 AND 31	91
33	Animal migration OR bird migration OR cell* OR membrane* OR molercul*	184,060
34	32 NOT 33	91

## I.6. Social Policy and Practice

Database name	Social Policy and Practice
Database search engine	OvidSP
Dates of database coverage	N/A
Date search conducted	17 September 2019
Total number of hits	5

#	Searches	Results
1	asylum* OR displaced OR emigra* OR emigre* OR foreign born OR foreign labor OR foreign labour OR foreign work* OR foreign-born OR foreign-work* OR foreigner* OR immigra* OR migra* OR people of concern OR person of concern OR persons of concern OR refugee* OR smuggl* OR traffick* OR transient* OR transmigrant*	10,050
2	abnormalit* OR abortion* OR abscess* OR accident* OR ache* OR aids OR ailment* OR alcohol* OR allerg* OR anorexia OR AMR OR antibiotic resistan* OR antimicrobial resistan* OR anxiet* OR allerg* OR apnoea OR arthritis OR ascariasis OR assault* OR asthma OR attack* OR bacteri* OR bipolar OR bite* OR blastoma* OR bleed* OR blind OR blood OR burn* OR cancer* OR cardio* OR Chagas OR chlamydia OR cholesterol OR coma OR complication* OR condition* OR condom* OR contraception OR cyst* OR dead OR deaf OR death* OR decay OR deform* OR dehydrat* OR dementia OR dengue OR depress* OR diabetes OR diarrhoea OR disabilit* OR disease* OR disorder* OR dracunculiasis OR drug* OR dysfunction* OR eczema OR enlargement* OR epilep* OR exhaust* OR failure OR fatal* OR fatigue OR fever* OR filariasis OR flu OR gall stone* gallstone* OR gonorrhea OR headache* OR health OR healthcare OR hearing loss OR helminth* OR hepatitis OR hernia* OR herpe* OR HIV OR hookworm* OR HPV OR hypertension OR illness* OR indigestion* OR infect* OR inflame* OR injur* OR leishmaniasis OR leprosy OR leukaemia OR leukemia OR lice OR life expectancy OR malaria OR malformat* OR malnutrition OR measles OR medical OR melanoma* OR mental* OR migraine OR miscarriage* OR morbidit* OR mortalit* OR muscl* OR myeloma OR nausea OR neuro* OR nutrition* OR onchocerciasis OR osteoarthritis OR osteoporosis OR pain* OR parasite* OR patient care OR physical activ* OR pneumonia OR poison* OR psoriasis OR psychiatric OR psychos* OR rabies OR rape* OR reproductiv* OR rheuma* OR ringworm* OR sarcoma* OR scabies OR schistosomiasis OR schizophren* OR seizure* OR sepsis* OR sexual* OR shock* OR sick* OR smoking	197,274

	OR sore* OR STD* OR stillbirth* OR stress* OR stroke* OR suicid* OR sunburn* OR syndrome* OR syphilis OR TB OR thrombosis OR tobacco OR STI* OR toothache* OR trachoma OR trauma* OR trichuriasis OR trichomoniasis OR trypanosomiasis OR tuberculosis OR tumor* OR tumour* OR ulcer* OR violence OR virus* OR vomit* OR wart* OR well-being OR wellbeing OR worm* OR wound*	
3	Malaysia OR Johor OR Kedah OR Kelantan OR Kuala Lumpur OR Labuan OR Malacca OR Melaka OR Malaya OR Negeri Sembilan OR Pahang OR Penang OR Perak OR Perlis OR Putrajaya OR Sabah OR Sarawak OR Selangor OR Terengganu	113
4	Malaysian	21
5	area* OR Borneo OR city OR cities OR district* OR island* OR isle* OR province* OR region* OR state* OR territor* OR village*	92,897
6	4 AND 5	5
7	3 OR 6	114
8	1 AND 2 AND 7	5
9	Animal migration OR bird migration OR cell* OR membrane* OR molecu*	447
10	8 NOT 9	5

**I.7. Summary of the identified records**

<b>Database</b>	<b>Hits</b>
Econlit	348
Embase	549
Global Health	382
Medline	364
PsycInfo	91
Social Policy & Practice	5
<b>Total</b>	<b>1,739</b>

# Supplementary file 3. Individual scores of the quality assessment

No.	Reference	Study design	Level of evidence	Answer to the quality appraisal question													Total score	Score in percentage	Quality of the study
				1	2	3	4	5	6	7	8	9	10	11	12	13			
1	Scheutz et al <sup>33</sup>	Prevalence	Des-3	V	X	X	V	V	V	V	X	X	-	-	-	5/9	55.6	Moderate	
2	Levy <sup>34</sup>	Prevalence	Des-2	X	X	V	X	V	V	X	X	V	-	-	-	4/9	44.4	Low	
3	Kassim et al <sup>35</sup>	Case series	Des-3	X	V	X	V	X	V	V	X	V	V	-	-	6/10	60.0	Moderate	
4	Zulkifli et al <sup>36</sup>	Analytical cross-sectional	Obs-4	X	X	N/A	V	V	X	X	-	-	-	-	-	2/6	33.3	Low	
5	Rajeswari et al <sup>37</sup>	Prevalence	Des-3	X	X	X	V	X	V	X	X	X	-	-	-	2/9	22.2	Low	
6	Jeyakumar <sup>38</sup>	Case series	Des-3	X	X	X	V	X	X	X	V	V	V	-	-	4/10	40.0	Low	
7	Jamaiah et al <sup>39</sup>	Case series	Des-3	X	X	X	V	V	X	X	X	V	V	-	-	4/10	40.0	Low	
8	Krahl & Hashim <sup>40</sup>	Prevalence	Des-3	V	V	V	X	V	V	V	V	X	-	-	-	7/9	77.8	High	
9	Zabedah et al <sup>41</sup>	Prevalence	Des-2	X	X	X	X	V	V	X	X	X	-	-	-	2/9	22.2	Low	
10	Dony et al <sup>42</sup>	Prevalence	Des-3	V	V	V	X	V	X	X	V	N/A	-	-	-	5/8	62.5	Moderate	
11	Chandran et al <sup>43</sup>	Case report	Des-4	V	X	V	V	V	N/A	N/A	V	-	-	-	-	5/6	83.3	High	
12	Nissapatom et al <sup>44</sup>	Prevalence	Des-3	X	X	V	X	V	V	X	V	N/A	-	-	-	4/8	50.0	Low	
13	Sobri et al <sup>45</sup>	Case series	Des-3	X	V	V	V	V	X	X	X	V	X	-	-	5/10	50.0	Low	
14	Leong <sup>46</sup>	Prevalence	Des-3	V	X	X	X	X	V	V	V	X	-	-	-	4/9	44.4	Low	
15	Sasidharan et al <sup>47</sup>	Prevalence	Des-2	V	V	V	X	V	V	V	V	X	-	-	-	7/9	77.8	High	

16	Masitah et al <sup>48</sup>	Case series	Des-3	V	X	X	X	X	X	V	X	X	X	-	-	2/9	22.2	Low
17	Shailendra & Prepageran <sup>49</sup>	Case report	Des-4	V	X	V	V	V	V	X	V	-	-	-	-	6/8	75.0	High
18	Chan et al <sup>50</sup>	Analytical cross-sectional	Obs-4	X	X	N/A	X	X	X	X	-	-	-	-	-	0/6	0.0	Low
19	Farhana et al <sup>51</sup>	Case series	Des-3	X	X	X	V	V	V	V	X	V	V	-	-	6/10	60.0	Low
20	Chan et al <sup>52</sup>	Analytical cross-sectional	Obs-4	X	X	N/A	X	X	X	X	-	-	-	-	-	0/6	0.0	Low
21	Murty <sup>53</sup>	Case report	Des-4	V	V	V	V	N/A	N/A	N/A	X	-	-	-	-	4/5	80.0	High
22	Murty et al <sup>54</sup>	Case series	Des-3	X	X	X	V	X	X	V	N/A	V	V	-	-	4/9	44.4	Low
23	Mustafa et al <sup>55</sup>	Prevalence	Des-2	V	X	X	X	X	V	V	V	X	-	-	-	4/9	44.4	Low
24	Su et al <sup>56</sup>	Analytical cross-sectional	Obs-4	V	X	V	X	X	V	V	-	-	-	-	-	4/7	57.1	Moderate
25	Daher et al <sup>57</sup>	Prevalence	Des-2	V	V	X	V	X	V	N/A	V	V	-	-	-	6/8	75.0	High
26	Ratnasingam et al <sup>58</sup>	Prevalence	Des-2	X	X	X	X	X	X	X	V	X	-	-	-	1/9	11.1	Low
27	Ab Rahman & Abdullah <sup>59</sup>	Case report	Des-4	V	V	V	V	V	V	X	V	-	-	-	-	7/8	87.5	High
28	Taib & Baba <sup>60</sup>	Case series	Des-3	X	X	X	V	X	X	V	X	V	X	-	-	3/10	30.0	Low
29	Osman et al <sup>61</sup>	Prevalence	Des-3	X	X	X	V	X	V	N/A	V	V	-	-	-	4/8	50.0	Low
30	Minhat et al <sup>62</sup>	Prevalence	Des-2	X	X	X	X	X	V	N/A	X	V	-	-	-	2/8	25.0	Low
31	Mendelsohn et al <sup>63</sup>	Qualitative	Qual-2	V	V	V	V	V	X	V	V	V	V	-	-	9/10	90.0	High
32	Mendelsohn et al <sup>64</sup>	Analytical cross-sectional	Obs-4	V	V	N/A	V	V	X	V	-	-	-	-	-	5/6	83.3	High

33	Kwan et al <sup>65</sup>	Case series	Des-3	X	V	X	V	X	X	V	X	X	V	-	-	4/10	40.0	Low
34	Santos et al <sup>66</sup>	Prevalence	Des-3	X	X	X	X	V	V	V	V	V	-	-	-	5/9	55.6	Moderate
35	Razali et al <sup>67</sup>	Case series	Des-3	V	V	V	V	X	V	V	X	V	V	-	-	8/10	80.0	High
36	Elmi et al <sup>68</sup>	Case control	Obs-3	X	V	V	X	V	X	V	X	X	V	-	-	5/10	50.0	Low
37	Santos et al <sup>69</sup>	Prevalence	Des-2	X	X	X	X	V	V	V	X	V	-	-	-	4/9	44.4	Low
38	William et al <sup>70</sup>	Prevalence	Des-2	V	V	V	X	V	V	V	V	X	-	-	-	7/9	77.8	High
39	Siah et al <sup>71</sup>	Prevalence	Des-2	X	X	X	X	X	V	X	X	X	-	-	-	1/9	11.1	Low
40	Guinto et al <sup>72</sup>	Scoping review	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41	Vijjian et al <sup>73</sup>	Analytical cross-sectional	Obs-4	V	X	N/A	X	X	X	X	-	-	-	-	-	1/6	16.7	Low
42	Azian et al <sup>74</sup>	Prevalence	Des-2	X	X	X	X	X	V	X	X	X	-	-	-	1/9	11.1	Low
43	Sahimin et al <sup>75</sup>	Prevalence	Des-2	X	X	X	X	X	V	V	V	X	-	-	-	3/9	33.3	Low
44	Noh et al <sup>76</sup>	Prevalence	Des-2	X	X	X	X	X	V	X	V	X	-	-	-	2/9	22.2	Low
45	Kamaludin & How <sup>77</sup>	Analytical cross-sectional	Obs-4	V	X	N/A	X	X	V	V	-	-	-	-	-	3/6	50.0	Low
46	Min et al <sup>78</sup>	Prevalence	Des-3	V	V	V	X	V	X	X	V	N/A	-	-	-	5/8	62.5	Moderate
47	Woh et al <sup>79</sup>	Prevalence	Des-3	X	X	X	V	V	V	X	V	X	-	-	-	4/9	44.4	Low
48	Tanabe et al <sup>80</sup>	Mixed method	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
49	Ratnalingam et al <sup>81</sup>	Prevalence	Des-2	V	X	X	X	V	V	X	X	X	-	-	-	3/9	33.3	Low

50	Woh et al <sup>82</sup>	Prevalence	Des-2	X	X	X	X	X	V	X	V	X	-	-	-	2/9	22.2	Low	
51	Noor & Shaker <sup>83</sup>	Analytical cross-sectional	Obs-4	V	X	V	V	V	V	V	-	-	-	-	-	6/7	85.7	High	
52	Noordin et al <sup>84</sup>	Prevalence	Des-3	X	X	X	X	V	V	X	V	X	-	-	-	3/9	33.3	Low	
53	Sahimin et al <sup>85</sup>	Prevalence	Des-2	X	X	X	V	X	V	V	V	X	-	-	-	4/9	44.4	Low	
54	Labao et al <sup>86</sup>	Prevalence	Des-3	X	X	X	X	V	V	V	V	V	-	-	-	5/9	55.6	Moderate	
55	Shaw et al <sup>87</sup>	Randomised controlled trial	Exp-2	X	X	X	X	X	X	X	X	V	V	V	V	X	4/13	30.8	Low
56	Rahman et al <sup>88</sup>	Case control	Obs-3	X	V	V	X	V	X	V	X	V	V	-	-	-	6/10	60.0	Moderate
57	Sahimin et al <sup>89</sup>	Prevalence	Des-2	X	X	X	V	X	V	V	V	X	-	-	-	4/9	44.4	Low	
58	Nwabichie et al <sup>90</sup>	Prevalence	Des-2	V	V	X	X	V	V	V	V	V	-	-	-	7/9	77.8	High	
59	Jeffree et al <sup>91</sup>	Case control	Obs-3	X	V	V	X	V	X	X	V	V	V	-	-	-	6/10	60.0	Moderate
60	Zerguine et al <sup>92</sup>	Analytical cross-sectional	Obs-4	X	V	V	X	X	V	V	-	-	-	-	-	4/7	57.1	Moderate	
61	Ya'acob et al <sup>93</sup>	Randomised controlled Trial	Exp-2	X	X	V	X	X	X	V	X	X	V	V	V	X	5/13	38.5	Low
62	Chuah et al <sup>9</sup>	Qualitative	Qual-2	V	V	V	V	V	X	V	X	V	V	-	-	-	8/10	80.0	High
63	Loganathan et al <sup>94</sup>	Qualitative	Qual-2	X	V	V	V	V	X	V	V	V	V	-	-	-	8/10	80.0	High
64	Rahman et al <sup>95</sup>	Prevalence	Des-3	X	X	X	X	V	X	X	V	V	-	-	-	3/9	33.3	Low	
65	Siah et al <sup>96</sup>	Qualitative	Qual-3	X	V	X	V	V	X	X	X	V	V	-	-	-	5/10	50.0	Low
66	Sahimin et al <sup>97</sup>	Prevalence	Des-2	X	X	X	V	X	V	X	V	X	-	-	-	3/9	33.3	Low	



67	Chuah et al <sup>98</sup>	Qualitative	Qual-2	V	V	V	V	V	X	V	X	V	V	-	-	8/10	80.0	High
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For peer review only

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# BMJ Open

## Developing an evidence assessment framework and appraising the academic literature on migrant health in Malaysia: a scoping review

Journal:	<i>BMJ Open</i>
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<b>Primary Subject Heading</b>:	Global health
Secondary Subject Heading:	Research methods, Public health
Keywords:	STATISTICS & RESEARCH METHODS, PUBLIC HEALTH, HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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TITLE

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5 1 **Developing an evidence assessment framework and**  
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9 2 **appraising the academic literature on migrant**  
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12 3 **health in Malaysia: a scoping review**  
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18 5 Allard W. de Smalen<sup>1,2</sup>, Zhie X. Chan<sup>3</sup>, Claudia Abreu Lopes<sup>3</sup>, Michaella Vanore<sup>1,2</sup>, Tharani  
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56 20 Word count: 6959  
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## ABSTRACT

**Abstract**

**Background:** A large number of international migrants in Malaysia face challenges in obtaining good health, the extent of which is still relatively unknown. This study aims to map the existing academic literature on migrant health in Malaysia and to provide an overview of the topical coverage, quality, and level of evidence of these scientific studies.

**Methods:** A scoping review was conducted using six databases, including Econlit, Embase, Global Health, Medline, PsycInfo, and Social Policy and Practice. Studies were eligible for inclusion if they were conducted in Malaysia, peer-reviewed, focused on a health dimension according to the Bay Area Regional Health Inequities Initiative (BARHII) framework, and targeted the vulnerable international migrant population. Data were extracted by using the BARHII framework and a newly developed decision tree to identify the type of study design and corresponding level of evidence. Modified Joanna Briggs Institute (JBI) checklists were used to assess study quality, and a multiple-correspondence analysis (MCA) was conducted to identify associations between different variables.

**Results:** 67 publications met the selection criteria and were included in the study. The majority (n=41) of studies included foreign workers. Over two-thirds (n=46) focused on disease and injury, and a similar number (n=46) had descriptive designs. The average quality of the papers was low, yet quality differed significantly among them. The MCA showed that high-quality studies were mostly qualitative designs that included refugees and focused on living conditions, while prevalence and analytical cross-sectional studies were mostly low quality.

## ABSTRACT

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4 43 **Conclusion:** This study provides an overview of the scientific literature on migrant health in  
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6 44 Malaysia published between 1965 and 2019. In general, the quality of these studies is low,  
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8 45 and various health dimensions have not been thoroughly researched. Therefore, researchers  
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10 46 should address these issues to improve the evidence base to support policymakers with high-  
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12 47 quality evidence for decision-making.

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15 48 **Key Words:** Malaysia, migrant, health, refugee, foreign worker, disease, evidence  
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18 49 assessment framework  
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## ABSTRACT

**Article summary****Strengths and limitations of this study**

- This study provides a comprehensive overview of migrant health research in Malaysia, including a summary table, critical assessment tables, and a multiple-correspondence analysis (MCA).
- Methodological contributions by creating an evidence assessment framework, including a decision tree that identifies the type of study design and corresponding level of evidence, and modified Joanna Briggs Institute (JBI) checklists.
- Exclusive focus on vulnerable migrants within the non-citizen population in Malaysia.
- Only English peer-reviewed academic articles were included in this study, and, therefore, much relevant information that could potentially be used to inform both policies and practice may have been excluded from this review.

## 62 Introduction

63 Worldwide, the international migrant population accounts for approximately 272 million  
 64 people, with almost one-third within Asia.<sup>1</sup> Due to its strategic geographic location and high  
 65 labour demand, Malaysia is among the top destination countries for international migrants in  
 66 the Asian region.<sup>2</sup> According to the Department of Statistics Malaysia (DOSM), the  
 67 documented non-citizen population represented 3.2 million people in 2019, which accounts  
 68 for 10% of Malaysia's total population.<sup>3</sup> DOSM defines a non-citizen as a person that resides  
 69 in Malaysia for six months or more in the reference year.<sup>4</sup> However, no subcategories were  
 70 included in this definition. According to the Office of the United Nations High Commissioner  
 71 for Human Rights (OHCHR), a non-citizen is an individual that does not have an effective  
 72 connection with the location where the person is situated according to the host nation, and  
 73 includes various types of migrants, such as foreigners with permanent residency, refugees,  
 74 asylum seekers, foreign labour, international students, stateless individuals, and victims of  
 75 human trafficking.<sup>5</sup> Other definitions of migrant-related terms that are used in this paper are  
 76 presented in Table 1.

**Table 1 | Definitions of migrant-related terms**

Term	Definition
Regular migrant worker (documented or legal migrant worker)	"A migrant worker or members of his or her family authorised to enter, to stay and to engage in a remunerated activity in the State of employment pursuant to the law of that State and to international agreements to which that State is a party." <sup>6(p. 29)</sup>
Irregular migrant worker (undocumented or illegal migrant worker)	"Migrant workers or members of their families, who are not authorised to enter, to stay or to engage in employment in a State." <sup>6(p. 102)</sup>
Refugee	"A person who, owing to a well-founded fear of persecution for reasons of race, religion, nationality, membership of a particular social group or political opinions, is outside the country of his nationality and is unable or, owing to such fear, is unwilling avail himself of the protection of that country." <sup>6(p. 79)</sup>
Asylum seeker	"A person who seeks safety from persecutions or serious harm in a country other than his or her own and awaits a decision on the application for refugee status under relevant international and national instruments. In case of a negative decision, the person must leave the country and may be expelled, as may any non-national in an irregular or unlawful situation, unless permission to stay is provided on humanitarian or other related grounds." <sup>6(p. 12)</sup>



## Materials and Methods

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3 77 The vast majority of non-citizens in Malaysia are migrant workers, where foreign labour can  
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5 78 be divided according to their visa status into regular and irregular migrant workers.  
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8 79 According to the Ministry of Home Affairs (MOHA), Malaysia issued 2 million work permits  
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10 80 to documented migrant workers in 2019.<sup>7</sup> However, the total number of migrant workers,  
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12 81 both documented and undocumented, is estimated to fall between 4.2 and 6.2 million people.<sup>2</sup>  
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14 82 Another group that contributes significantly to the non-citizen population in Malaysia are  
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16 83 refugees and asylum seekers. The terms refugees and asylum seekers are often used  
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18 84 interchangeably, yet, these populations differ by their legal status in destination countries and  
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20 85 subsequent vulnerabilities (see definitions in Table 1). In 2019, an approximate 178,580  
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22 86 refugees and asylum seekers were registered with the United Nations High Commissioner for  
23  
24 87 Refugees (UNHCR) in Malaysia, where 153,770 (86%) came from Myanmar. The remaining  
25  
26 88 number (14%) came from Yemen, Syria, Afghanistan, Iraq, Palestine, Pakistan, Sri Lanka,  
27  
28 89 Somalia, and other countries.<sup>8</sup>  
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33 90  
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36 91 Refugees, asylum seekers, and both documented and undocumented low-skilled foreign  
37  
38 92 workers can be classified as vulnerable migrants in Malaysia, as these populations may face  
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40 93 significant hardships in their new country of residence.<sup>9 10</sup> Vulnerable migrants are more  
41  
42 94 prone to being exploited and abused, have an increased need to be protected by duty-bearers,  
43  
44 95 and are not able to fully benefit from their human rights.<sup>11</sup> Health is among these affected  
45  
46 96 human rights, as migrant workers and refugees could encounter various challenges to  
47  
48 97 maintain proper health and prevent poor health outcomes, including difficulties in accessing  
49  
50 98 healthcare and obtaining quality health services.<sup>11-13</sup> According to Sweileh et al,<sup>14</sup> assessing  
51  
52 99 the current status of scientific output and identifying research gaps could positively contribute  
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56  
57 100 towards improving the evidence base for advocating for migrant health needs. Scoping  
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## Materials and Methods

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3 101 reviews can be helpful to map the academic literature and have been used by different  
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5 102 researchers to present the available evidence on migrant health issues in other countries.<sup>15 16</sup>  
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11 104 Despite the burgeoning academic literature on migrant health in Malaysia, health information  
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14 105 on migrant-related issues is still limited, and public data remains difficult to access.

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16 106 Aggravating the matter, there is no overall picture currently available of the evidence base on  
17  
18 107 migrant health in Malaysia, including critical appraisal of the quality of research. Therefore,  
19  
20 108 this study aims to map the existing academic literature on migrant health in Malaysia since  
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22  
23 109 1965 to identify the trends and gaps in this field, as well as to present an overview of the  
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25 110 topical coverage, quality, and level of evidence of these scientific studies.  
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## 111 **Method**

### 112 **General methods**

113 A scoping review was conducted, following the Preferred Reporting Items for Systematic  
114 reviews and Meta-Analyses – Extension for Scoping Reviews (PRISMA-ScR) guidelines<sup>17</sup>  
115 (Supplementary file 1). A pre-review protocol was developed to guide decisions for literature  
116 selection and structure of the review, and included the review question, aim, search strategy,  
117 selection criteria, and risk of bias assessment. However, the protocol was not formally  
118 registered and changed to some extent over the course of this review. The pre-review  
119 protocol can be accessed on request from the first author. Data were extracted and organised  
120 using the Bay Area Regional Health Inequities Initiative (BARHII) framework.<sup>18</sup> In addition,  
121 a decision tree was developed to classify the type of study design and level of evidence of  
122 each journal article. Subsequently, a quality assessment of the included literature was  
123 conducted by using the Joanna Briggs Institute (JBI) critical appraisal toolkit.<sup>19</sup> Lastly, the  
124 data was analysed, and a multiple-correspondence analysis (MCA) was applied to explore  
125 existing relationships between variables, including the type of migrant, main health  
126 dimension, quality of the study, and research design.

### 127 **Patient and public involvement**

128 Patients and the public were not involved in this study.

### 129 **Conceptual framework**

130 The Bay Area Regional Health Inequities Initiative (BARHII) framework was utilised to  
131 organise the identified literature in this scoping review into specific factors that shape  
132 equitable health outcomes (Figure 1). The BARHII framework was selected due to its  
133 comprehensive nature and inclusion of various health dimensions, whereas other models

## Materials and Methods

1  
2  
3 134 focused on specific public health elements or lacked clear explanation regarding the included  
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5 135 health-related components of the model.<sup>20 21</sup>  
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11 137 [INSERT FIGURE 1]  
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17 139 The BARHII framework consists of six dimensions: 1) social inequities; 2) institutional  
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19 140 inequities; 3) living conditions; 4) risk behaviour; 5) disease and injury; and 6) mortality. In  
20  
21 141 addition, each health dimension contains various subdimensions (as presented in Figure 1).  
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23

24 142 Except for ‘social inequities,’ the other five categories were used to describe which health  
25  
26 143 dimension the particular articles focused on. The social inequities element was incorporated  
27  
28 144 by describing the population of interest, which was divided into three categories: foreign  
29  
30 145 workers, asylum seekers and refugees, and unclassified migrants. The lattermost category  
31  
32 146 was applied if a paper used the term ‘migrants’ or ‘immigrants’ but lacked specific  
33  
34 147 information to classify the study population as foreign workers or asylum seekers/refugees.  
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38 148 Institutional inequities include the practices of corporations, businesses, government  
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40 149 agencies, schools, not-for-profit organisations as well as laws, regulations, and policies that  
41  
42 150 could influence health outcomes (e.g., a regulation that obligates companies to financially  
43  
44 151 compensate an individual in case of a work incident).  
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48 152 Living conditions consist of the physical environment (e.g., indoor air pollution), economic  
49  
50 153 and work environment (e.g., unemployment), social environment (e.g., discrimination in the  
51  
52 154 neighbourhood), and service environment (e.g., healthcare) that people live in, and that play a  
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54 155 role in determining their health outcomes (e.g., denied healthcare access due to visa status).  
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## Materials and Methods

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3 156 Risk behaviour includes smoking, poor nutrition, low physical activity, violence, alcohol and  
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5 157 other drugs, and sexual behaviour. This dimension reflects the way someone acts and how  
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7  
8 158 that increases or decreases the risk of obtaining a particular health outcome (e.g., the attitude  
9  
10 159 and related behaviour towards smoking could influence an individual's level of risk of  
11  
12 160 developing lung cancer).

15 161 Disease and injury consist of communicable diseases (also known as infectious diseases; e.g.,  
16  
17 162 chlamydia), chronic diseases (also known as non-communicable diseases; e.g., cancer), and  
18  
19  
20 163 injuries (e.g., fractured bone). This dimension describes the number of people or individual  
21  
22 164 cases with a particular health outcome (e.g., ten out of the 100 people suffered from cancer).

25 165 Mortality was changed to 'mortality and morbidity' and focused on death and disease rates of  
26  
27 166 the study population (e.g., ten out of 1,000 live births of children under the age of one died)  
28  
29  
30 167 to distinguish epidemiological studies with larger samples from descriptive studies with  
31  
32 168 smaller samples, where the latter were categorised as disease and injury studies.

35 169 Furthermore, some additional subdimensions were created during the data extraction stage, as  
36  
37 170 these were lacking in the original BARHII framework (e.g., the subdimension 'mental health'  
38  
39 171 was added to the disease and injury dimension).

### 172 **Search strategy**

45 173 Based on the guidelines of the London School of Hygiene and Tropical Medicine<sup>22</sup> and  
46  
47 174 Bramer et al<sup>23</sup> on selecting the number and types of databases that should be included in  
48  
49  
50 175 biomedical systematic searches, six databases were selected for this study: Econlit, Embase,  
51  
52 176 Global Health, Medline, PsycInfo, and Social Policy and Practice. This scoping review  
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55 177 includes studies from 1965 onwards until 2019. However, all identified records were  
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57 178 retrieved from the six databases to manually screen the data for publication date-related  
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59 179 issues. The search process was conducted by AS and included a two-stage procedure to

## Materials and Methods

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2  
3 180 ensure that the search was exhaustive and to minimise the risk of missing potentially eligible  
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5 181 studies. The first stage focused on identifying English-language key words and Medical  
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7 182 Subject Headings (MeSH) terms for migrants (e.g., immigrants, foreign workers, refugees),  
8  
9 183 health (e.g., disease, infection, disorder), and Malaysia (e.g., Sabah, Kuala Lumpur) through  
10  
11 184 reading search strategies of other review studies on migrant health as well as utilising medical  
12  
13 185 terminology of renowned medical institutions, such as the Mayo Clinic. Subsequently, these  
14  
15 186 items were combined by using Boolean operators (e.g., migrant AND health AND Malaysia)  
16  
17 187 in the search platform of each database (Supplementary file 2).  
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**188 Selection criteria**

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25 189 Studies were eligible for inclusion if they met the following inclusion criteria: 1) conducted  
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27 190 in Malaysia, including cross-national studies in which Malaysia was included; 2) published in  
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29 191 peer-reviewed academic journals; 3) primary outcomes of the study included a health-related  
30  
31 192 variable from at least one of the five health dimensions of the BARHII framework; 4)  
32  
33 193 employment of one of the following study designs: literature synthesis (systematic review,  
34  
35 194 meta-analysis, other scientific review designs), qualitative (interviews, focus group  
36  
37 195 discussions), and/or quantitative (randomised controlled trial, cohort, case-control, cross-  
38  
39 196 sectional, case series, case report) study design; 5) written in English; 6) inclusion of  
40  
41 197 international (im)migrants, foreign workers, asylum seekers, and refugees, as these groups  
42  
43 198 were considered as vulnerable migrant populations in Malaysia. Articles that included both  
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45 199 migrants and the general population were included in this study if sufficient information  
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47 200 concerning the migrant population was available.  
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53 201 Studies were excluded if they were: 1) conducted or included data from 1965 or earlier, as  
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55 202 Singapore was part of Malaysia until 1965, and this study is careful to only include Malaysia  
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57 203 studies without Singapore; 2) grey literature; 3) opinion papers, editorials, fieldnotes of  
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## Materials and Methods

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3 204 symposia, conferences and workshop abstracts; 4) focused on non-citizens and foreigners,  
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5 205 where it was unclear whether a vulnerable migrant population was included (such as  
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7 206 permanent residents, naturalised persons, expatriates, temporary visitors, tourists, Malaysian  
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9 207 returnees, and international students); 5) only presented migrants as a control variable and no  
10  
11 208 other information regarding migrants was available.  
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209 **Data extraction**

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18 210 Three reviewers (AWS, ZXC, and NSP) were involved in the screening process, where all  
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20 211 had experience in the domain of public health and AWS and NSP had practical knowledge  
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22 212 with respect to conducting systematic reviews due to previous research work. Titles and  
23  
24 213 abstracts were exported by AWS and subsequently moved into Rayyan, an open-source  
25  
26 214 software designed to support systematic reviews. AWS and ZXC were the main reviewers,  
27  
28 215 where AWS conducted an entire screening of titles and abstracts and ZXC assessed a  
29  
30 216 randomly selected 20% sample. Independent screening was carried out by using the 'blind'  
31  
32 217 function of Rayyan, with both researchers working separately. The first stage involved  
33  
34 218 screening titles and abstracts according to the inclusion criteria. Subsequently, AWS and  
35  
36 219 ZXC conducted an independent full-text screening of all potential articles and attached  
37  
38 220 comments to each article on why the paper was included or excluded. After each screening  
39  
40 221 stage, AWS and ZXC compared their findings and discussed the discrepancies. In both  
41  
42 222 stages, the discrepancies were about 13% to 14% of the papers and were mostly around the  
43  
44 223 study design and target populations. Conflicts were examined and resolved by NSP.  
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51 224 Following the full-text screening stage, the data were extracted by one reviewer (AWS) and  
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53 225 disaggregated by the different dimensions of the BARHII framework, including the type of  
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55 226 migrant (social inequities), main health dimension (institutional inequities, living conditions,  
56  
57 227 risk behaviour, disease and injury, and mortality and morbidity), and health subdimensions.  
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## Materials and Methods

228 For the next stage, a decision tree was developed to ensure that the correct quality appraisal  
 229 tool by study design was selected and to identify the level of evidence of the included  
 230 literature (Figure 2). Although various research designs were included in the decision tree,  
 231 some study designs did not fit in this model, such as the mixed-method design.

232

233 [INSERT FIGURE 2]

234

235 The decision tree built on the study design tree from the Centre for Evidence-Based Medicine  
 236 (CEBM)<sup>24</sup> and essentially allowed research of varying designs to be consistently, reliably  
 237 classified into one of several design families. The newly developed decision tree was created  
 238 through a two-step process. First, a table was created that included definitions of various  
 239 research designs, and, subsequently, specific traits of these definitions were used to develop  
 240 guiding questions for the decision tree (Table 2).

Table 2 | Definitions of included study designs

Study design	Definition
Analytical studies	Studies that strive to quantify the relationship between a particular exposure or intervention and the outcome of interest, where these studies include a comparison group to compare the outcome rates. <sup>24</sup>
Systematic review	A study that is conducted systematically to collect all published evidence – that comply with the specified inclusion criteria – and provide a summary of the results to answer a specific research question. <sup>25</sup>
Randomised controlled trial (RCT)	An experimental study that includes at least two groups – treatment group and control group – to compare the outcomes between the group that received the intervention/drug and the group that received a placebo/no treatment. The participants of the group are randomly allocated to one of the groups. <sup>26</sup>
Quasi-experimental study/non-RCT	An experimental study that includes at least two groups – treatment group and control group – to compare the outcomes between the group that received the intervention/drug and the group that received a placebo. The participants of the group are not randomly allocated to one of the groups. <sup>27</sup>
Cohort study	A study that follows a group of people over time, where the participants are sampled based on the presence or absence of a particular exposure to compare the outcome of interest with a control group. <sup>26</sup>
Case-control study	A study that includes a group of people selected on the outcome of interest (cases) and a group without the outcome of interest (controls), followed by assessing previous exposure of both groups to determine if there is a relationship between the level of exposure and outcome of interest. <sup>26</sup>
Analytical cross-sectional	A study that looks at two groups – exposed and unexposed – and the outcome of interest at a particular point or period of time to compare the differences between the two groups. <sup>26</sup>



## Materials and Methods

Descriptive studies	Studies that do not strive to quantify a relationship between variables, but simply describe the disease outcome and characteristics within a defined population. Note that descriptive studies can still include analytic components. <sup>24</sup>
Prevalence study	A study that looks at a population at a particular point or period of time to describe the prevalence of an outcome of interest. <sup>26</sup>
Case series	A study where only subjects are included with a particular outcome of interest to describe the shared and diverging characteristics of this study population. <sup>28</sup>
Case report	A study that describes an unfamiliar or extraordinary outcome of one individual. <sup>28</sup>

241

242 Second, Tomlin & Borgetto's<sup>29</sup> model was utilised to identify the level of evidence of the  
 243 included literature, as the study designs that were included in their model were in line with  
 244 the research designs in the definitions table. In addition, it was one of the few models that  
 245 deconstructed the single-hierarchy framework and assigned study designs to different  
 246 categories depending on the study objective (e.g., if the study design did not aim to provide a  
 247 causal-relationship, but simply describe a particular outcome, the study design would be  
 248 classified as descriptive research), and, therefore, valued studies with different objectives  
 249 equally. Tomlin & Borgetto's model consists of four dimensions, including descriptive  
 250 research, experimental research, outcome research, and qualitative research. Each of these  
 251 dimensions contains four subclasses to show the level of evidence within each class, where  
 252 level 1 is the highest level of evidence and level 4 the lowest. The assignment of these levels  
 253 to the different study designs are based on the degree of internal validity/authenticity and  
 254 external validity/transferability, where level 1 is regarded with the highest level of these two  
 255 measures and level 4 ranks the lowest. Table 3 shows the different research dimensions that  
 256 correspond with the included study designs and level of evidence.

**Table 3 | Level of evidence for each study design**

Research design†	Level of evidence	Abbreviation
<b>Descriptive research</b>		
Systematic review of descriptive studies	1	Des-1
Prevalence study with analytical component	2	Des-2
Case series and prevalence study without analytical component	3	Des-3
Case report	4	Des-4
<b>Experimental research</b>		
Systematic review/meta-analysis of experimental studies	1	Exp-1
Randomised controlled trial	2	Exp-2

## Materials and Methods

Group quasi-experimental study (a.k.a. non-RCT)	3	Exp-3
Quasi-experimental study with single subject	4	Exp-4
<b>Observational research</b>		
Systematic review/meta-analysis of observational studies	1	Obs-1
Cohort study	2	Obs-2
Case-control	3	Obs-3
Analytical cross-sectional study	4	Obs-4
<b>Qualitative research</b>		
Systematic review/meta-synthesis of qualitative studies	1	Qual-1
Group qualitative studies with more rigor*	2	Qual-2
Group qualitative studies with less rigor	3	Qual-3
Qualitative study with a single informant	4	Qual-4

1 = Highest level of evidence; 4 = lowest level of evidence.

\*Rigor was subjectively assessed and based on the number of included participants, amount of collected data, and detailed explanation how the study was conducted.

†The following terminology of Tomlin & Borgetto's model have been modified to align with the included research designs in this study: association/correlation studies = prevalence studies with analytical component; normative/descriptive studies = prevalence studies without analytical component; individual case studies = case report; controlled-clinical trials = group quasi-experimental study; single-subject studies = quasi-experimental study with single subject; pre-existing groups comparisons with covariate analysis = cohort study; one-group pre-post studies = analytical cross-sectional study.

After incorporating feedback on the questions used to identify the research design and multiple testing rounds to assess if the questions were specific enough to distinguish these designs within the full set of articles, the final version of the decision tree – as seen in Figure 2 – was used to extract the data.

### Quality appraisal and level of evidence assessment

The quality assessment of the included studies was conducted by one reviewer (AWS) based on the Joanna Briggs Institute (JBI) critical appraisal tools, as this toolkit includes checklists for a wide variety of study designs that are most in line with the research designs included in this study. Additional objective criteria specific to migrant health studies were developed for each question of the JBI checklists to increase the reliability of the quality assessment. An example is provided in Table 4.

## Materials and Methods

**Table 4 | Example of additional objective criteria for the JBI toolkit**

Question	“Were the study subjects and the setting described in detail?” <sup>30(p. 3)</sup>
Original explanation	“The study sample should be described in sufficient detail so that other researchers can determine if it is comparable to the population of interest to them. The authors should provide a clear description of the population from which the study participants were selected or recruited, including demographics, location, and time period.” <sup>30(p. 4)</sup>
Additional objective criteria	<p>‘Yes’ should be selected if different demographic variables are presented in absolute numbers, including age (aggregated in individual years or age categories), sex, and nationality. In addition, the setting should be described by providing the name of the location and/or a description of the location.</p> <p>‘No/unclear’ should be selected if a description regarding age, sex, and/or nationality in absolute numbers are lacking. Note that using only means and ratios will not be sufficient to answer this question, and ‘no/unclear’ should be selected. In addition, ‘no/unclear’ should be selected if the name and/or description of the location is not given.</p>

278

279 After discussing the additional criteria and piloting the tools, slight modifications were made

280 for the JBI tools, and these final versions were used to assess the quality of the papers. The

281 modified checklists can be accessed on request from the first author.

282 Questions were answered with ‘Yes (V)’ if the study met the criteria according to

283 descriptions provided in the final version of the JBI toolkit. ‘No/Unclear (X)’ was selected if

284 the study did not address the question or if information to assess the given criteria was

285 lacking. The score concerning the quality of the study was determined by summing up all

286 ‘Yes’ answers and dividing this number by the total number of answered questions, which

287 differed by study design in the JBI tools. Questions that were answered with ‘Not applicable

288 (N/A)’ were excluded from the calculation. As the JBI toolkit has no standard scoring index,

289 the following scoring system was applied: 1) low quality = 0% to 50%; 2) moderate quality =

290 above 50% and below 75%; 3) high quality = 75% or higher. Although a four-band scoring

291 system – where each category would include a 25% scoring range – was considered, a three-

292 band scoring system was selected because the three given categories – low, moderate, and

293 high – would simplify the interpretation concerning the quality of the study. In a four-band

294 system, the distinction and classification of the two middle categories are less straightforward

## Materials and Methods

1  
2  
3 295 compared to the three-band scoring system. Further, the first two categories in a four-band  
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5 296 scoring system would still represent a poor-quality study, and, hence, should be used to signal  
6  
7 297 more cautious interpretation of the study results among readers. The cut-off score was based  
8  
9 298 on the idea that if a study could answer 'yes' to only half or less of the questions, it would not  
10  
11 299 be sufficient to transmit a reliable message to the audience. Therefore, at least more than half  
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13 300 of the questions should be answered with 'yes' to obtain a moderate score. The 75% cut-off  
14  
15 301 was still based on the idea of having four equal scoring categories, where 75% and above  
16  
17 302 would be classified as a high-quality study and would inform the audience with a more  
18  
19 303 credible message.

**304 Data analysis**

26  
27 305 Data concerning the type of migrant, health dimension, health subdimension, research design,  
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29 306 level of evidence, and quality assessment score were imported into Microsoft Excel for Mac  
30  
31 307 (version 16.28). Mean quality scores were calculated for the different variables by using  
32  
33 308 Microsoft Excel, including the type of migrant, health dimension, health subdimension,  
34  
35 309 research design, and level of evidence. RStudio (version 1.0.136; Macintosh; Intel Mac OS X  
36  
37 310 10\_15) was utilised to conduct chi-square tests and a multiple-correspondence analysis  
38  
39 311 (MCA). An MCA is a descriptive technique that can be utilised to visually demonstrate  
40  
41 312 relationships among the levels of several categorical variables – here, these include the type  
42  
43 313 of migrant, main health dimension, quality of the study, and research design – in a two-  
44  
45 314 dimensional space. The MCA projects categories in a two-dimensional space with axes  
46  
47 315 defined by latent dimensions (and, therefore, it is not possible to label the axes), based on  
48  
49 316 weighted Euclidean distances.<sup>31</sup> The MCA allows categories with similar profiles to be  
50  
51 317 grouped together, where a closer distance of categories within the same quadrant  
52  
53 318 demonstrates a stronger relationship, whereas categories that are further apart and in opposite  
54  
55 319 quadrants present weaker associations.<sup>32</sup> In addition to the MCA, chi-square tests were

## Materials and Methods

1  
2  
3 320 conducted to assess whether categorical variables were independent (e.g., not associated). It  
4  
5 321 should be noted that a few studies included two BARHII dimensions, yet, the analysis only  
6  
7 322 allowed one dimension to be included. Therefore, only the most prominent dimension, based  
8  
9 323 on the amount of attention given to the specific dimension in the article, was selected and  
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11 324 used for the analysis.  
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For peer review only

## Results

**Results**

The study selection process is presented in Figure 3. After removing the duplicates, 1,282 original records were identified. A total of 1,136 papers were excluded after the title and abstract screening stage due to focusing on another population of interest, lacking focus on a BARHII health dimension, not being a peer-reviewed academic article, and including data before 1965. As a result, 146 articles were eligible for the full-text screening stage. Subsequently, full-text articles were retrieved from these 146 records, and eventually, 67 papers met the inclusion criteria and were included in this review.

[INSERT FIGURE 3]

**Characteristics of included papers**

This section first demonstrates the findings of each BARHII dimension, followed by the results on the quality and level of evidence of the included studies. Lastly, existing relationships between the type of study design, study quality of the study, type of migrant, and main health dimension are shown. Table 5 presents a descriptive summary of all included articles, including the study design and corresponding level of evidence, study period, type of migrant, sample population, main health dimension, health subdimension, quality assessment score and a short description of the study.

## Results

Table 5   Summary table of included articles								
Reference	Study design	Study period	Type of migrant	Sample population	Main category	Subcategory	Quality score	Summary
Scheutz et al <sup>33</sup>	Prevalence (Des-3)	January to May 1982	Asylum seekers & refugees	361 Vietnamese refugees	Disease & injury	Non-communicable disease (Oral health)	Moderate (55.6)	Dental health of refugees was examined, and the study showed a positive relationship between the average number of tooth decay and missing teeth and increase in age among younger refugees.
Levy <sup>34</sup>	Prevalence (Des-2)	July to August 1984	Asylum seekers & refugees	297 children (94 Filipino, 104 Muruts, 99 Kadazan)	Disease & injury	Communicable disease (Parasite)	Low (44.4)	Three groups of children – one refugee group and two indigenous groups – were examined for six types of intestinal parasites. Among the three groups, Filipino refugee children presented significant higher rates of <i>Trichuris trichiura</i> and <i>ascaris lumbricoides</i> compared to both groups.
Kassim et al <sup>35</sup>	Case series (Des-3)	1985 to 1986	Unclassified migrants <sup>1</sup>	86 children (7 migrants, <sup>2</sup> 34 Malays, 16 Chinese, 3 mixed origin)	Risk behaviour	Violence & abuse (Neglect)	Moderate (60.0)	In total, 86 children were identified as cases suffering from different types of abuse. Among this group were 7 irregular migrant children, where they were identified as neglected, due to lacking nutritional and physical needs.
Zulkifli et al <sup>36</sup>	Analytical cross-sectional (Obs-4)	N/A <sup>2</sup>	Unclassified migrants	1,515 people (336 migrants, <sup>2</sup> 1,075 citizens)	Living conditions	Service environment (Healthcare utilisation) Mortality & morbidity Mortality rates (Under-five mortality)	Low (33.3)	A comparison between migrants and locals regarding maternal and child health outcomes were studied. Migrant women had a lower usage of contraceptives and antenatal care, but used the services of traditional birth attendants more compared to local women. In addition, migrant women had statistically significantly higher rates regarding infant mortality compared to locals.

## Results

Rajeswari et al <sup>37</sup>	Prevalence (Des-3)	N/A <sup>2</sup>	Foreign workers <sup>3</sup>	456 children (10 Indonesians, 357 Malays, 78 Orang Asli, 11 Indian)	Disease & injury	Communicable disease (Parasite)	Low (22.2)	School children were examined for different types of helminths and protozoa, and the study showed that children from migrant workers had the highest prevalence.
Jeyakumar <sup>38</sup>	Case series (Des-3)	10 May 1993 to 08 July 1993	Unclassified migrants <sup>1,4</sup>	27 migrants (23 Bangladeshi, 4 Indonesians)	Risk behaviour	Poor nutrition (Nutrition deficiency)	Low (40.0)	Twenty-seven detained irregular migrants were sent to the hospital to treat ankle oedema, where they showed a positive response to thiamine treatment.
Jamaiah et al <sup>39</sup>	Case series (Des-3)	1983 to 1992	Unclassified migrants <sup>1</sup>	134 people (22 Indonesian, 22 Others, <sup>2,5</sup> 40 Chinese, 37 Malays, 13 Indians)	Disease & injury	Communicable disease (Parasite)	Low (40.0)	A total of 134 malaria cases were admitted to University Hospital Kuala Lumpur between 1983 and 1992, including 22 irregular Indonesian migrants (16.4%) and 22 (16.4%) other foreigners (such as other irregular migrants from Bangladesh, India, and Thailand, as well as Vietnamese refugees. In addition, chloroquine-resistance was found in 9 irregular Indonesian migrants and 6 other foreigners.
Krahl & Hashim <sup>40</sup>	Prevalence (Des-3)	January 1994 to June 1996	Foreign workers <sup>6,7</sup>	39 people (20 Indonesians, 16 Filipinos, 1 Bruneian, 1 Singaporean, 1 Thai)	Disease & Injury	Mental health (Psychiatric disorders)	High (77.8)	Within a two-year period, 39 foreigners were admitted to the psychiatric wards of UHKL., including 30 migrant workers that suffered from a psychiatric disorder. Domestic workers represented with 23 cases the largest group among these foreign workers.
Zabedah et al <sup>41</sup>	Prevalence (Des-2)	N/A <sup>2</sup>	Unclassified migrants	37 people identified; 27 people included (17 Filipinos, 10 locals)	Risk behaviour	Alcohol & other drugs (Inhalant)	Low (22.2)	Among the 37 suspected solvent abusers (glue sniffers) that were admitted to Bukit Padang Psychiatric Hospital, 27 children admitted using



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								these inhalants. Almost two-third of the cases were Filipino immigrants.
Dony et al <sup>42</sup>	Prevalence (Des-3)	N/A <sup>2</sup>	Unclassified migrants	3,908 people (943 foreigners, <sup>2</sup> 2,965 nationals)	Mortality & Morbidity	Morbidity rates (Tuberculosis & leprosy)	Moderate (62.5)	An epidemiological study aimed to present the tuberculosis and leprosy trends in Sabah. Since 1990, at least 24% of the annual tuberculosis cases were among Indonesian and Filipino migrants, where the annual rate differed between 100 to 200 cases per 100,000 population between 1990 and 2000. Furthermore, leprosy rates among migrants differed from 4.39 cases to 6.19 cases per 100,000 population between 1996 and 2001.
Chandran et al <sup>43</sup>	Case report (Des-4)	N/A <sup>2</sup>	Foreign workers	1 Myanmar	Disease & injury	Communicable disease (Parasite)	High (83.3)	A Jabouley procedure was carried out to treat a 30-year-old Myanmar worker that suffered from a filarial infection. After the procedure, the patient was discharged, but did not show for the follow-up.
Nissapatorn et al <sup>44</sup>	Prevalence (Des-3)	January 2000 to April 2004	Foreign workers	1,885 patients <sup>2</sup>	Disease & injury	Communicable disease (Parasite)	Low (50.0)	Within a four-year period, 1,885 medical records of the University of Malaya Medical Centre were reviewed to identify the prevalence of four common protozoan infections. In total, 28 malaria cases were identified, where 60.7% was among foreigners. The majority of this group consisted of foreign workers.
Sobri et al <sup>45</sup>	Case series (Des-3)	January 1995 to December 2001	Unclassified migrants	42 people (7 Indonesians, 1 Burmese, 1 Siamese (Thai), 1	Disease & injury	Communicable disease (Bacteria)	Low (50.0)	In total, 42 patients were diagnosed with tuberculosis meningitis at the Kuala Lumpur Hospital during a 7-year period. Eleven (9.5%)

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				<i>Bangladeshi, 1 Nepalese, 23 Malays, 6 Chinese, 2 Indians)</i>				out of the 42 tuberculosis meningitis patients were among immigrants.
Leong <sup>46</sup>	Prevalence (Des-3)	1 January 1997 to 31 December 2004	Foreign workers	<i>3,117 Indonesians</i>	Disease & injury	Various diseases (various diseases)	Low (44.4)	During an 8-year-period, 3,117 female migrant (domestic) workers were screened at a private clinic in Johor Bahru, where 223 (7.2%) of them presented medical problems. Hypertension, pulmonary tuberculosis and hepatitis B were the top three major issues.
Sasidharan et al <sup>47</sup>	Prevalence (Des-2)	June 1999 to September 2001	Foreign workers	697 people <i>(26 Bangladeshi, 276 Malays, 229 Chinese, 166 Indians)</i>	Disease & injury	Communicable disease (Bacteria)	High (77.8)	From 1999 to 2002, a total of 697 patients were examined for Helicobacter pylori infection. Twenty-six Bangladeshi foreign workers were among this group, and the infection was present in 6 of them.
Masitah et al <sup>48</sup>	Case series (Des-3)	N/A <sup>2</sup>	Foreign workers	N/A <sup>2</sup>	Disease & injury	Communicable disease (Parasite)	Low (22.2)	During a 6-year period, different malaria registries were reviewed to identify the number of cases in Selangor. The number of annual malaria cases decreased from 172 people in 2001 to 90 people in 2006, while the proportion of cases among migrant workers increased from 57% to 75%, respectively.
Shailendra & Prepageran <sup>49</sup>	Case report (Des-4)	N/A <sup>2</sup>	Foreign workers	<i>1 Myanmar</i>	Disease & injury	Communicable disease (Parasite)	High (75.0)	A 38-year-old Myanmar migrant worker presented a case of oropharyngeal rhinosporidiosis. The abnormal growths were removed, and the patient did not show any recurrence of the disease after a 3-month follow-up.

## Results

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
Chan et al <sup>50</sup>	Analytical cross-sectional (Obs-4)	N/A <sup>2</sup>	Foreign workers <sup>1</sup>	699 people (336 Indonesians, 45 Bangladeshi, 45 Indians, 26 Nepalese, 22 Myanmar, 17 Pakistani, 3 Africans, <sup>2</sup> 3 Sri Lankans, 3 Thai, 1 Chinese, 198 Malaysians)	Disease & injury	Communicable disease (Parasite)	Low (0.0)		A sample of 699 people were screened for toxoplasmosis, including 501 migrant workers. Among the migrant workers, 171 (34.1%) cases tested positive for the IgG antibodies test and 26 (5.2%) cases tested positive for the IgM antibodies test. The statistical analysis showed that the infection rate – using the IgG test – was significantly higher among local residents compared to the foreign workers.																																				
Farhana et al <sup>51</sup>	Case series (Des-3)	1999 to 2008	Foreign workers	34 people (3 Myanmar, 1 Indonesian, 1 Pakistani, 14 Chinese, 9 Malays, 6 Indians)	Disease & injury	Communicable disease (Parasite)	Low (60.0)		A total of 34 amoebiasis cases were admitted to University Malaya Medical Centre during a 10-year-period, including five foreign workers.																																				
Chan et al <sup>52</sup>	Analytical cross-sectional (Obs-4)	N/A <sup>2</sup>	Foreign workers <sup>1</sup>	699 people (336 Indonesians, 45 Bangladeshi, 45 Indians, 26 Nepalese, 22 Myanmar, 17 Pakistani, 3 Africans, <sup>2</sup> 3 Sri Lankans, 3 Thai,	Disease & injury	Communicable disease (Parasite)	Low (0.0)		A sample of 699 people were screened for toxoplasmosis, including 501 migrant workers. Among the migrant workers, 171 (34.1%) cases tested positive for the IgG antibodies test and 26 (5.2%) cases tested positive for the IgM antibodies test. The statistical analysis showed that the infection rate – using the IgG test – was significantly higher among local residents compared to the foreign workers.																																				

## Results

				1 Chinese, 198 Malaysians)					
Murty <sup>53</sup>	Case report (Des-4)	N/A <sup>2</sup>	Foreign workers	1 Myanmar	Disease & injury	Non-communicable disease (Benign)	High (80.0)		A 37-year-old foreign worker was found dead, and the post-mortem examination showed that the case suffered from a cystic tumour in the heart.
Murty et al <sup>54</sup>	Case series (Des-3)	1996 to 2005	Foreign workers	27 people (16 Indonesians, 1 Bangladeshi, 1 Punjabi, <sup>2</sup> 1 Bajau, <sup>2</sup> 5 Malays, 2 Indians, 1 Chinese)	Disease & injury	Injury (Physical trauma)	Low (44.4)		During a 10-year study period, 27 cases of fatal lightning strikes were identified. The majority of the cases were among foreign workers, where Indonesians had with 16 people (59.3%) the highest prevalence.
Mustafa et al <sup>55</sup>	Prevalence (Des-2)	August 2006 to March 2009	Foreign workers	558 patients (34 foreign labour, <sup>2</sup> 347 Malays, 97 Indians, 80 Chinese)	Disease & injury	Communicable disease (Virus)	Low (44.4)		A total of 558 suspected dengue cases were identified, including 34 migrant workers. Among the foreign labour group, 20 patients presented acute dengue, 4 patients presented recent dengue, and 10 patients tested negative for dengue.
Su et al <sup>56</sup>	Analytical cross-sectional (Obs-4)	3 January 2007 to 24 April 2007	Foreign workers	194 people <sup>8</sup> (95% Indonesians, 5% Bangladeshi)	Disease & injury	Injury (Physical syndrome)	Moderate (57.1)		During a 4-month cross-sectional study, 234 migrant workers were examined for level of occupational vibration exposure and health outcomes. In total, 18% of the migrant workers suffered from hand-arm vibration syndrome (HAVS). In addition, different HAVS-related symptoms were significantly higher among workers with high levels of exposure compared to migrant workers with low levels of exposure.

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1	Daher et al <sup>57</sup>	Prevalence (Des-2)	September 2009 to April 2010	Unclassified migrants	253 <i>Iraqi</i>	Disease & injury	Mental health (Quality of life)	High (75.0)	Health-related quality of life of 253 Iraqi migrants was examined, showing that their quality of life was moderate and statically significant higher levels were found among males and married people.
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3	Ratnasingam et al <sup>58</sup>	Prevalence (Des-2)	January 2010 to November 2010	Foreign workers	5,340 people (1,348 <i>Bangladeshi</i> , 843 <i>Myanmar</i> , 743 <i>Nepalese</i> , 217 <i>Indonesians</i> , 2,190 Malaysians)	Disease & injury	Injury (Physical trauma)	Low (11.1)	A total of 5,340 workers in the furniture industry were examined, where 59% of this population was foreign labour. Compared to local workers, migrant workers had less occupational accidents and a more positive work-oriented mentality.
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5	Ab Rahman & Abdullah <sup>59</sup>	Case report (Des-4)	N/A <sup>2</sup>	Foreign workers	1 <i>Nepalese</i>	Disease & injury	Communicable disease (Parasite)	High (87.5)	A 24-year-old Nepalese migrant worker presented a long medical history of different symptoms, including fever, abdominal pain, and poor appetite. Clinical examination showed that the patient suffered from a visceral leishmaniasis and malaria co-infection, and he was treated with chloroquine and amphotericin B. A follow-up was carried out after 6 months and the man remained well.
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7	Taib & Baba <sup>60</sup>	Case series (Des-3)	2006 to 2009	Foreign workers	75 patients (38 <i>foreigners</i> , <sup>8</sup> 37 locals)	Disease & injury	Communicable disease (Bacteria)	Low (30.0)	A total of 75 leprosy cases were detected at the Hospital Kuala Lumpur Hansen's Clinic during a 4-year period. With 38 patients, foreign workers represented more than half of the cases.
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9	Osman et al <sup>61</sup>	Prevalence (Des-3)	June 2012 to September 2012	Unclassified migrants	108 <i>Iraqi</i>	Risk behaviour	Sexual behaviour (HPV knowledge)	Low (50.0)	Knowledge and awareness regarding cervical cancer and pap smear tests were assessed among 108 Iraqi migrant women. In general, this population lacks understanding regarding
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								cervical cancer and the importance of pap smear tests.
Minhat et al <sup>62</sup>	Prevalence (Des-2)	April 2010 to June 2010	Unclassified migrants	271 Iranians	Risk behaviour	Sexual behaviour (HPV knowledge)	Low (25.0)	The knowledge regarding HPV vaccination of 271 Iranian female migrants was evaluated and showed that the majority of the study population has poor knowledge regarding this matter. Marital status was the only predicative factor that was statistically significant, where married women were 3.6 times more likely to have good HPV knowledge.
Mendelsohn et al <sup>63</sup>	Qualitative (Qual-2)	July 2010 to September 2010	Asylum seekers & refugees	14 Myanmar <sup>9</sup>	Living conditions	Service environment (Healthcare utilisation)	High (90.0)	Fourteen Myanmar refugees were interviewed to explore the difficulties that this group has in accessing anti-retroviral therapy (ART). Barriers to comply to ART include lack of an UNHCR identity card, fear of arrest during travelling to the hospital, corruption, financial issues, and receiving small quantities of ART medication per refill.
Mendelsohn et al <sup>64</sup>	Analytical cross-sectional (Obs-4)	April 2010 to July 2010	Asylum seekers & refugees	299 people (146 Myanmar, 5 Others, <sup>2</sup> 148 Malaysians)	Living conditions	Service environment (Healthcare utilisation)	High (83.3)	ART compliance and virological outcomes were compared between HIV-infected refugees and locals, where the study showed that both groups had similar rates of compliance and unsuppressed viral loads.
Kwan et al <sup>65</sup>	Case series (Des-3)	2008 to 2013	Unclassified migrants	27 people (3 Indonesians, 2 Indians, 2 Nepalese, 2 Myanmar, 1 Sri	Disease & injury	Communicable disease (Bacteria)	Low (40.0)	Between 2008 and 2013, 27 leprosy cases were identified by reviewing the Dermatology Clinic census. Out of the 27 identified leprosy cases, 37% of them were among immigrants.

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				<i>Lankan, 17 Malaysians)</i>					
Santos et al <sup>66</sup>	Prevalence (Des-3)	February 2013 to June 2013	Foreign workers	<i>317 people (110 Sri Lankans, 85 Indonesians, 71 Indians,<sup>8</sup> 22 Nepalese, 20 Indians,<sup>8</sup> 9 Myanmar)</i>	Disease & injury	Injury (Physical syndrome)	Moderate (55.6)		A sample of 317 migrant workers were examined to explore the prevalence of musculoskeletal pain among this group. Almost two-third (203 people) of the surveyed migrant workers suffered from work-related musculoskeletal complaints. Pain in the knee/leg/foot area was the most common, as 85 migrant workers reported this outcome.
Razali et al <sup>67</sup>	Case series (Des-3)	2000 to 2012	Unclassified migrants	<i>18 females (2 Indonesians, 1 Myanmar, 6 Malays, 5 Chinese, 3 Indians, 1 Punjabi)</i>	Risk behaviour	Violence & abuse (Murder)	High (80.0)		Clinical records of two forensic psychiatric institutions were reviewed during 2000 and 2012.  A total of 18 cases that committed maternal filicide were detected, including 3 immigrant women that suffered from adverse life events.
Elmi et al <sup>68</sup>	Case control (Obs-3)	January 2010 to April 2014	Unclassified migrants	<i>209 cases (49 migrants,<sup>2</sup> 265 locals)</i>	Disease & injury	Communicable disease (Bacteria)	Low (50.0)		A case control study was conducted to identify risk factors regarding multidrug-resistant tuberculosis (MDR-TB) development. The study showed that MDR-TB was more prevalent than non-MDR-TB among foreign patients, and that MDR-TB was significantly higher among migrants compared to locals.
Santos et al <sup>69</sup>	Prevalence (Des-2)	March 2013 to April 2013	Foreign workers	<i>317 people (110 Sri Lankans, 85 Indonesians, 71 Indians,<sup>8</sup> 22 Nepalese, 20</i>	Living conditions	Economic & work environment (Occupational hazards)	Low (44.4)		The study assessed overall levels of pain and identified perceived environmental hazards among a group of foreign workers. In total, 204 out of 317 migrant workers suffered from musculoskeletal pain, and noise (37.5%) and

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				<i>Indians,<sup>8</sup> 9 Myanmar)</i>	Disease & injury	Injury (Physical syndrome)		dust (37.2%) were perceived as the main environmental hazards among this group.
William et al <sup>70</sup>	Prevalence (Des-2)	4 July 2012 to 3 July 2014	Unclassified migrants	176 people (53 Filipinos, 6 Indonesians, 106 Indigenous, 10 Chinese, 1 Indian)	Disease & injury	Communicable disease (Bacteria & Virus)	High (77.8)	During a 2-year study, 176 participants that tested positive for pulmonary tuberculosis at the Luyang Clinic in Kota Kinabalu were enrolled in the study. More than one-third of the patients (33.5%) were migrants. In addition, out of the three patients with a HIV co-infection, one was a migrant.
Siah et al <sup>71</sup>	Prevalence (Des-2)	N/A <sup>2</sup>	Asylum seekers & refugees	89 children (39.3% Myanmar, 21.3% Somali, 22.5% Sudanese, 16.9% Others <sup>2</sup> )	Disease & injury	Mental health (Quality of life)	Low (11.1)	A total of 89 refugee children were surveyed to investigate factors that influence their quality of life. Experiencing deportation, lower levels of education and unemployment of their fathers were significantly associated with a lower quality of life.
Guinto et al <sup>72</sup>	Scoping review <sup>10</sup>	2000 to 2014	Foreign workers	N/A	Institutional inequities	Laws & regulations (Universal Health Coverage)	N/A	The study presented implementation challenges of universal health coverage (UHC) in Southeast Asian countries. Malaysia implemented some measures regarding healthcare for migrant workers, however, government-run UHC is still lacking.
Vijian et al <sup>73</sup>	Analytical cross- sectional (Obs-4)	2010 to 2015	Foreign workers	50 people (8 Bangladeshi, 6 Nepalese, 3 Myanmar, 1 African, <sup>2,11</sup> 1 Pakistani, 1 Vietnamese, 14	Disease & injury	Non-communicable disease (Perforation)	Low (16.7)	Twenty foreign workers and 30 local patients that suffered from perforated peptic ulcers were compared to each other to assess the difference in characteristics between these two groups. Several characteristics were significantly different, where foreign workers were on average 18 years younger (mean age = 30.4),

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				Malays, 12 Chinese, 4 Indians)				suffered from smaller-sized ulcers, and experienced lower levels of post-operative complications.
Azian et al <sup>74</sup>	Prevalence (Des-2)	N/A <sup>2</sup>	Foreign workers	2,153 samples <sup>12</sup> (1,422 Bangladeshi, 349 Indians, 201 Nepalese, 78 Indonesians, 58 Vietnamese, 45 Myanmar)	Disease & injury	Communicable disease (Parasite)	Low (11.1)	A total of 2,153 blood samples were taken from migrant workers that were located in seven states of Peninsular Malaysia and were tested for leishmaniasis infection. More than half (55.3%) of the collected blood samples were found positive.
Sahimin et al <sup>75</sup>	Prevalence (Des-2)	September 2014 to August 2015	Foreign workers	388 people (167 Indonesians, 81 Nepalese, 70 Bangladeshi, 47 Indians, 23 Myanmar)	Disease & injury	Communicable disease (Parasite)	Low (33.3)	A cross-sectional study was conducted to examine the prevalence of different intestinal parasitic infections among foreign labour. Out of the 388 migrant workers, infection rates were between 52.1% and 84%. Higher infection rates significantly associated with migrants from Nepal and India, recently arrived in the country, and less than 1-year work experience in Malaysia.
Noh et al <sup>76</sup>	Prevalence (Des-2)	N/A <sup>2</sup>	Foreign workers	600 foreign workers <sup>2</sup>	Living conditions	Service environment (Healthcare utilisation)	Low (22.2)	Data of 600 foreign workers was obtained to explore their healthcare utilisation. Most of them utilise health services occasionally (88.5%) and the majority (61.4%) goes to government hospitals.
Kamaludin & How <sup>77</sup>	Analytical cross- sectional (Obs-4)	February 2016 to April 2016	Foreign workers	120 people <sup>2</sup> (60 foreign workers, 60 local workers)	Risk behaviour	Hazard & safety awareness (environmental risk)	Low (50.0)	The study compared environmental health awareness between 60 local workers and 60 migrant workers, where the latter group showed significant lower levels of awareness.

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1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	Min et al <sup>78</sup>	Prevalence (Des-3)	January 2011 to December 2013	Foreign workers	440 people (46 Indonesians, 37 Bangladeshi, 33 Nepalese, 17 Myanmar, 11 Pakistani, 8 Others, <sup>2</sup> 226 Malays, 32 Chinese, 20 Others, <sup>2</sup> 10 Indians)	Disease & injury	Injury (Physical trauma)	Moderate (62.5)	Medical records of the Hospital Sultan Ismail in Johor Bahru were reviewed between January 2011 and December 2013 to describe the prevalence of work-related ocular traumas. More than one-third of the ocular injuries were among foreign workers and contributed to two-third of the open eye traumas.
16 17 18 19 20 21 22 23 24 25 26 27 28 29	Woh et al <sup>79</sup>	Prevalence (Des-3)	N/A <sup>2</sup>	Foreign workers	317 people (140 Indians, 80 Nepalese, 36 Indonesians, 29 Bangladeshi, 18 Myanmar, 7 Pakistani, 4 Sri Lankans, 2 Vietnamese, 1 Thai)	Disease & injury	Communicable disease (Bacteria)	Low (44.4)	A cross-sectional study was conducted among 317 migrant food handlers from Ipoh, Kuala Terengganu, and Shah Alam to assess the Salmonella prevalence of this group, resulting in nine (2.8%) people testing positive. Seven out of these 9 cases presented multidrug resistance towards trimethoprim-sulfamethoxazole (6 cases), streptomycin (7 cases), ampicillin (4 cases), chloramphenicol (4 cases), sulphonamides (6 cases), and tetracycline (7 cases).
30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46	Tanabe et al <sup>80</sup>	Mixed-method <sup>10</sup>	N/A <sup>2</sup>	Asylum seekers & refugees	Participants per method <sup>9</sup> (422 Myanmar - survey; 66 Myanmar - focus group; 6 people <sup>2</sup> - interviews; 4	Living conditions	Service environment (Healthcare utilisation)	N/A	A multiple-country study was conducted to explore barriers regarding family planning services among refugees, where the main challenges included lack of understanding and misinformation concerning contraceptives, language barriers, financial issues, detention

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				facility assessments)				concerns, and distance of service delivery points.
Ratnalingam et al <sup>81</sup>	Prevalence (Des-2)	N/A <sup>2</sup>	Foreign workers	207 patients <sup>2</sup>	Disease & injury	Communicable disease (Bacteria)	Low (33.3)	A total of 207 patients from four different hospitals in Malaysia were enrolled in the study to describe the characteristics and risk factors of microbial keratitis. More than one-fourth of the cases were due to work-related traumas, where 34.2% of these cases were among male migrant workers.
Woh et al <sup>82</sup>	Prevalence (Des-2)	N/A <sup>2</sup>	Foreign workers	383 swab samples <sup>12</sup> (Indians, Nepalese, Indonesians, Bangladeshi, Myanmar, Pakistani, Sri Lankans, Thai, Vietnamese)	Risk behaviour	Hygiene & sanitation (Food preparation)	Low (22.2)	A total of 383 hand swabs were obtained from migrant food handlers to investigate the prevalence of aerobic plate counts (APC), Staphylococcus aureus, and Escherichia coli, resulting in 99.5%, 64.4%, and 20.8% testing positive, respectively. In general, levels of the first two exceeded the acceptable standard. Infection rates were significantly higher among food handles from India compared food handlers from Nepal. In addition, significant higher rates were found among cooks, followed by waiters, compared to managers.
Noor & Shaker <sup>83</sup>	Analytical cross-sectional (Obs-4) <sup>13</sup>	N/A <sup>2</sup>	Foreign workers	119 Indonesians	Disease & injury	Mental health (Stress)	High (85.7)	A sample of 119 migrant workers were examined to explore the relationship between psychological distress and workplace discrimination, and the effect of coping strategy on stress levels. The study showed that workplace discrimination increased levels of stress. In addition, problem-oriented coping

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								strategies were related to lower stress levels, while the emotional and avoidance coping strategy was associated to higher levels of stress.
Noordin et al <sup>84</sup>	Prevalence (Des-3)	September 2014 to August 2015	Foreign workers	484 foreign labour (246 Indonesians, 103 Nepalese, 69 Bangladeshi, 51 Indians, 14 Myanmar, 1 Vietnamese)	Disease & injury	Communicable disease (Parasite)	Low (33.3)	Lymphatic filariasis prevalence among foreign labour was determined by screening 484 migrant workers, showing that 6.8% and 2.1% suffered from bancroftian filariasis and brugian filariasis, respectively.
Sahimin et al <sup>85</sup>	Prevalence (Des-2)	September 2014 to August 2015	Foreign workers	484 people (247 Indonesians, 99 Nepalese, 72 Bangladeshi, 52 Indians, 14 Myanmar)	Disease & injury	Communicable disease (Parasite)	Low (44.4)	A total of 484 foreign workers were sampled to describe the prevalence of Toxoplasma gondii and factors related to higher infection rates. In total, 278 migrant workers (57.4%) tested positive for T gondii, where significant higher levels of infection were associated with Nepalese origin, newly arrived in Malaysia, and working in manufacturing.
Labao et al <sup>86</sup>	Prevalence (Des-3)	N/A <sup>2</sup>	Foreign workers	60 Filipinos	Disease & injury	Injury (Physical syndrome)	Moderate (55.6)	A cross-sectional study was conducted to investigate which body regions were presenting the most work-related musculoskeletal complaints among migrant workers. The major affected areas included the shoulder (60%), lower back (60%), upper back (48.3%), and neck (45%) regions.
Shaw et al <sup>87</sup>	Randomised controlled trial	N/A <sup>2</sup>	Asylum seekers & refugees	39 Afghans	Disease & injury	Mental health (Stress)	Low (30.8)	In order to assess the impact of cognitive behavioural therapy (CBT) on emotional distress, an 8-week intervention was conducted

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## Results

	(Exp-2)								among 39 female refugees. As a result, the intervention significantly lowered levels of posttraumatic stress, anxiety, emotional distress, and depression.
Rahman et al <sup>88</sup>	Case control (Obs-3)	N/A <sup>2</sup>	Unclassified migrants <sup>4</sup>	<i>61 people (52 Myanmar, 9 Others<sup>2</sup>)</i>	Risk behaviour	Poor nutrition (Nutrition deficiency)	Moderate (60.0)		A case control study was conducted to determine the factors that were related to bilateral leg swelling among detained irregular migrants. Out of the 226 inmates, 21 Myanmar were identified as cases and were compared to 41 controls from Myanmar, Indonesia, Nepal, and Vietnam. The study showed that the illness was caused due to a thiamine deficiency, as the patients lacked the consumption of meat. Intravenous and oral thiamine treatment was provided, and the patients responded well to it.
Sahimin et al <sup>89</sup>	Prevalence (Des-2)	September 2014 to August 2015	Foreign workers	<i>388 people (167 Indonesians, 81 Nepalese, 70 Bangladeshi, 47 Indians, 23 Myanmar)</i>	Disease & injury	Communicable disease (Parasite)	Low (44.4)		A sample of 388 foreign workers were examined to describe the prevalence of <i>Giardia duodenalis</i> and <i>Cryptosporidium parvum</i> , showing that 42 people (10.8%) and 12 people (3.1%) tested positive, respectively. Indonesian nationality, work in the manufacturing and service sector, and newly arrived in Malaysia were significantly associated with <i>G. duodenalis</i> , while <i>C. parvum</i> was only significantly associated with employment in the food industry.
Nwabichie et al <sup>90</sup>	Prevalence (Des-2)	N/A <sup>2</sup>	Unclassified migrants	<i>320 people<sup>2</sup> (50% Nigerians, 15% Ghanaians,</i>	Risk behaviour	Sexual behaviour (HPV knowledge)	High (77.8)		In total, 320 African female migrants were surveyed to investigate risk factors that are related to higher HPV risk behaviour. Only

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				35% Others [from Sudan, Tanzania, Kenya and South Africa]				27.2% of the sample obtained cervical cancer screening, where higher levels of screening were significantly associated with having knowledge regarding cervical cancer, being married, having a standard health care provider, and no perceived barriers when obtaining the check-up.
Jeffree et al <sup>91</sup>	Case control (Obs-3)	N/A <sup>2</sup>	Foreign workers	470 people <sup>2</sup>	Disease & injury	Communicable disease (Parasite)	Moderate (60.0)	A case-control study was conducted to determine the risk factors related to a malaria outbreak, where rubber tappers – including one migrant worker – presented a higher infection rate.
Zerguine et al <sup>92</sup>	Analytical cross-sectional (Obs-4)	June 2016 to September 2016	Foreign workers	323 people (155 Bangladeshi, 126 Indonesians, 25 Pakistani, 11 Nepalese, 6 Chinese)	Disease & injury	Injury (Physical trauma)	Moderate (57.1)	A total of 323 migrant workers were sampled to investigate the prevalence and causes of workplace injuries, and examine the relationship between these traumas and safety commitment variables. The study showed that 22.6% of the foreign workers suffered from a work-related injury, mostly due to falls from heights (31.5%), and that there was a significant association between various injuries and different safety commitment-related variables, such as safe equipment and safety training.
Ya'acob et al <sup>93</sup>	Randomised controlled Trial (Exp-2)	N/A <sup>2</sup>	Foreign workers	54 Indonesians	Disease & injury	Injury (Physical syndrome)	Low (38.5)	A workplace intervention was conducted to assess the effect of Kiken Yochi training on musculoskeletal symptoms among foreign workers, where the study showed that the intervention significantly decreased

## Results

								musculoskeletal symptoms in feet and ankle areas compared to the control group.
Chuah et al <sup>9</sup>	Qualitative (Qual-2)	July 2016 to November 2017	Asylum seekers & refugees	20 stakeholders <sup>14</sup>	Living conditions	Service environment (Healthcare utilisation)	High (80.0)	Twenty stakeholders were interviewed to explore the barriers that refugees and asylum seekers encounter during healthcare utilisation, showing that cultural competency, insufficient health literacy, healthcare expenses, and not being aware of their rights were the main challenges.
Loganathan et al <sup>94</sup>	Qualitative (Qual-2)	July 2018 to September 2018	Foreign workers	18 stakeholders <sup>14</sup>	Living conditions	Service environment (Healthcare utilisation)	High (80.0)	A qualitative study with 18 stakeholders demonstrated that migrant workers face several complications with respect to utilising healthcare, including financial issues, discrimination, lack of valid passports and work permits, cultural competency, and physical barriers.
Rahman et al <sup>95</sup>	Prevalence (Des-3)	N/A <sup>2</sup>	Foreign workers	314 Bangladeshi	Living conditions	Service environment (Healthcare utilisation) Disease & injury Various diseases (various diseases)	Low (33.3)	A group of 314 migrant workers were sampled to present the distribution of diseases and healthcare utilisation pattern. Fever and sprains were the most reported diseases among the group that suffered from an illness in the last two weeks, while fever and gastrointestinal diseases were the most prevalent among the group that suffered from an illness in the last month. In addition, the majority (approx. 60%) visited hospitals to seek treatment.
Siah et al <sup>96</sup>	Qualitative (Qual-3)	N/A <sup>2</sup>	Asylum seekers & refugees	8 stakeholders	Living conditions	Social environment (Prejudice)	Low (50.0)	Eight people stakeholders were interviewed to explore the forms of discrimination that refugee

Results

				(5 refugees, <sup>2</sup> 3 locals)				children experience. The study shows that refugee children suffer from denied access to health care, not receiving proper education, and being judged by their social environment.
Sahimin et al <sup>97</sup>	Prevalence (Des-2)	September 2014 and August 2015	Foreign workers	<i>610 people (246 Indonesians, 99 Nepalese, 72 Bangladeshi, 14 Indians, 14 Myanmar)</i>	Disease & injury	Communicable disease (Parasite)	Low (33.3)	Four different diagnostic tests were applied to identify <i>Strongyloides stercoralis</i> among migrant workers, where prevalence rates differed between 0.8% and 35.8%
Chuah et al <sup>98</sup>	Qualitative (Qual-2)	July 2016 to January 2018	Asylum seekers & refugees	20 stakeholders <sup>14</sup>	Living conditions	Service environment (Healthcare utilisation)	High (80.0)	Twenty stakeholders were interviewed to identify the challenges with respect to accessing healthcare among refugees, showing that out of pocket healthcare spending, language and cultural competency barriers, and access to medication are the top healthcare challenges.

\*Sample population in *italic* represents the migrant population;

\*\*The following abbreviations are used in the table: N/A = Data not available; HPV = Human Papilloma Virus

<sup>1</sup>Includes irregular migrants.

<sup>2</sup>Data to present detailed information is lacking.

<sup>3</sup>Includes children of migrant workers, which is according to the IOM (2011) definition still classified as migrant workers

<sup>4</sup>Includes detained migrants.

<sup>5</sup>Includes refugees, international students, expats, and unclassified migrants.

<sup>6</sup>Includes 3 expats; <sup>7</sup>Includes 6 transnational marriage migrants.

<sup>8</sup>Ambiguous reporting of the data.

<sup>9</sup>Includes a multiple-country study, and, therefore, subjects that were included in countries other than Malaysia are not reported in this table.

<sup>10</sup>Level of evidence and quality appraisal is not available for this study design.

<sup>11</sup>Includes an international student.

<sup>12</sup>Number of samples might not be similar to the number of study participants.

<sup>13</sup>Despite of lacking a comparison group, this study was identified as an analytical cross-sectional study due to the aim – testing two hypotheses – and comprehensive statistical analysis.

<sup>14</sup>Representing the population of interest (as shown in the ‘type of migrant’ category).

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## Results

**359 Health dimension and type of migrant**

360 The literature was first assessed to understand the trends and topical coverage of research  
361 against the six dimensions of the BARHII public health framework. The first dimension,  
362 social inequities, was used to describe the population of interest and refers to the type of  
363 migrant (e.g., foreign workers, asylum seekers and refugees, or unclassified migrants). The  
364 other five dimensions focused on elements that influence the health status of the population  
365 of interest, including institutional inequities, living conditions, risk behaviour, disease and  
366 injury, and mortality and morbidity. These latter five categories are outlined below and  
367 include results on the types of migrants researched within these dimensions. Figures 4 and 5  
368 present overviews of the number of studies disaggregated by health dimension and type of  
369 migrant, respectively.

370

371 [INSERT FIGURE 4]

372

373 [INSERT FIGURE 5]

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**375 Institutional inequities**

376 One paper addressed the institutional inequities dimension<sup>72</sup> by exploring the inclusion of  
377 migrant workers into national universal health coverage (UHC) policies in five countries of  
378 the Association of Southeast Asian Nations (ASEAN): Indonesia, Philippines, Malaysia,  
379 Thailand and Singapore. The researchers stated that Malaysia has implemented a medical  
380 insurance policy for foreign labour by obligating documented migrant workers to be enrolled  
381 in private insurance schemes, as non-citizens have no access to UHC at public facilities.

## Results

382 ***Living conditions***

383 Eleven papers were classified under the living conditions dimension, where most articles  
384 (n=9/11) addressed the service environment subdimension.<sup>9 36 63 64 76 80 94 95 98</sup> All of these  
385 papers studied the asylum seeker and refugee population, except for one article that focused  
386 on migrant workers.<sup>94</sup> Half the studies used qualitative methods to explore barriers to  
387 healthcare utilisation and showed that language difficulties, discrimination, insufficient health  
388 literacy, and cultural differences were common issues. One study focused on the social  
389 environment subdimension and showed that refugee children experienced discrimination by  
390 locals and other refugees of different ethnicities and national origins, such as stereotyping  
391 them as criminals.<sup>96</sup> Santos et al<sup>69</sup> assessed elements related to the work environment  
392 subdimension by investigating perceived environmental hazards among foreign workers,  
393 demonstrating that noise and dust were perceived as the greatest occupational health threats.

394 ***Risk behaviour***

395 Ten studies researched the risk behaviour dimension, with most articles (n=8/10) conducted  
396 on general migrant populations without clear identification of which migrant categories were  
397 included in their study.<sup>35 38 41 61 62 67 88 90</sup> Three of these articles focused on the sexual  
398 behaviour subdimension, exploring risk behaviour related to human papillomavirus (HPV).  
399 The studies showed that a significant number of migrant women have high HPV risk  
400 behaviour due to lack of understanding with respect to cervical cancer, the screening process,  
401 and poor knowledge concerning HPV vaccination.<sup>61 62 90</sup> Two papers, classified within the  
402 poor nutrition subdimension, showed poor health outcomes among detained migrants due to  
403 nutrition deficiencies.<sup>38 88</sup> The other articles among unclassified migrants included two  
404 studies on violence and abuse, exploring maternal filicide<sup>67</sup> and neglecting children<sup>35</sup>; and  
405 one study on alcohol and other drugs, pertaining to inhalants' usage.<sup>41</sup> These three studies

## Results

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3 406 simply showed that migrants represent a certain proportion of the identified cases. Only the  
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5 407 study on the use of inhalants presented more cases among migrants than locals. Two final  
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7 408 studies included foreign workers and explored the hygiene and sanitation and hazard and  
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9 409 safety awareness subdimensions.<sup>77 82</sup> Kamaludin & How<sup>77</sup> stated that migrant workers had  
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11 410 significantly less knowledge regarding environmental health, such as air quality, natural  
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13 411 hazards, sanitation, and industrial hazards, compared to local workers. Woh et al<sup>82</sup>  
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15 412 investigated the level of hygiene among migrant food handlers and argued that personal  
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17 413 hygiene and sanitation measures should be improved among this population.  
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414 ***Disease and injury***

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26 415 With a total of 46 studies, the disease and injury dimension presented the largest study field  
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28 416 of interest related to the BARHII framework. Most articles (n=36/46) studied foreign  
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30 417 workers,<sup>37 40 43 44 46-56 58-60 66 69 73-75 78 79 81 83-86 89 91-93 95 97</sup> while only six and four articles  
31  
32 418 included unclassified migrants<sup>39 45 57 65 68 70</sup> and refugee populations,<sup>33 34 71 87</sup> respectively. The  
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34 419 majority (n=27/46) of the articles studied communicable diseases, where 18 of these studies  
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36 420 focused on parasites,<sup>34 37 39 43 44 48-52 59 74 75 84 85 89 91 97</sup> eight on bacteria,<sup>45 47 60 65 68 70 79 81</sup> and  
37  
38 421 two on viruses.<sup>55 70</sup> Most of the studies were descriptive and presented that migrants,  
39  
40 422 irrespective of the defined type, represented a significant share among the study populations.  
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42 423 Non-communicable diseases were studied far less compared to communicable diseases and  
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44 424 were only specifically addressed in three articles.<sup>33 53 73</sup> Scheutz et al<sup>33</sup> found high numbers of  
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46 425 different non-communicable oral complications among Vietnamese refugees, such as tooth  
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48 426 decay and missing teeth. Vijian et al<sup>73</sup> compared the difference in characteristics between  
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50 427 foreign workers and Malaysian patients with perforated peptic ulcers, showing that the  
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52 428 treated foreign labour population were younger, experienced fewer post-operative  
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## Results

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3 429 complications, and had smaller-sized ulcers compared to locals. Murty<sup>53</sup> reported a case  
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5 430 study, presenting a deceased migrant worker due to a cystic tumour in the heart region.  
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9 431 In addition to the studies that focused on single disease outcomes, two studies were  
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11 432 conducted that presented distributions of various diseases among foreign workers, including  
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13 433 communicable and non-communicable disorders.<sup>46 95</sup> Five studies focused on the mental  
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15 434 health subdimension, where these studies concentrated on describing psychiatric disorders,<sup>40</sup>  
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17 435 determining quality of life-related risk factors,<sup>57 71</sup> and testing the effect of different coping  
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19 436 mechanisms and therapy sessions on the level of stress.<sup>83 87</sup> Nine studies explored the injury  
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21 437 subdimension, where nearly all (n=8/9) studies focused on work-related injuries. Most of  
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23 438 these studies examined the prevalence of particular injuries and traumas, including fatal  
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25 439 lightning strikes,<sup>54</sup> ocular traumas,<sup>78</sup> and musculoskeletal pain.<sup>66 69 86</sup> Ratnasingam et al<sup>58</sup>  
26  
27 440 compared the number of occupational incidents between local workers and migrant workers,  
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29 441 where foreign workers had less accidents. In addition, two papers described risk factors for  
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31 442 work-related injuries, such as high machine-related vibration exposure<sup>56</sup> and low levels of the  
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33 443 company's safety commitment (as assessed by foreign workers themselves).<sup>92</sup> Ya'acob et al<sup>93</sup>  
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35 444 conducted an RCT to evaluate the impact of a specific workplace intervention on  
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37 445 musculoskeletal symptoms (MMS) among foreign labour and showed that the intervention  
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39 446 reduced musculoskeletal symptoms in the foot and ankle regions significantly compared to  
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41 447 the control group.

#### 448 ***Mortality and morbidity***

449 Two papers addressed the mortality and morbidity dimension by showing incidence rates  
450 among general cohorts of migrants. Zulkifli et al<sup>36</sup> conducted a study on maternal and child  
451 health in Sabah and identified that infant mortality rates were significantly higher for  
452 migrants compared to locals. Dony et al<sup>42</sup> also conducted a study in Sabah and showed that at

## Results

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3 453 least 24% of new tuberculosis cases detected since 1990 were among migrants and that  
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5 454 leprosy incidence rates among migrants were on average 3.7 times higher than incidence rates  
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8 455 among Malaysians.  
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11 456 **Level of evidence and quality of the study**  
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15 457 In total, 65 articles were included in the quality assessment; Tables 6 and 7 show the mean  
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17 458 quality scores of the papers disaggregated by BARHII dimension and level of evidence,  
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19 459 respectively. Two articles – representing a scoping review<sup>72</sup> and mixed-method design<sup>80</sup> –  
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21 460 were excluded from this assessment, as the JBI toolkit does not accommodate these study  
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24 461 designs. The quality assessment scores can be found in Supplementary file 3. In addition,  
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26 462 Figure 6 shows an overview of the number of studies disaggregated by research design.  
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Results

**Table 6 | Number and average quality of included articles disaggregated by type of migrant and BARHII dimensions**

Category	Number of studies per study design with level of evidence									Total # studies	Mean quality	References
	CR-4	AC-4	QL-3	CS-3	PR-3	CC-3	QL-2	PR-2	RC-2			
<i>Type of migrant</i>												
Asylum seekers & refugees	-	1	1	-	1	-	3	2	1	10 <sup>1</sup>	4.4%	9 33 34 63 64 71 80 87 96 98
Foreign workers	4	7	-	4	10	1	1	12	1	41 <sup>2</sup>	4.7%	37 40 43 44 46-56 58-60 66 69 72-79 81-86 89 91-95 97
Unclassified migrants	-	1	-	6	2	2	-	5	-	16	5.7%	35 36 38 39 41 42 45 57 61 62 65 67 68 70 88 90
<i>Dimension of BARHII framework</i>												
Institutional inequities	-	-	-	-	-	-	-	-	-	1 <sup>2</sup>	-	72
Living conditions	-	2	1	-	1	-	4	2	-	11 <sup>1</sup>	4.7%	9 36 63 64 69 76 80 94-96 98
Risk behaviour	-	1	-	3	1	1	-	4	-	10	4.7%	35 38 41 61 62 67 77 82 88 90
Disease & injury	4	6	-	7	11	2	-	14	2	46	4.3%	33 34 37 39 40 43-60 65 66 68-71 73-75 78 79 81 83-87
Mortality & morbidity	-	1	-	-	1	-	-	-	-	2	4.9%	89 91-93 95 97
<i>Subdimensions of institutional inequities</i>												
Laws & regulations	-	-	-	-	-	-	-	-	-	1 <sup>2</sup>	-	72
<i>Subdimensions of living conditions</i>												
Social environment	-	-	1	-	-	-	-	-	-	1	5.0%	96
Economic and work environment	-	-	-	-	-	-	-	1	-	1	4.4%	69
Service environment	-	2	-	-	1	-	4	1	-	9 <sup>1</sup>	5.8%	9 36 63 64 76 80 94 95 98
<i>Subdimensions of risk behaviour</i>												
Poor nutrition	-	-	-	1	-	1	-	-	-	2	5.0%	38 88
Violence & abuse	-	-	-	2	-	-	-	-	-	2	5.0%	35 67
Alcohol & other drugs	-	-	-	-	-	-	-	1	-	1	4.2%	41
Sexual behaviour	-	-	-	-	1	-	-	2	-	3	4.9%	61 62 90
Hygiene & sanitation	-	-	-	-	-	-	-	1	-	1	4.2%	82
Hazard & safety awareness	-	1	-	-	-	-	-	-	-	1	5.0%	77

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Results

<i>Subdimensions of disease &amp; injury</i>												
Communicable disease	3	2	-	6	4	2	-	10	-	27	42%	34 37 39 43-45 47-52 55 59 60 65 68 70 74 75 79 81 84
Non-communicable disease	1	1	-	-	1	-	-	-	-	3	5%	85 89 91 97
Injury	-	2	-	1	3	-	-	2	1	9	14%	33 53 73
Mental health	-	1	-	-	1	-	-	2	1	5	8%	54 56 58 66 69 78 86 92 93
Various diseases	-	-	-	-	2	-	-	-	-	2	3%	40 57 71 83 87
												46 95
<i>Subdimensions of mortality &amp; morbidity</i>												
Mortality rates	-	1	-	-	-	-	-	-	-	1	3%	36
Morbidity rates	-	-	-	-	1	-	-	-	-	1	5%	42
<b>Total</b>	<b>4</b>	<b>9</b>	<b>1</b>	<b>10</b>	<b>13</b>	<b>3</b>	<b>4</b>	<b>19</b>	<b>2</b>	<b>67<sup>1,2</sup></b>	<b>42%</b>	<b>9 33-98</b>

463 \*Abbreviations for the type of study with the related level of evidence (the number after the dash) are used to describe the included studies: CR-4 = case report; AC-4 = analytical cross-sectional  
 464 study; QL-3 = qualitative study with less rigour; CS-3 = case series; PR-3 = prevalence study without analytical component; CC-3 = case control; QL-2 = qualitative study with more rigor; PR-2  
 465 = prevalence study with analytical component; RC-2 = randomised controlled trial.  
 466 \*\*Level of evidence ranks from 1 to 4, where 1 is the highest level of evidence and 4 is the lowest level.  
 467 <sup>1</sup>Includes a mixed-method design, which was not appraised for level of evidence nor quality of the study;  
 468 <sup>2</sup>Includes a scoping review design, which was not appraised for level of evidence nor quality of the study.

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Results

**Table 7 | Number and average quality of included articles disaggregated by research design category**

Research design	Level of evidence	Included studies	Mean quality	References
<i>Descriptive research</i>				
Systematic review of descriptive studies	1	-	-	-
Prevalence study with analytical component	2	19	39.7%	34 41 47 55 57 58 62 69-70 74-76 81 82 85 89 90 97
Case series	3	10	46.7%	35 38 39 45 48 51 54 60 63 67
Prevalence study without analytical component	3	13	49.8%	33 37 40 42 44 46 61 66 78 79 84 86 95
Case report	4	4	81.5%	43 49 53 59
<b>Total</b>		<b>46</b>	<b>47.7%</b>	33-35 37-49 51 53-55 57-60 65-67 69-71 74-76 78 79 81 82 84-86 89 90 95 97
<i>Experimental research</i>				
Systematic review/meta-analysis of experimental studies	1	-	-	-
Randomised controlled trial	2	2	34.7%	87 93
Group quasi-experimental study (non-randomised)	3	-	-	-
Quasi-experimental study with single subject	4	-	-	-
<b>Total</b>		<b>2</b>	<b>34.7%</b>	87 93
<i>Observational research</i>				
Systematic review/meta-analysis of observational studies	1	-	-	-
Cohort study	2	-	-	-
Case-control	3	3	56.7%	68 88 91
Analytical cross-sectional study	4	9	42.6%	36 50 52 56 64 73 77 83 92
<b>Total</b>		<b>12</b>	<b>46.1%</b>	36 50 52 56 64 68 73 77 83 88 91 92
<i>Qualitative research</i>				
Systematic review/meta-synthesis of qualitative studies	1	-	-	-
Group qualitative studies with more rigor	2	4	82.5%	9 63 94 98
Group qualitative studies with less rigor	3	1	50.0%	96
Qualitative study with a single informant	4	-	-	-
<b>Total</b>		<b>5</b>	<b>76.0%</b>	9 63 94 96 98
<b>Total</b>		<b>67<sup>1</sup></b>	<b>49.2%</b>	9 33-98

<sup>1</sup>Includes a mixed-method design and a scoping review, which were both not assessed for the level of evidence nor quality appraisal.

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## Results

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10 472 In general, the quality of the evidence base on migrant health in Malaysia is low (49.2%) and  
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12 473 consists mostly of level 3 evidence papers (n=27/65). Level 2 evidence represents 38.5% of  
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14 474 the evidence base (n=25/65), followed by level 4 evidence papers (n=13/65). No level 1  
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16 475 evidence studies (systematic reviews or meta-analyses) were identified. The majority of the  
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18 476 papers (n=41/65) focused on foreign workers, however, studies that included asylum seekers  
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20 477 and refugees have the highest mean quality (58.4%). Furthermore, only four out of five  
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22 478 BARHII health dimensions were included in the quality assessment. The living conditions  
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24 479 dimension has the highest average score (59.7%), followed by the risk behaviour dimension  
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26 480 (48.7%), mortality and morbidity dimension (47.9%), and the disease and injury dimension  
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28 481 (46.3%). Moreover, the descriptive research category represents the majority (70.8%) of the  
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30 482 evidence base with a mean quality of 47.7%. The qualitative research category has the  
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32 483 highest mean quality and is the only research category with a high-quality score (76%).  
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39 484 **Associations between different variables**  
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42 485 Figure 7 presents the results of the multiple-correspondence analysis (MCA), showing  
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44 486 different associations between four dimensions: 1) type of study design; 2) quality of the  
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46 487 study; 3) type of migrant; and 4) main health dimension. Chi-square test results were utilised  
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48 488 to assess whether categorical variables were independent.  
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56 490 [INSERT FIGURE 7]  
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## Results

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3 492 High-quality studies tend to include refugees and asylum seekers ( $X^2 = 17.005$ ,  $df = 4$ , p-  
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5 493 value = 0.001928), focus on living conditions ( $X^2 = 131.94$ ,  $df = 6$ , p-value =  $< 2.2e-16$ ), and  
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7 494 have a qualitative research design ( $X^2 = 656.35$ ,  $df = 12$ , p-value =  $< 2.2e-16$ ). Moreover,  
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9 495 studies that included foreign workers tend to focus on diseases and injuries ( $X^2 = 374.52$ ,  $df =$   
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11 496 6, p-value =  $< 2.2e-16$ ) and contain a case report study design ( $X^2 = 576.87$ ,  $df = 12$ , p-value  
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13 497 =  $< 2.2e-16$ ). Furthermore, research that included the unclassified migrant population tend to  
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15 498 study the risk behaviour, and mortality and morbidity dimensions ( $X^2 = 374.52$ ,  $df = 6$ , p-  
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17 499 value =  $< 2.2e-16$ ). Lastly, prevalence studies, and, to a lesser extent, analytical cross-  
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19 500 sectional studies, tend to have a low-quality score ( $X^2 = 656.35$ ,  $df = 12$ , p-value =  $< 2.2e-$   
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Conclusion

## 502 Discussion

### 503 Key findings

504 This study mapped the existing academic literature on migrant health in Malaysia and  
 505 assessed the quality and level of evidence of these scientific studies. The majority of these  
 506 studies focus on the ‘disease and injury’ dimension, especially infectious diseases, and  
 507 includes mostly foreign workers. Two health dimensions (institutional inequality, and  
 508 morbidity and mortality) as well as various subdimensions of each health dimension, are  
 509 lacking substantial research. In addition, only a few papers include the asylum seeker and  
 510 refugee population, and a vast amount do not provide any details to classify the type of  
 511 migrant. The average quality of the papers was low, yet quality differed significantly among  
 512 the studies. High-quality studies were mostly qualitative designs that included refugees and  
 513 focused on living conditions, while prevalence and analytical cross-sectional studies were  
 514 mostly low quality. In terms of research trends, no specific changes in type of migrant, health  
 515 dimension or quality of the study have been observed over the last six decades. However, it  
 516 should be noted that qualitative research made its entry in the early 2010s and made up a vast  
 517 amount of the papers published in recent years. Future research priorities based on the  
 518 existing evidence and identified gaps are summarised in Table 8.

**Table 8 | Main recommendations to improve future research on migrant health**

Recommendation
Improve the description of the target migrant population by including information regarding the type of migrant (e.g., foreign worker, refugee), visa status (e.g., regular, irregular), country of origin, socioeconomic variables (e.g., level of education, income), mode of transport during migration journey (e.g., boat, car), and the existence of forced entry (e.g., human trafficking, forced marriage).
Create associations between different stages of migration (pre-departure, travel, destination, interception, and return phase) and health outcomes.
More research output concerning governance and institutional inequities and mortality and morbidity, and, consequently, conduct a time series analysis between these two dimensions to identify and possible relationships.
More research output regarding non-communicable diseases, especially on the main causes of death in Malaysia; cardiovascular diseases, chronic respiratory diseases, and diabetes.

## Conclusion

More research output concerning several subdimension of risk behaviour, especially on smoking, physical inactivity, and alcohol abuse.
Evaluate the impact of health and non-health policies on migrant health.
Explore living conditions regarding the physical environment, such as housing and environmental conditions, and the impact on migrant health outcomes.
Promotion of guidelines on study conduct and reporting among researchers.

519

520 Among the five BARHII health dimensions, institutional inequities, and mortality and  
 521 morbidity were the least represented. Yet, studies concerning the influence of governance on  
 522 migrant health are of utmost importance, as overarching governance can affect health  
 523 outcomes of the other BARHII dimensions.<sup>99 100</sup> Similarly, epidemiological research on  
 524 mortality and morbidity rates are necessary for population health statistics, to identify disease  
 525 patterns, document changes over time, and inform plans of action to tackle these health  
 526 issues.<sup>101</sup> Further research should focus on migrant health governance, as well as  
 527 epidemiological research on morbidity and mortality among both migrants and non-migrants,  
 528 to better understand the effects of policies on migrant health, which is particularly relevant in  
 529 low- and middle-income countries (LMICs) where the evidence gap is so acute.<sup>102</sup>  
 530 Furthermore, a recent systematic review on the effects of non-health-targeted policies on  
 531 migrant health in high-income countries showed that non-health policies (e.g., restrictive  
 532 immigration policies) were associated with poor health outcomes.<sup>103</sup> It is therefore important  
 533 that policies in other sectors (potentially including, e.g., immigration, labour, education) are  
 534 also assessed for their potential consequences for migrant health.

535 Living conditions were represented in eleven studies and focused mainly (n=9/11) on the  
 536 service environment by addressing the healthcare setting. However, there is scarce  
 537 information on the social and economic environments that different categories of migrants  
 538 must navigate and no data on the physical environment at all. Research conducted in other  
 539 countries demonstrates the importance of these three subdimensions on migrant health.<sup>104-106</sup>

## Conclusion

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3 540 Shao et al<sup>104</sup> argued that inequalities regarding the level of income (economic environment)  
4  
5 541 influenced health outcomes among internal migrant workers in China. He & Wong<sup>105</sup> stated  
6  
7 542 that poor mental health among female migrant workers in China was related to gender-  
8  
9 543 specific stressors (social environment). Al-Khatib et al<sup>106</sup> demonstrated that poor housing  
10  
11 544 conditions (physical environment) in a refugee camp were directly associated with various  
12  
13 545 upper respiratory tract diseases. These studies underscore the importance of different  
14  
15 546 environments on migrant health, motivating a focus of future research on the health impact of  
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17 547 living conditions other than healthcare utilisation.  
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23 548 Ten studies were conducted on risk behaviour with different subdimensions, from hygiene  
24  
25 549 and sanitation to violent and abusive behaviour. However, all of these subdimensions were  
26  
27 550 under-researched, as only limited elements of each subdimension were discussed. For  
28  
29 551 instance, three studies focused on sexual behaviour by addressing HPV knowledge.<sup>61 62 90</sup>  
30  
31 552 Yet, no attention was given to other sexual behaviour-related topics, such as condom use,  
32  
33 553 HIV knowledge, and birth control. Although these studies have been conducted in Malaysia,  
34  
35 554 this research is lacking in the migration context.<sup>107-109</sup> Therefore, future research should focus  
36  
37 555 on broader aspects of each subdimension, as demonstrated in research elsewhere. For  
38  
39 556 example, Renzaho & Burns<sup>110</sup> addressed the poor nutrition subdimension by showing that  
40  
41 557 dietary patterns among African migrants changed negatively after arriving in Australia due to  
42  
43 558 the increased intake of fast food and processed food. Ganle et al<sup>111</sup> concentrated on the sexual  
44  
45 559 risk behaviour subdimension and stated that 71% of the sampled refugees in Ghana had  
46  
47 560 transactional sex, and only 12% used contraceptives. Bosdriesz et al<sup>112</sup> compared smoking  
48  
49 561 between migrants and non-migrants in the United States (US) and showed that migrants  
50  
51 562 smoked less than US citizens. As a significant number of migrants in Malaysia come from  
52  
53 563 Indonesia, a population that smokes almost twice as much as Malaysians, smoking behaviour  
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55 564 among this migrant group may differ from locals.<sup>113</sup> Therefore, future research should further  
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## Conclusion

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3 565 explore the differences in other risk behaviours, such as smoking, between Malaysians and  
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5 566 migrants in Malaysia.

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9 567 Disease and injury was the most researched dimension, representing more than two-thirds of  
10  
11 568 the evidence base on migrant health in Malaysia. Despite the strong representation, over half  
12  
13 569 the research papers concentrated on communicable diseases, while only a few examined non-  
14  
15 570 communicable diseases, consistent with global research output on international migrant  
16  
17 571 workers.<sup>114</sup> As the World Health Organization (WHO)<sup>115</sup> states that approximately 74% of all  
18  
19 572 deaths in Malaysia are attributable to non-communicable disease, in particular cardiovascular  
20  
21 573 disease, chronic respiratory disease, and diabetes, there is a need to expand research on non-  
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23 574 communicable disease trends and outcomes among the migrant population in Malaysia.

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28 575 We found that the majority of studies involved foreign workers (n=41/67), and only ten  
29  
30 576 studies examined asylum seekers and refugees as the primary population of interest. Our  
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32 577 findings, therefore, offer useful synthesis on migrant worker's health specifically, which is  
33  
34 578 lacking relative to studies on asylum seekers and refugees in global migration health  
35  
36 579 research.<sup>14</sup> Furthermore, eleven studies did not specify the included migrant population. This  
37  
38 580 issue could have occurred due to missing information on the type of migrant in the dataset  
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40 581 that the researchers used for their studies. For example, the Ministry of Health (MOH) will  
41  
42 582 not report anything more detailed than 'non-Malaysian,' as no further information on non-  
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44 583 citizens are collected during patient registration at MOH facilities. Ideally, all research on  
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46 584 migrants should clearly specify the type of migrants being studied and not omit crucial  
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48 585 details, such as gender, visa status, and country of origin. Also, human trafficking could  
49  
50 586 significantly affect a person's health and vulnerability, yet, there is very little known about  
51  
52 587 the health issues experienced by trafficked persons in Malaysia.<sup>116</sup> While the vulnerabilities  
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54 588 experienced by trafficked persons intersect with other migration-related vulnerabilities like  
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## Conclusion

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3 589 gender, ethnicity or documentation status, victims of human trafficking should be categorised  
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5 590 separately, to reflect their own unique status and vulnerability. The travel routes or modes of  
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7 591 transportation used by migrants to come to Malaysia may influence migrant health in  
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9  
10 592 different ways as well, as different routes or modes of transportation may be linked with  
11  
12 593 specific hazards. Related to this issue is the lack of evidence on migrant health with specific  
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14 594 stages of migration, including pre-departure, travel, destination interception, and return,  
15  
16 595 where health outcomes might differ between these stages.<sup>117</sup>  
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20 596 Lastly, this scoping review revealed that the average quality of studies on migrant health in  
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22 597 Malaysia is poor (49.2%) and that most of these studies have level 3 (n=27/65) or level 2  
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24 598 (n=25/65) evidence. Only qualitative studies with more rigour (level 2 evidence) and those  
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26 599 that focus on living conditions and include the refugee and asylum seeker populations, tend to  
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28 600 have a high-quality score. Therefore, there is a clear need to conduct research that will  
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30 601 provide strong evidence to support practices and policies that will positively impact migrant  
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32 602 health. Creating standard research design-specific guidelines, if not existing already, and,  
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34 603 subsequently, promoting these materials among academics and research institutions, could  
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36 604 increase the quality of future research work. Furthermore, researchers should follow study  
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38 605 design specific reporting guidelines, to ensure that all relevant information is captured in  
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40 606 publications for further evidence synthesis, such as this review.  
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**607 Limitations**

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50 608 This study is the first systematic literature synthesis and scoping review on migrant health in  
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52 609 Malaysia and presents a comprehensive overview of all identified peer-reviewed articles that  
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54 610 met the inclusion criteria. Specific recommendations based on this research are provided to  
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56 611 improve the evidence base on migrant health in Malaysia. Furthermore, we utilised a self-  
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58 612 developed decision tree and modified JBI checklists to help identify the type of study design  
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## Conclusion

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3 613 and corresponding level of evidence of the included studies. We found this evidence  
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5 614 assessment framework to be useful for the quality assessment of migrant health-related  
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7 615 studies, and it might be useful for other research fields as well. Yet, our review has several  
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9 616 limitations. As this paper focuses exclusively on vulnerable migrants within the non-citizen  
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11 617 population in Malaysia, we excluded other non-citizen groups, such as expatriates and  
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13 618 international students, based on the assumption that these groups are less vulnerable (e.g.,  
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15 619 expatriates in Malaysia have more privileges in terms of recognition regarding their roles in  
16  
17 620 society, receive better financial compensation, and tend to have access to many other benefits  
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19 621 compared to foreign workers). However, we acknowledge that other non-citizen groups may  
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21 622 face challenges in obtaining proper healthcare in Malaysia as well, such as issues related to  
22  
23 623 cultural competency among foreign students and retirees.<sup>118 119</sup> In addition, papers including  
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25 624 non-citizens without further description were excluded, although these studies may have  
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27 625 included the vulnerable migrant population.

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34 626 Only academic peer-reviewed studies were included, thus excluding grey literature,  
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36 627 editorials, and opinion papers. Also, only English language articles were included, resulting  
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38 628 in the exclusion of one identified paper in Bahasa Malaysia (the Malay language).<sup>120</sup>  
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40 629 Aggravating the issue, other Malaysian articles might not have been identified due to the lack  
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42 630 of Malaysian keywords in the search strategy. As a result, much relevant information that  
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44 631 could potentially be used to inform both policies and practice, as well as to make this review  
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46 632 more comprehensive, may have been excluded from this review.

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51 633 Inter-rater reliability was limited to a 20% sample of the records in the first (abstract and title)  
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53 634 screening stage, and no data extraction nor quality assessment was verified by a second  
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55 635 reviewer due to time and resource constraints. Yet, we anticipate low selection bias as the  
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57 636 health dimensions in the BARHII framework present clear distinctions between each other,  
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## Conclusion

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3 637 and most of the included papers used objective indicators. For example, when a paper was  
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5 638 measuring the knowledge and awareness regarding the pap smear test among female  
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7 639 migrants, it would be classified as a 'risk behaviour' study. Furthermore, we believe that the  
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9 640 development of the decision tree and additional objective criteria for the JBI tools – an  
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11 641 example was given earlier in Table 4 – reduced the subjectivity of this study, and, hence,  
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13 642 increases the reliability. Yet, future research is needed to validate both the decision tree and  
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15 643 modified JBI toolkit.

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20 644 Besides the BARHII framework, various conceptual public health models are available, and  
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22 645 these models may include different (sub)dimensions. For instance, the WHO Commission on  
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24 646 Social Determinants of Health (CSDH) framework includes material circumstances, such as  
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26 647 food availability, whereas this dimension is not included in the BARHII framework.<sup>121</sup>  
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29 648 Similarly, critical appraisal tools other than the JBI toolkit are available, which could address  
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31 649 different points to determine the quality of the study. Therefore, it would be helpful to assess  
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33 650 other public health models and critical appraisal tools to see if they include additional  
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35 651 elements (e.g., food availability) that would be beneficial for future studies.

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40 652 Likewise, a decision tree was developed by using the characteristics of the used definitions of  
41  
42 653 different research designs as well as the specific traits of Tomlin & Borgetto's<sup>29</sup> level of  
43  
44 654 evidence model. Using other definitions and level of evidence models could result in a  
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46 655 different level of evidence categorisation. However, we believe this review makes a strong  
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48 656 methodological contribution by combining study designs and level of evidence in a unified  
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50 657 decision tree, which can be used by researchers conducting systematic or scoping reviews  
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52 658 where accurate classification of the study design and associated evidence level, is important.

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57 659 In order to conduct the multiple-correspondence analysis (MCA), the dataset could only  
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59 660 include one unit per dimension for each paper. As some studies included multiple BARHII

## Conclusion

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2  
3 661 dimensions, only the most prominent dimension was included in the analysis. As a result, the  
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5 662 analysis may suffer from some selection bias and present slightly different outcomes  
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7 663 compared to an analysis that includes the other BARHII dimensions.  
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11 664 Lastly, no adjustments were made for outliers in the quality assessment. Therefore, some  
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13 665 papers with extremely high or low scores could have influenced specific dimensions and  
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15 666 might not reflect the quality of those dimensions perfectly.  
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667 **Conclusion**

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23 668 Migrant health remains an issue in Malaysia, yet, the quality of the evidence needed to  
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25 669 inform policies is currently lacking. Research-specific reporting guidelines should be  
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27 670 followed to improve the credibility and quality of the evidence base. Furthermore, future  
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29 671 research should focus more on evidence gaps in the mortality and morbidity, and institutional  
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31 672 inequities dimensions, and certain subdimensions, such as non-communicable diseases,  
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33 673 housing conditions, and physical inactivity, to provide a comprehensive picture of migrant  
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35 674 health in Malaysia. Apart from demonstrating the research gaps, this paper also makes  
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37 675 methodological contributions to migrant health research by providing a modified JBI toolkit  
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39 676 and a decision tree that identifies the type of study design and corresponding level of  
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41 677 evidence, both of which can be utilised in other research fields as well.  
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1  
2  
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4

5  
6 725 N/A  
7  
8

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10

11  
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13  
14

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16

17  
18 729 The pre-review protocol and modified JBI checklists can be accessed on request from the  
19  
20 730 first author.  
21  
22

23 731 **Figure legends:**  
24

25  
26 732 Figure 1. Bay Area Regional Health Inequities Initiative (BARHII) framework.  
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28  
29 733 Figure 2. Decision tree to identify the type of study design and corresponding level of  
30  
31 734 evidence.  
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34 735 Figure 3. Flowchart of the data selection process.  
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37 736 Figure 4. Number of studies disaggregated by health dimension.  
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40 737 Figure 5. Number of studies disaggregated by type of migrant.  
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43 738 Figure 6. Number of studies disaggregated by research design.  
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46 739 Figure 7. Results of the multiple-correspondence analysis (MCA).  
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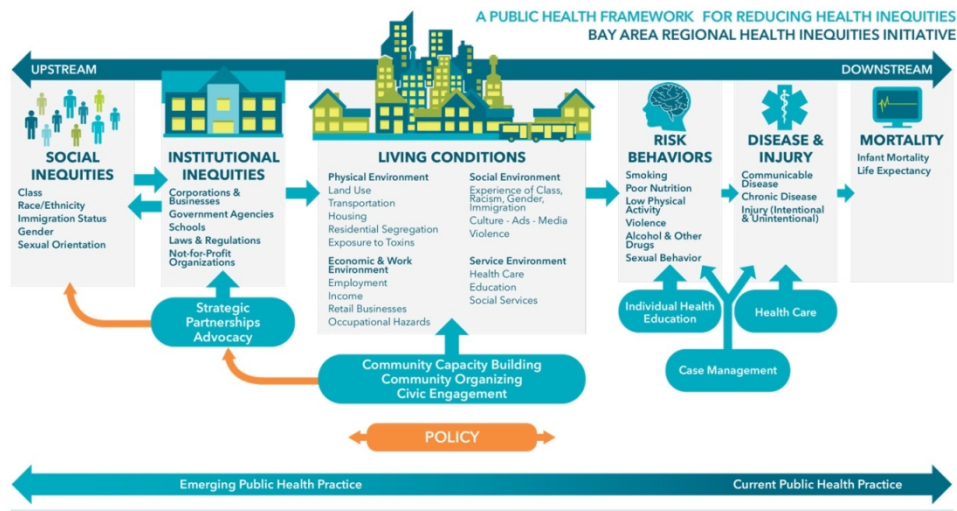


Figure 1. Bay Area Regional Health Inequities Initiative (BARHII) framework.

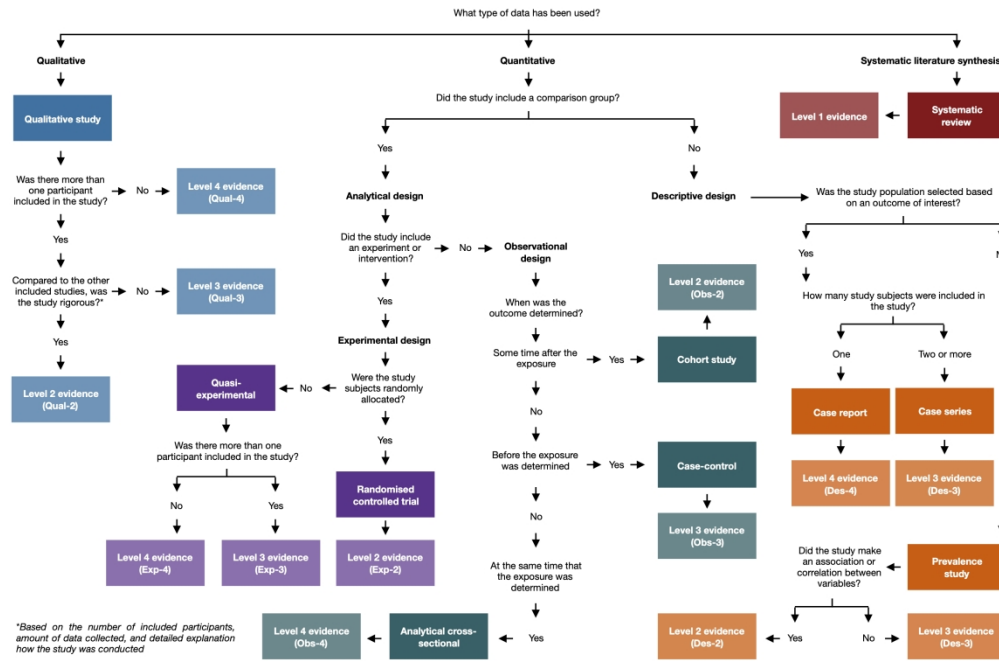


Figure 2. Decision tree to identify the type of study design and corresponding level of evidence.



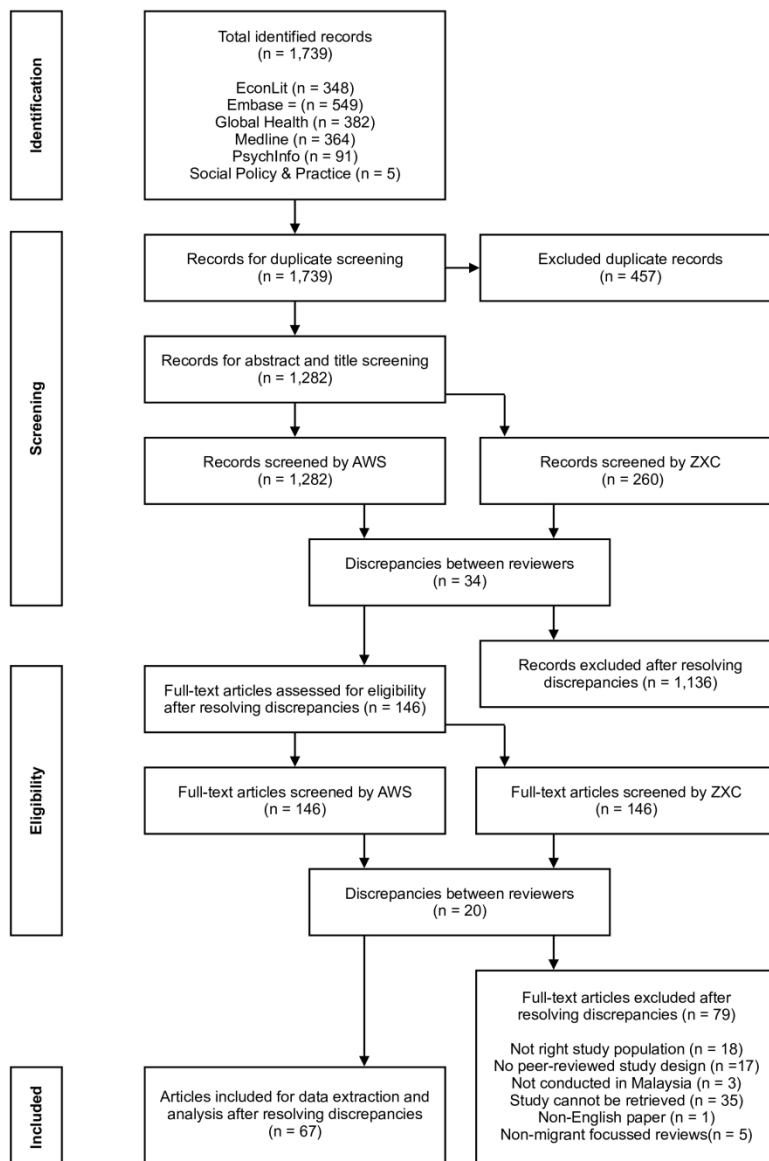


Figure 3. Flowchart of the data selection process.

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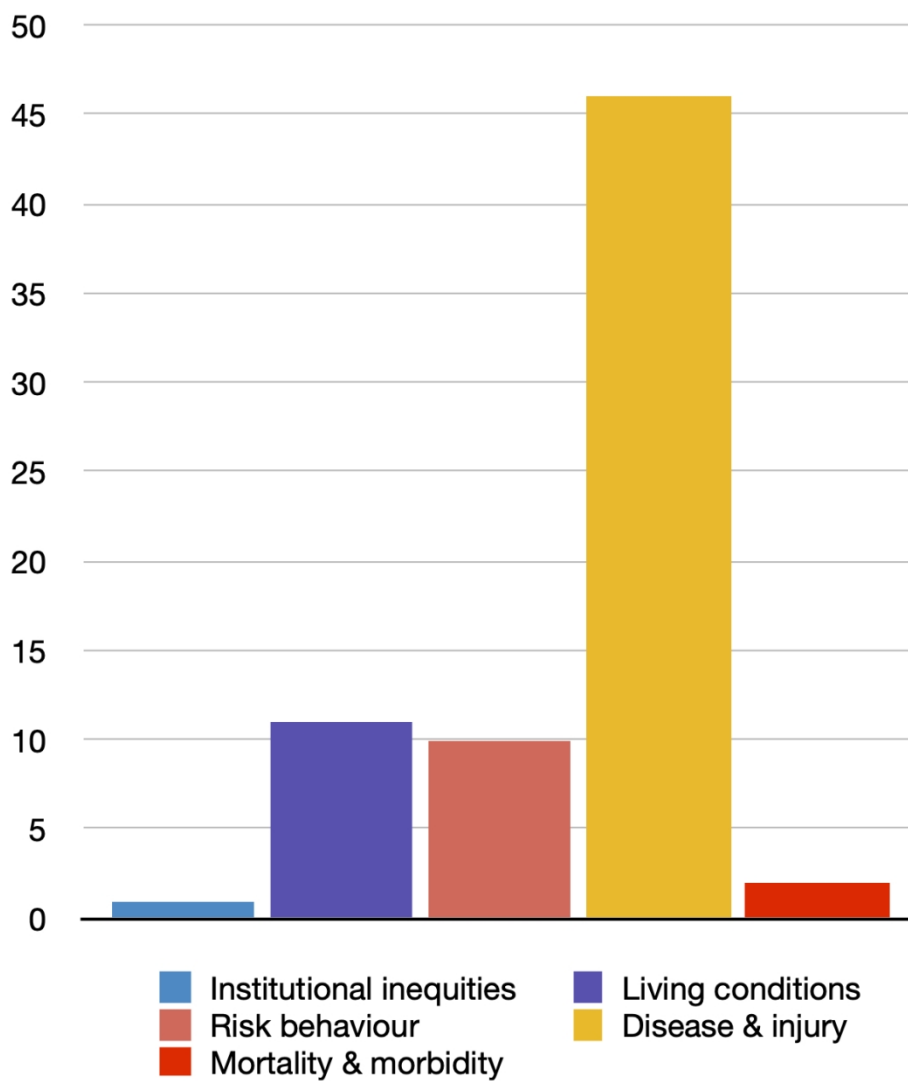


Figure 4. Number of studies disaggregated by health dimension.

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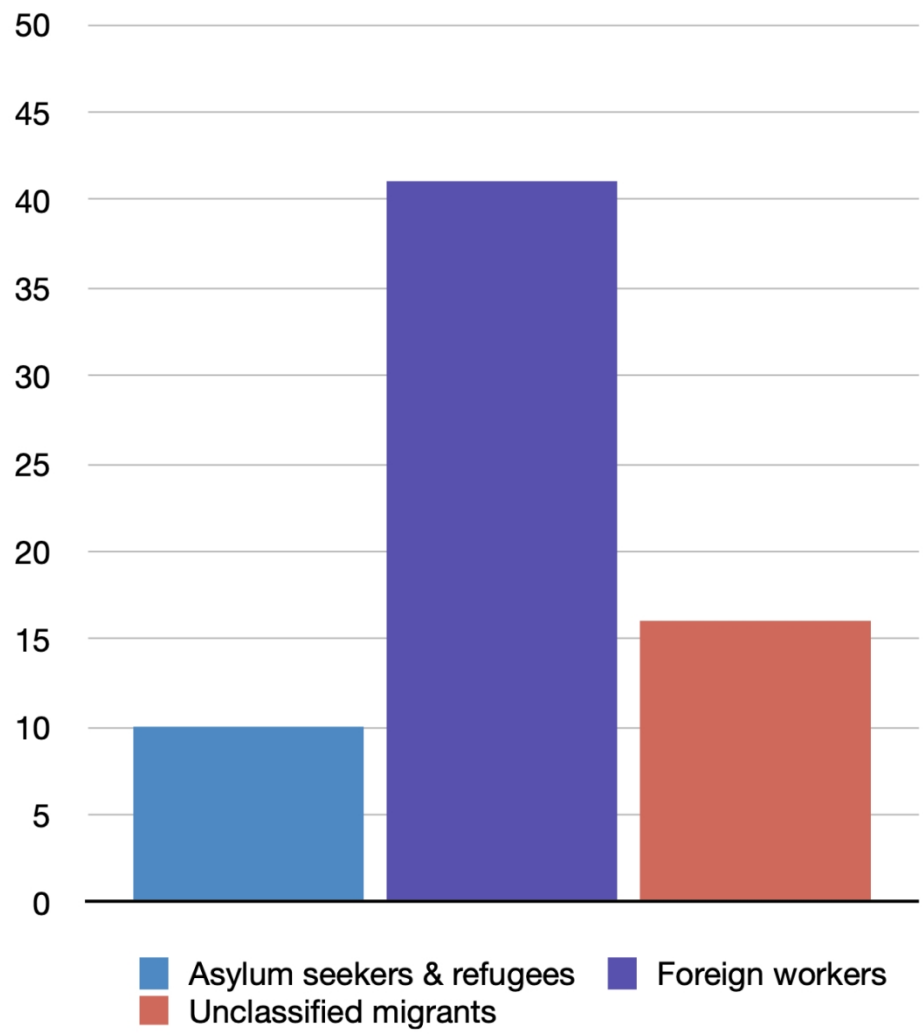


Figure 5. Number of studies disaggregated by type of migrant.

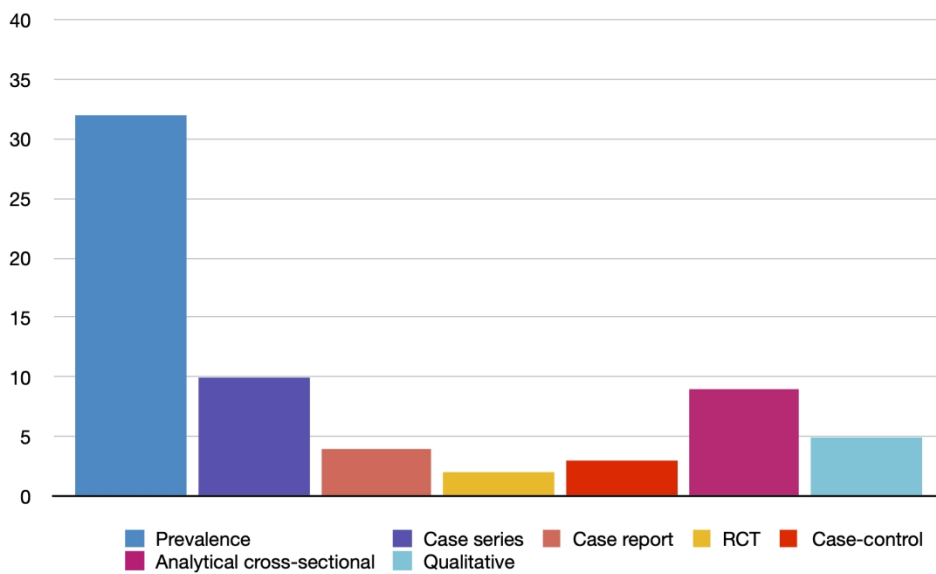


Figure 6. Number of studies disaggregated by research design.

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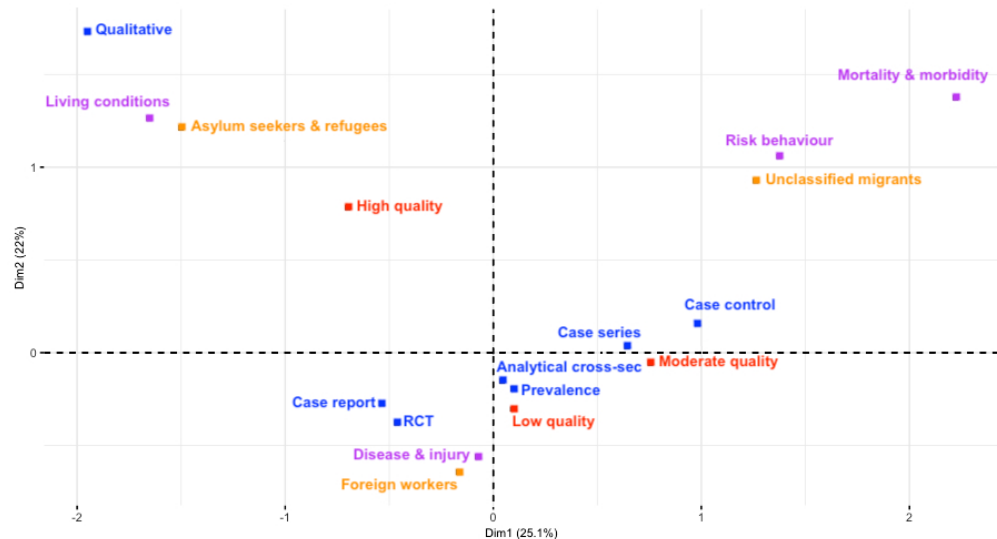


Figure 7. Results of the multiple-correspondence analysis (MCA).

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## Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
<b>TITLE</b>			
Title	1	Identify the report as a scoping review.	
<b>ABSTRACT</b>			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	
<b>INTRODUCTION</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	
<b>METHODS</b>			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	



SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
<b>RESULTS</b>			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	
<b>DISCUSSION</b>			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	
Limitations	20	Discuss the limitations of the scoping review process.	
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	
<b>FUNDING</b>			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

\* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med.* 2018;169:467–473. doi: [10.7326/M18-0850](https://doi.org/10.7326/M18-0850).



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## Supplementary file 2. Detailed search strategy

### I.1. EconLit

Database name	EconLit
Database search engine	OvidSP
Dates of database coverage	1886 to September 12, 2019
Date search conducted	17 September 2019
Total number of hits	348

#	Searches	Results
1	asylum* OR displaced OR emigra* OR emigre* OR foreign born OR foreign labor OR foreign labour OR foreign work* OR foreign-born OR foreign-work* OR foreigner* OR immigra* OR migra* OR people of concern OR person of concern OR persons of concern OR refugee* OR smuggl* OR traffick* OR transient* OR transmigrant*	120,090
2	abnormalit* OR abortion* OR abscess* OR accident* OR ache* OR aids OR ailment* OR alcohol* OR allerg* OR anorexia OR AMR OR antibiotic resistan* OR antimicrobial resistan* OR anxiet* OR allerg* OR apnoea OR arthritis OR ascariasis OR assault* OR asthma OR attack* OR bacteri* OR bipolar OR bite* OR blastoma* OR bleed* OR blind OR blood OR burn* OR cancer* OR cardio* OR Chagas OR chlamydia OR cholesterol OR coma OR complication* OR condition* OR condom* OR contraception OR cyst* OR dead OR deaf OR death* OR decay OR deform* OR dehydrat* OR dementia OR dengue OR depress* OR diabetes OR diarrhoea OR disabilit* OR disease* OR disorder* OR dracunculiasis OR drug* OR dysfunction* OR eczema OR enlargement* OR epilep* OR exhaust* OR failure OR fatal* OR fatigue OR fever* OR filariasis OR flu OR gall stone* gallstone* OR gonorrhoea OR headache* OR health OR healthcare OR hearing loss OR helminth* OR hepatitis OR hernia* OR herpe* OR HIV OR hookworm* OR HPV OR hypertension OR illness* OR indigestion* OR infect* OR inflame* OR injur* OR leishmaniasis OR leprosy OR leukaemia OR leukemia OR lice OR life expectancy OR malaria OR malformat* OR malnutrition OR measles OR medical OR melanoma* OR mental* OR migraine OR miscarriage* OR morbidit* OR mortalit* OR muscl* OR myeloma OR nausea OR neuro* OR nutrition* OR onchocerciasis OR osteoarthritis OR osteoporosis OR pain* OR parasite* OR patient care OR physical activ* OR pneumonia OR poison* OR	373,019



	psoriasis OR psychiatric OR psychos* OR rabies OR rape* OR reproductiv* OR rheuma* OR ringworm* OR sarcoma* OR scabies OR schistosomiasis OR schizophren* OR seizure* OR sepsis* OR sexual* OR shock* OR sick* OR smoking OR sore* OR STD* OR stillbirth* OR stress* OR stroke* OR suicid* OR sunburn* OR syndrome* OR syphilis OR TB OR thrombosis OR tobacco OR STI* OR toothache* OR trachoma OR trauma* OR trichuriasis OR trichomoniasis OR trypanosomiasis OR tuberculosis OR tumor* OR tumour* OR ulcer* OR violence OR virus* OR vomit* OR wart* OR well-being OR wellbeing OR worm* OR wound*	
3	Malaysia OR Johor OR Kedah OR Kelantan OR Kuala Lumpur OR Labuan OR Malacca OR Melaka OR Malaya OR Negeri Sembilan OR Pahang OR Penang OR Perak OR Perlis OR Putrajaya OR Sabah OR Sarawak OR Selangor OR Terengganu	6,883
4	Malaysian	1,654
5	area* OR Borneo OR city OR cities OR district* OR island* OR isle* OR province* OR region* OR state* OR territor* OR village*	367,269
6	4 AND 5	361
7	3 OR 6	6,925
8	1 AND 2 AND 7	348
9	Animal migration OR bird migration OR cell* OR membrane* OR molecu*	2,622
10	8 NOT 9	348

## I.2. Embase

Database name	Embase
Database search engine	OvidSP
Dates of database coverage	1947 to 2019 September 13
Date search conducted	17 September 2019
Total number of hits	549

#	Searches	Results
1	asylum* OR displaced OR emigra* OR emigre* OR foreign born OR foreign labor OR foreign labour OR foreign work* OR foreign-born OR foreign-work* OR foreigner* OR immigra* OR migra* OR people of concern OR person of concern OR persons of concern OR refugee* OR smuggl* OR traffick* OR transient* OR transmigrant*	1,124,805
2	asylum seeker [MeSH]	793
3	emigrant [MeSH]	293
4	foreign worker [MeSH]	5,306
5	human trafficking [MeSH]	697
6	migrant worker [MeSH]	1,548
7	migrant [MeSH]	35,567
8	migration [MeSH]	45,436
9	immigrant [MeSH]	16,376
10	refugee [MeSH]	12,425
11	refugee camp [MeSH]	553
12	undocumented immigrant [MeSH]	350
13	1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12	1,125,119
14	abnormalit* OR abortion* OR abscess* OR accident* OR ache* OR aids OR ailment* OR alcohol* OR allerg* OR anorexia OR AMR OR antibiotic resistan* OR antimicrobial resistan* OR anxiet* OR allerg* OR apnoea OR arthritis OR ascariasis OR assault* OR asthma OR attack* OR bacteri* OR bipolar OR bite* OR blastoma*	31,271,711

	OR bleed* OR blind OR blood OR burn* OR cancer* OR cardio* OR Chagas OR chlamydia OR cholesterol OR coma OR complication* OR condition* OR condom* OR contraception OR cyst* OR dead OR deaf OR death* OR decay OR deform* OR dehydrat* OR dementia OR dengue OR depress* OR diabetes OR diarrhoea OR disabilit* OR disease* OR disorder* OR dracunculiasis OR drug* OR dysfunction* OR eczema OR enlargement* OR epilep* OR exhaust* OR failure OR fatal* OR fatigue OR fever* OR filariasis OR flu OR gall stone* gallstone* OR gonorrhoea OR headache* OR health OR healthcare OR hearing loss OR helminth* OR hepatitis OR hernia* OR herpe* OR HIV OR hookworm* OR HPV OR hypertension OR illness* OR indigestion* OR infect* OR inflame* OR injur* OR leishmaniasis OR leprosy OR leukaemia OR leukemia OR lice OR life expectancy OR malaria OR malformat* malnutrition OR measles OR medical OR melanoma* OR mental* OR migraine OR miscarriage* OR morbidit* OR mortalit* OR muscl* OR myeloma OR nausea OR neuro* OR nutrition* OR onchocerciasis OR osteoarthritis OR osteoporosis OR pain* OR parasite* OR patient care OR physical activ* OR pneumonia OR poison* OR psoriasis OR psychiatric OR psychos* OR rabies OR rape* OR reproductiv* OR rheuma* OR ringworm* OR sarcoma* OR scabies OR schistosomiasis OR schizophren* OR seizure* OR sepsis* OR sexual* OR shock* OR sick* OR smoking OR sore* OR STD* OR stillbirth* OR stress* OR stroke* OR suicid* OR sunburn* OR syndrome* OR syphilis OR TB OR thrombosis OR tobacco OR STI* OR toothache* OR trachoma OR trauma* OR trichuriasis OR trichomoniasis OR trypanosomiasis OR tuberculosis OR tumor* OR tumour* OR ulcer* OR violence OR virus* OR vomit* OR wart* OR well-being OR wellbeing OR worm* OR wound*	
15	accident [MeSH]	209,815
16	diseases [MeSH]	23,553,673
17	health [MeSH]	688,819
18	health behavior [MeSH]	396,908
19	health care [MeSH]	5,107,719
20	health care facility [MeSH]	1,641,961
21	health care policy [MeSH]	188,812
22	health service [MeSH]	5,405,209
23	infection [MeSH]	3,626,633
24	injury [MeSH]	2,303,491
25	malnutrition [MeSH]	178,039

26	morbidity [MeSH]	361,003
27	mortality [MeSH]	1,081,969
28	neoplasm [MeSH]	4,683,051
29	parasite [MeSH]	36,154
30	virus [MeSH]	907,130
31	14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 21 OR 22 OR 23 OR 24 OR 25 OR 26 OR 27 OR 28 OR 29 OR 30	32,849,152
32	Malaysia OR Johor OR Kedah OR Kelantan OR Kuala Lumpur OR Labuan OR Malacca OR Melaka OR Malaya OR Negeri Sembilan OR Pahang OR Penang OR Perak OR Perlis OR Putrajaya OR Sabah OR Sarawak OR Selangor OR Terengganu	28,901
33	Malaysian	1,611
34	area* OR Borneo OR city OR cities OR district* OR island* OR isle* OR province* OR region* OR state* OR territor* OR village*	7,357,992
35	33 AND 34	395
36	32 OR 35	29,057
37	13 AND 31 AND 36	651
38	Animal migration OR bird migration OR cell* OR membrane* OR molecu*	10,280,170
39	37 NOT 38	549

### I.3. Global Health

Database name	Global Health
Database search engine	OvidSP
Dates of database coverage	1910 to 2019 Week 36
Date search conducted	17 September 2019
Total number of hits	382

#	Searches	Results
1	asylum* OR displaced OR emigra* OR emigre* OR foreign born OR foreign labor OR foreign labour OR foreign work* OR foreign-born OR foreign-work* OR foreigner* OR immigra* OR migra* OR people of concern OR person of concern OR persons of concern OR refugee* OR smuggl* OR traffick* OR transient* OR transmigrant*	89,712
2	immigrants [MeSH]	7,830
3	migrant labour [MeSH]	1,006
4	migrants [MeSH]	3,576
5	migration [MeSH]	3,819
6	refugees [MeSH]	3,687
7	1 OR 2 OR 3 OR 4 OR 5 OR 6	89,712
8	abnormalit* OR abortion* OR abscess* OR accident* OR ache* OR aids OR ailment* OR alcohol* OR allerg* OR anorexia OR AMR OR antibiotic resistan* OR antimicrobial resistan* OR anxiet* OR allerg* OR apnoea OR arthritis OR ascariasis OR assault* OR asthma OR attack* OR bacteri* OR bipolar OR bite* OR blastoma* OR bleed* OR blind OR blood OR burn* OR cancer* OR cardio* OR Chagas OR chlamydia OR cholesterol OR coma OR complication* OR condition* OR condom* OR contraception OR cyst* OR dead OR deaf OR death* OR decay OR deform* OR dehydrat* OR dementia OR dengue OR depress* OR diabetes OR diarrhoea OR disabilit* OR disease* OR disorder* OR dracunculiasis OR drug* OR dysfunction* OR eczema OR enlargement* OR epilep* OR exhaust* OR failure OR fatal* OR fatigue OR fever* OR filariasis OR flu OR gall stone* gallstone* OR gonorrhoea OR headache* OR health OR healthcare OR hearing loss OR helminth* OR hepatitis OR hernia* OR herpe* OR HIV OR hookworm* OR HPV OR hypertension OR illness* OR	3,675,317

	indigestion* OR infect* OR inflame* OR injur* OR leishmaniasis OR leprosy OR leukaemia OR leukemia OR lice OR life expectancy OR malaria OR malformat* OR malnutrition OR measles OR medical OR melanoma* OR mental* OR migraine OR miscarriage* OR morbidit* OR mortalit* OR muscl* OR myeloma OR nausea OR neuro* OR nutrition* OR onchocerciasis OR osteoarthritis OR osteoporosis OR pain* OR parasite* OR patient care OR physical activ* OR pneumonia OR poison* OR psoriasis OR psychiatric OR psychos* OR rabies OR rape* OR reproductiv* OR rheuma* OR ringworm* OR sarcoma* OR scabies OR schistosomiasis OR schizophren* OR seizure* OR sepsis* OR sexual* OR shock* OR sick* OR smoking OR sore* OR STD* OR stillbirth* OR stress* OR stroke* OR suicid* OR sunburn* OR syndrome* OR syphilis OR TB OR thrombosis OR tobacco OR STI* OR toothache* OR trachoma OR trauma* OR trichuriasis OR trichomoniasis OR trypanosomiasis OR tuberculosis OR tumor* OR tumour* OR ulcer* OR violence OR virus* OR vomit* OR wart* OR well-being OR wellbeing OR worm* OR wound*	
9	accidents [MeSH]	14,359
10	diseases [MeSH]	2,302,791
11	health [MeSH]	283,009
12	health behaviour [MeSH]	11,560
13	health care [MeSH]	91,876
14	health policy [MeSH]	20,150
15	health services [MeSH]	88,605
16	infection [MeSH]	100,189
17	injuries [MeSH]	3,171
18	malnutrition [MeSH]	28,215
19	morbidity [MeSH]	28,845
20	mortality [MeSH]	135,836
21	neoplasm [MeSH]	225,495
22	parasites [MeSH]	488,622
23	viruses [MeSH]	496,168
24	8 OR 9 OR 10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23	3,688,190

25	Malaysia OR Johor OR Kedah OR Kelantan OR Kuala Lumpur OR Labuan OR Malacca OR Melaka OR Malaya OR Negeri Sembilan OR Pahang OR Penang OR Perak OR Perlis OR Putrajaya OR Sabah OR Sarawak OR Selangor OR Terengganu	17,417
26	Malaysian	3,366
27	area* OR Borneo OR city OR cities OR district* OR island* OR isle* OR province* OR region* OR state* OR territor* OR village*	1,392,874
28	26 AND 27	1,138
29	25 OR 28	17,513
30	7 AND 24 AND 29	429
31	Animal migration OR bird migration OR cell* OR membrane* OR molercul*	833,650
32	30 NOT 31	382

#### I.4. Medline

Database name	Medline
Database search engine	OvidSP
Dates of database coverage	1946 to September Week 1 2019
Date search conducted	17 September 2019
Total number of hits	364

#	Searches	Results
1	asylum* OR displaced OR emigra* OR emigre* OR foreign born OR foreign labor OR foreign labour OR foreign work* OR foreign-born OR foreign-work* OR foreigner* OR immigra* OR migra* OR people of concern OR person of concern OR persons of concern OR refugee* OR smuggl* OR traffick* OR transient* OR transmigrant*	720,051
2	“Emigrants and Immigrants” [MeSH]	11,337
3	“Emigration and Immigration” [MeSH]	24,805
4	Human Trafficking [MeSH]	347
5	Refugees [MeSH]	9,508
6	“Transients and Migrants”	10,955
7	1 OR 2 OR 3 OR 4 OR 5 OR 6	720,051
8	abnormalit* OR abortion* OR abscess* OR accident* OR ache* OR aids OR ailment* OR alcohol* OR allerg* OR anorexia OR AMR OR antibiotic resistan* OR antimicrobial resistan* OR anxiet* OR allerg* OR apnoea OR arthritis OR ascariasis OR assault* OR asthma OR attack* OR bacteri* OR bipolar OR bite* OR blastoma* OR bleed* OR blind OR blood OR burn* OR cancer* OR cardio* OR Chagas OR chlamydia OR cholesterol OR coma OR complication* OR condition* OR condom* OR contraception OR cyst* OR dead OR deaf OR death* OR decay OR deform* OR dehydrat* OR dementia OR dengue OR depress* OR diabetes OR diarrhoea OR disabilit* OR disease* OR disorder* OR dracunculiasis OR drug* OR dysfunction* OR eczema OR enlargement* OR epilep* OR exhaust* OR failure OR fatal* OR fatigue OR fever* OR filariasis OR flu OR gall stone* gallstone* OR gonorrhoea OR headache* OR health OR healthcare OR hearing loss OR helminth* OR hepatitis OR hernia* OR herpe* OR HIV OR hookworm* OR HPV OR hypertension OR illness* OR	21,089,958



	indigestion* OR infect* OR inflame* OR injur* OR leishmaniasis OR leprosy OR leukaemia OR leukemia OR lice OR life expectancy OR malaria OR malformat* OR malnutrition OR measles OR medical OR melanoma* OR mental* OR migraine OR miscarriage* OR morbidit* OR mortalit* OR muscl* OR myeloma OR nausea OR neuro* OR nutrition* OR onchocerciasis OR osteoarthritis OR osteoporosis OR pain* OR parasite* OR patient care OR physical activ* OR pneumonia OR poison* OR psoriasis OR psychiatric OR psychos* OR rabies OR rape* OR reproductiv* OR rheuma* OR ringworm* OR sarcoma* OR scabies OR schistosomiasis OR schizophren* OR seizure* OR sepsis* OR sexual* OR shock* OR sick* OR smoking OR sore* OR STD* OR stillbirth* OR stress* OR stroke* OR suicid* OR sunburn* OR syndrome* OR syphilis OR TB OR thrombosis OR tobacco OR STI* OR toothache* OR trachoma OR trauma* OR trichuriasis OR trichomoniasis OR trypanosomiasis OR tuberculosis OR tumor* OR tumour* OR ulcer* OR violence OR virus* OR vomit* OR wart* OR well-being OR wellbeing OR worm* OR wound*	
9	Accidents [MeSH]	182,330
10	“Delivery of Health Care” [MeSH]	1,028,923
11	Disease [MeSH]	181,324
12	Health [MeSH]	344,725
13	Health Behavior [MeSH]	301,243
14	Health Facilities [MeSH]	756,386
15	Health Policy [MeSH]	102,614
16	Health Services [MeSH]	2,044,089
17	Infection [MeSH]	765,299
18	Malnutrition [MeSH]	118,335
19	Morbidity [MeSH]	524,764
20	Mortality [MeSH]	364,390
21	Neoplasms [MeSH]	3,212,183
22	Parasites [MeSH]	6,776
23	Viruses [MeSH]	754,871
24	“Wounds and Injuries” [MeSH]	873,897

25	8 OR 9 OR 10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23 OR 24	21,770,503
26	Malaysia OR Johor OR Kedah OR Kelantan OR Kuala Lumpur OR Labuan OR Malacca OR Melaka OR Malaya OR Negeri Sembilan OR Pahang OR Penang OR Perak OR Perlis OR Putrajaya OR Sabah OR Sarawak OR Selangor OR Terengganu	17,824
27	Malaysian	4,673
28	area* OR Borneo OR city OR cities OR district* OR island* OR isle* OR province* OR region* OR state* OR territor* OR village*	4,572,673
29	27 AND 28	1,297
30	26 OR 29	18,038
31	7 AND 25 AND 30	404
32	Animal migration OR bird migration OR cell* OR membrane* OR molercul*	6,952,122
33	31 NOT 32	364

### I.5. PsychInfo

Database name	PsychInfo
Database search engine	OvidSP
Dates of database coverage	1806 to September Week 2 2019
Date search conducted	17 September 2019
Total number of hits	91

#	Searches	Results
1	asylum* OR displaced OR emigra* OR emigre* OR foreign born OR foreign labor OR foreign labour OR foreign work* OR foreign-born OR foreign-work* OR foreigner* OR immigra* OR migra* OR people of concern OR person of concern OR persons of concern OR refugee* OR smuggl* OR traffick* OR transient* OR transmigrant*	112,729
2	Asylum seeking [MeSH]	487
3	Foreign workers [MeSH]	530
4	Human migration [MeSH]	12,788
5	Human trafficking [MeSH]	844
6	Immigration [MeSH]	21,250
7	Refugees [MeSH]	5,580
8	1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7	113,572
9	abnormalit* OR abortion* OR abscess* OR accident* OR ache* OR aids OR ailment* OR alcohol* OR allerg* OR anorexia OR AMR OR antibiotic resistan* OR antimicrobial resistan* OR anxiet* OR allerg* OR apnoea OR arthritis OR ascariasis OR assault* OR asthma OR attack* OR bacteri* OR bipolar OR bite* OR blastoma* OR bleed* OR blind OR blood OR burn* OR cancer* OR cardio* OR Chagas OR chlamydia OR cholesterol OR coma OR complication* OR condition* OR condom* OR contraception OR cyst* OR dead OR deaf OR death* OR decay OR deform* OR dehydrat* OR dementia OR dengue OR depress* OR diabetes OR diarrhoea OR disabilit* OR disease* OR disorder* OR dracunculiasis OR drug* OR dysfunction* OR eczema OR enlargement* OR epilep* OR exhaust* OR failure OR fatal* OR fatigue OR fever* OR filariasis OR flu OR gall stone* gallstone* OR gonorrhoea OR headache*	3,197,191

	OR health OR healthcare OR hearing loss OR helminth* OR hepatitis OR hernia* OR herpe* OR HIV OR hookworm* OR HPV OR hypertension OR illness* OR indigestion* OR infect* OR inflame* OR injur* OR leishmaniasis OR leprosy OR leukaemia OR leukemia OR lice OR life expectancy OR malaria OR malformat* OR malnutrition OR measles OR medical OR melanoma* OR mental* OR migraine OR miscarriage* OR morbidit* OR mortalit* OR muscl* OR myeloma OR nausea OR neuro* OR nutrition* OR onchocerciasis OR osteoarthritis OR osteoporosis OR pain* OR parasite* OR patient care OR physical activ* OR pneumonia OR poison* OR psoriasis OR psychiatric OR psychos* OR rabies OR rape* OR reproductiv* OR rheuma* OR ringworm* OR sarcoma* OR scabies OR schistosomiasis OR schizopren* OR seizure* OR sepsis* OR sexual* OR shock* OR sick* OR smoking OR sore* OR STD* OR stillbirth* OR stress* OR stroke* OR suicid* OR sunburn* OR syndrome* OR syphilis OR TB OR thrombosis OR tobacco OR STI* OR toothache* OR trachoma OR trauma* OR trichuriasis OR trichomoniasis OR trypanosomiasis OR tuberculosis OR tumor* OR tumour* OR ulcer* OR violence OR virus* OR vomit* OR wart* OR well-being OR wellbeing OR worm* OR wound*	
10	Accidents [MeSH]	13,047
11	Chronic illness [MeSH]	27,898
12	“Death and Dying” [MeSH]	37,732
13	Health [MeSH]	239,359
14	Health Behavior [MeSH]	29,441
15	Health Care Delivery [MeSH]	93,926
16	Health Care Policy [MeSH]	11,882
17	Health Care Services [MeSH]	199,129
18	Health Care Utilization [MeSH]	15,311
19	Infectious disorders [MeSH]	60,085
20	Injuries [MeSH]	25,738
21	Morbidity [MeSH]	7,010
22	Neoplasms [MeSH]	49,460
23	Nutritional deficiencies [MeSH]	3,952
24	Parasitic disorders [MeSH]	1,068
25	Viral disorders [MeSH]	50,123

26	9 OR 10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23 OR 24 OR 25	3,211,923
27	Malaysia OR Johor OR Kedah OR Kelantan OR Kuala Lumpur OR Labuan OR Malacca OR Melaka OR Malaya OR Negeri Sembilan OR Pahang OR Penang OR Perak OR Perlis OR Putrajaya OR Sabah OR Sarawak OR Selangor OR Terengganu	3,636
28	Malaysian	1,676
29	area* OR Borneo OR city OR cities OR district* OR island* OR isle* OR province* OR region* OR state* OR territor* OR village*	1,025,257
30	28 AND 29	391
31	27 OR 30	3,727
32	8 AND 26 AND 31	91
33	Animal migration OR bird migration OR cell* OR membrane* OR molercul*	184,060
34	32 NOT 33	91

## I.6. Social Policy and Practice

Database name	Social Policy and Practice
Database search engine	OvidSP
Dates of database coverage	N/A
Date search conducted	17 September 2019
Total number of hits	5

#	Searches	Results
1	asylum* OR displaced OR emigra* OR emigre* OR foreign born OR foreign labor OR foreign labour OR foreign work* OR foreign-born OR foreign-work* OR foreigner* OR immigra* OR migra* OR people of concern OR person of concern OR persons of concern OR refugee* OR smuggl* OR traffick* OR transient* OR transmigrant*	10,050
2	abnormalit* OR abortion* OR abscess* OR accident* OR ache* OR aids OR ailment* OR alcohol* OR allerg* OR anorexia OR AMR OR antibiotic resistan* OR antimicrobial resistan* OR anxiet* OR allerg* OR apnoea OR arthritis OR ascariasis OR assault* OR asthma OR attack* OR bacteri* OR bipolar OR bite* OR blastoma* OR bleed* OR blind OR blood OR burn* OR cancer* OR cardio* OR Chagas OR chlamydia OR cholesterol OR coma OR complication* OR condition* OR condom* OR contraception OR cyst* OR dead OR deaf OR death* OR decay OR deform* OR dehydrat* OR dementia OR dengue OR depress* OR diabetes OR diarrhoea OR disabilit* OR disease* OR disorder* OR dracunculiasis OR drug* OR dysfunction* OR eczema OR enlargement* OR epilep* OR exhaust* OR failure OR fatal* OR fatigue OR fever* OR filariasis OR flu OR gall stone* gallstone* OR gonorrhea OR headache* OR health OR healthcare OR hearing loss OR helminth* OR hepatitis OR hernia* OR herpe* OR HIV OR hookworm* OR HPV OR hypertension OR illness* OR indigestion* OR infect* OR inflame* OR injur* OR leishmaniasis OR leprosy OR leukaemia OR leukemia OR lice OR life expectancy OR malaria OR malformat* OR malnutrition OR measles OR medical OR melanoma* OR mental* OR migraine OR miscarriage* OR morbidit* OR mortalit* OR muscl* OR myeloma OR nausea OR neuro* OR nutrition* OR onchocerciasis OR osteoarthritis OR osteoporosis OR pain* OR parasite* OR patient care OR physical activ* OR pneumonia OR poison* OR psoriasis OR psychiatric OR psychos* OR rabies OR rape* OR reproductiv* OR rheuma* OR ringworm* OR sarcoma* OR scabies OR schistosomiasis OR schizophren* OR seizure* OR sepsis* OR sexual* OR shock* OR sick* OR smoking	197,274

	OR sore* OR STD* OR stillbirth* OR stress* OR stroke* OR suicid* OR sunburn* OR syndrome* OR syphilis OR TB OR thrombosis OR tobacco OR STI* OR toothache* OR trachoma OR trauma* OR trichuriasis OR trichomoniasis OR trypanosomiasis OR tuberculosis OR tumor* OR tumour* OR ulcer* OR violence OR virus* OR vomit* OR wart* OR well-being OR wellbeing OR worm* OR wound*	
3	Malaysia OR Johor OR Kedah OR Kelantan OR Kuala Lumpur OR Labuan OR Malacca OR Melaka OR Malaya OR Negeri Sembilan OR Pahang OR Penang OR Perak OR Perlis OR Putrajaya OR Sabah OR Sarawak OR Selangor OR Terengganu	113
4	Malaysian	21
5	area* OR Borneo OR city OR cities OR district* OR island* OR isle* OR province* OR region* OR state* OR territor* OR village*	92,897
6	4 AND 5	5
7	3 OR 6	114
8	1 AND 2 AND 7	5
9	Animal migration OR bird migration OR cell* OR membrane* OR molecu*	447
10	8 NOT 9	5

**I.7. Summary of the identified records**

<b>Database</b>	<b>Hits</b>
Econlit	348
Embase	549
Global Health	382
Medline	364
PsycInfo	91
Social Policy & Practice	5
<b>Total</b>	<b>1,739</b>



# Supplementary file 3. Individual scores of the quality assessment

No.	Reference	Study design	Level of evidence	Answer to the quality appraisal question													Total score	Score in percentage	Quality of the study
				1	2	3	4	5	6	7	8	9	10	11	12	13			
1	Scheutz et al <sup>33</sup>	Prevalence	Des-3	V	X	X	V	V	V	V	X	X	-	-	-	5/9	55.6	Moderate	
2	Levy <sup>34</sup>	Prevalence	Des-2	X	X	V	X	V	V	X	X	V	-	-	-	4/9	44.4	Low	
3	Kassim et al <sup>35</sup>	Case series	Des-3	X	V	X	V	X	V	V	X	V	V	-	-	6/10	60.0	Moderate	
4	Zulkifli et al <sup>36</sup>	Analytical cross-sectional	Obs-4	X	X	N/A	V	V	X	X	-	-	-	-	-	2/6	33.3	Low	
5	Rajeswari et al <sup>37</sup>	Prevalence	Des-3	X	X	X	V	X	V	X	X	X	-	-	-	2/9	22.2	Low	
6	Jeyakumar <sup>38</sup>	Case series	Des-3	X	X	X	V	X	X	X	V	V	V	-	-	4/10	40.0	Low	
7	Jamaiah et al <sup>39</sup>	Case series	Des-3	X	X	X	V	V	X	X	X	V	V	-	-	4/10	40.0	Low	
8	Krahl & Hashim <sup>40</sup>	Prevalence	Des-3	V	V	V	X	V	V	V	V	X	-	-	-	7/9	77.8	High	
9	Zabedah et al <sup>41</sup>	Prevalence	Des-2	X	X	X	X	V	V	X	X	X	-	-	-	2/9	22.2	Low	
10	Dony et al <sup>42</sup>	Prevalence	Des-3	V	V	V	X	V	X	X	V	N/A	-	-	-	5/8	62.5	Moderate	
11	Chandran et al <sup>43</sup>	Case report	Des-4	V	X	V	V	V	N/A	N/A	V	-	-	-	-	5/6	83.3	High	
12	Nissapatom et al <sup>44</sup>	Prevalence	Des-3	X	X	V	X	V	V	X	V	N/A	-	-	-	4/8	50.0	Low	
13	Sobri et al <sup>45</sup>	Case series	Des-3	X	V	V	V	V	X	X	X	V	X	-	-	5/10	50.0	Low	
14	Leong <sup>46</sup>	Prevalence	Des-3	V	X	X	X	X	V	V	V	X	-	-	-	4/9	44.4	Low	
15	Sasidharan et al <sup>47</sup>	Prevalence	Des-2	V	V	V	X	V	V	V	V	X	-	-	-	7/9	77.8	High	

16	Masitah et al <sup>48</sup>	Case series	Des-3	V	X	X	X	X	X	V	X	X	X	-	-	2/9	22.2	Low
17	Shailendra & Prepageran <sup>49</sup>	Case report	Des-4	V	X	V	V	V	V	X	V	-	-	-	-	6/8	75.0	High
18	Chan et al <sup>50</sup>	Analytical cross-sectional	Obs-4	X	X	N/A	X	X	X	X	-	-	-	-	-	0/6	0.0	Low
19	Farhana et al <sup>51</sup>	Case series	Des-3	X	X	X	V	V	V	V	X	V	V	-	-	6/10	60.0	Low
20	Chan et al <sup>52</sup>	Analytical cross-sectional	Obs-4	X	X	N/A	X	X	X	X	-	-	-	-	-	0/6	0.0	Low
21	Murty <sup>53</sup>	Case report	Des-4	V	V	V	V	N/A	N/A	N/A	X	-	-	-	-	4/5	80.0	High
22	Murty et al <sup>54</sup>	Case series	Des-3	X	X	X	V	X	X	V	N/A	V	V	-	-	4/9	44.4	Low
23	Mustafa et al <sup>55</sup>	Prevalence	Des-2	V	X	X	X	X	V	V	V	X	-	-	-	4/9	44.4	Low
24	Su et al <sup>56</sup>	Analytical cross-sectional	Obs-4	V	X	V	X	X	V	V	-	-	-	-	-	4/7	57.1	Moderate
25	Daher et al <sup>57</sup>	Prevalence	Des-2	V	V	X	V	X	V	N/A	V	V	-	-	-	6/8	75.0	High
26	Ratnasingam et al <sup>58</sup>	Prevalence	Des-2	X	X	X	X	X	X	X	V	X	-	-	-	1/9	11.1	Low
27	Ab Rahman & Abdullah <sup>59</sup>	Case report	Des-4	V	V	V	V	V	V	X	V	-	-	-	-	7/8	87.5	High
28	Taib & Baba <sup>60</sup>	Case series	Des-3	X	X	X	V	X	X	V	X	V	X	-	-	3/10	30.0	Low
29	Osman et al <sup>61</sup>	Prevalence	Des-3	X	X	X	V	X	V	N/A	V	V	-	-	-	4/8	50.0	Low
30	Minhat et al <sup>62</sup>	Prevalence	Des-2	X	X	X	X	X	V	N/A	X	V	-	-	-	2/8	25.0	Low
31	Mendelsohn et al <sup>63</sup>	Qualitative	Qual-2	V	V	V	V	V	X	V	V	V	V	-	-	9/10	90.0	High
32	Mendelsohn et al <sup>64</sup>	Analytical cross-sectional	Obs-4	V	V	N/A	V	V	X	V	-	-	-	-	-	5/6	83.3	High

33	Kwan et al <sup>65</sup>	Case series	Des-3	X	V	X	V	X	X	V	X	X	V	-	-	4/10	40.0	Low
34	Santos et al <sup>66</sup>	Prevalence	Des-3	X	X	X	X	V	V	V	V	V	-	-	-	5/9	55.6	Moderate
35	Razali et al <sup>67</sup>	Case series	Des-3	V	V	V	V	X	V	V	X	V	V	-	-	8/10	80.0	High
36	Elmi et al <sup>68</sup>	Case control	Obs-3	X	V	V	X	V	X	V	X	X	V	-	-	5/10	50.0	Low
37	Santos et al <sup>69</sup>	Prevalence	Des-2	X	X	X	X	V	V	V	X	V	-	-	-	4/9	44.4	Low
38	William et al <sup>70</sup>	Prevalence	Des-2	V	V	V	X	V	V	V	V	X	-	-	-	7/9	77.8	High
39	Siah et al <sup>71</sup>	Prevalence	Des-2	X	X	X	X	X	V	X	X	X	-	-	-	1/9	11.1	Low
40	Guinto et al <sup>72</sup>	Scoping review	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41	Vijjian et al <sup>73</sup>	Analytical cross-sectional	Obs-4	V	X	N/A	X	X	X	X	-	-	-	-	-	1/6	16.7	Low
42	Azian et al <sup>74</sup>	Prevalence	Des-2	X	X	X	X	X	V	X	X	X	-	-	-	1/9	11.1	Low
43	Sahimin et al <sup>75</sup>	Prevalence	Des-2	X	X	X	X	X	V	V	V	X	-	-	-	3/9	33.3	Low
44	Noh et al <sup>76</sup>	Prevalence	Des-2	X	X	X	X	X	V	X	V	X	-	-	-	2/9	22.2	Low
45	Kamaludin & How <sup>77</sup>	Analytical cross-sectional	Obs-4	V	X	N/A	X	X	V	V	-	-	-	-	-	3/6	50.0	Low
46	Min et al <sup>78</sup>	Prevalence	Des-3	V	V	V	X	V	X	X	V	N/A	-	-	-	5/8	62.5	Moderate
47	Woh et al <sup>79</sup>	Prevalence	Des-3	X	X	X	V	V	V	X	V	X	-	-	-	4/9	44.4	Low
48	Tanabe et al <sup>80</sup>	Mixed method	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
49	Ratnalingam et al <sup>81</sup>	Prevalence	Des-2	V	X	X	X	V	V	X	X	X	-	-	-	3/9	33.3	Low

50	Woh et al <sup>82</sup>	Prevalence	Des-2	X	X	X	X	X	V	X	V	X	-	-	-	2/9	22.2	Low	
51	Noor & Shaker <sup>83</sup>	Analytical cross-sectional	Obs-4	V	X	V	V	V	V	V	-	-	-	-	-	6/7	85.7	High	
52	Noordin et al <sup>84</sup>	Prevalence	Des-3	X	X	X	X	V	V	X	V	X	-	-	-	3/9	33.3	Low	
53	Sahimin et al <sup>85</sup>	Prevalence	Des-2	X	X	X	V	X	V	V	V	X	-	-	-	4/9	44.4	Low	
54	Labao et al <sup>86</sup>	Prevalence	Des-3	X	X	X	X	V	V	V	V	V	-	-	-	5/9	55.6	Moderate	
55	Shaw et al <sup>87</sup>	Randomised controlled trial	Exp-2	X	X	X	X	X	X	X	X	V	V	V	V	X	4/13	30.8	Low
56	Rahman et al <sup>88</sup>	Case control	Obs-3	X	V	V	X	V	X	V	X	V	V	-	-	-	6/10	60.0	Moderate
57	Sahimin et al <sup>89</sup>	Prevalence	Des-2	X	X	X	V	X	V	V	V	X	-	-	-	4/9	44.4	Low	
58	Nwabichie et al <sup>90</sup>	Prevalence	Des-2	V	V	X	X	V	V	V	V	V	-	-	-	7/9	77.8	High	
59	Jeffree et al <sup>91</sup>	Case control	Obs-3	X	V	V	X	V	X	X	V	V	V	-	-	-	6/10	60.0	Moderate
60	Zerguine et al <sup>92</sup>	Analytical cross-sectional	Obs-4	X	V	V	X	X	V	V	-	-	-	-	-	4/7	57.1	Moderate	
61	Ya'acob et al <sup>93</sup>	Randomised controlled Trial	Exp-2	X	X	V	X	X	X	V	X	X	V	V	V	X	5/13	38.5	Low
62	Chuah et al <sup>9</sup>	Qualitative	Qual-2	V	V	V	V	V	X	V	X	V	V	-	-	-	8/10	80.0	High
63	Loganathan et al <sup>94</sup>	Qualitative	Qual-2	X	V	V	V	V	X	V	V	V	V	-	-	-	8/10	80.0	High
64	Rahman et al <sup>95</sup>	Prevalence	Des-3	X	X	X	X	V	X	X	V	V	-	-	-	3/9	33.3	Low	
65	Siah et al <sup>96</sup>	Qualitative	Qual-3	X	V	X	V	V	X	X	X	V	V	-	-	-	5/10	50.0	Low
66	Sahimin et al <sup>97</sup>	Prevalence	Des-2	X	X	X	V	X	V	X	V	X	-	-	-	3/9	33.3	Low	

67	Chuah et al <sup>98</sup>	Qualitative	Qual-2	V	V	V	V	V	X	V	X	V	V	-	-	8/10	80.0	High
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