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A Scoping Review of Food Safety at Transport stations in Africa

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2
3 31 **Abstract**
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5 32 **Background:** The World Health Organisation (WHO) has declared food safety as a public
6
7 33 health concern. Transport hubs such as taxi ranks, bus stations, and other transport exchange
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9 34 sites are major food trading/purchasing sites, particularly in Africa. Research evidence is
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11 35 needed to improve food safety policies and ensure consumption of safe food, owing to the
12
13 36 increasing burden of foodborne diseases, particularly in the WHO Africa Region. Therefore,
14
15 37 we systematically mapped and described research evidence on food safety at transport stations
16
17 38 in Africa.

18 39 **Methods:** Guided by the Arksey and O'Malley framework, we searched for original research
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20 40 articles in PubMed, Web of Science, and EBSCOhost (Academic search complete, CINAHL
21
22 41 with Full-text, and Health Source), SCOPUS, and Google Scholar from their inception to
23
24 42 October 2020. We included studies that focused on food safety, involved transport stations,
25
26 43 involved African countries, and were published in English. Two investigators independently
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28 44 screened the articles at the abstract and full-text stages in parallel, guided by the eligibility
29
30 45 criteria, and then extracted all relevant data. Thematic analysis was used to organise the data
31
32 46 into themes and sub-themes, and a narrative summary of the findings is presented.

33 47 **Results:** Of the total 23,852 articles obtained from the database searches, 18 studies published
34
35 48 in six countries met the inclusion criteria. These 18 studies were published between 1997 and
36
37 49 2019, with the most (5) in 2014. Of the 18 studies, 50% (9) were conducted in South Africa,
38
39 50 three studies in Ghana, two in Ethiopia, and one study each in Nigeria, Kenya, Lesotho, and
40
41 51 Zambia. Most (44.4%) of the included studies focused on microbial safety of food; few studies
42
43 52 (22.2%) focused on hygienic practices, and one study investigated the perspective of
44
45 53 consumers or buyers. Most of the included studies reported that food sold at transport hubs
46
47 54 failed to meet the minimum standard. The microbes detected in the foods were *Salmonella* spp,
48
49 55 *E. coli*, *Shigella* spp, *Bacillus* sp, *Staphylococcus Aureus*, which resulted mainly from poor
50
51 56 hygiene practices.

52 57 **Conclusion:** There is limited research that focused on food safety at transport stations in
53
54 58 Africa, especially on aspects such as hygiene practices, food storage, occupational health and
55
56 59 food safety, and nutritious aspects. Therefore, we recommend more research in these areas,
57
58 60 using various primary study designs, to inform and improve food safety policies and practices
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60 61 for transport stations in African countries alongside improving access to clean water/hand
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62 62 washing facilities, and undertaking of structural changes to facilitate behaviours and
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64 63 monitoring for unintended consequences such as livelihoods of vulnerable populations.

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3 64 **Keywords:** Food safety, Transport stations, Taxi ranks, Automobile station, Bus stops, Africa
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7 66 **Article summary**
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10 67 **Strengths and limitations of this study**
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12

- 13 68 • To the best of our knowledge this is the first scoping review to systematically explore
14 literature and describe research evidence on food safety at transport stations as well as
15 identify research gaps for future studies in Africa.
16 69
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18 70
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20 71 • This scoping review evidence sources were searched using systematic approach, and
21 duplicate screening.
22 72
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24 73 • This review is limited to Africa as well as English language publications.
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88 **Background**

89 The World Health Organisation (WHO) estimates that more than 600 million people fall sick
90 (almost 1 in 10 people) with foodborne diseases annually, of which nearly 420 000 people die,
91 and about 33 million years of healthy lives are lost every year worldwide [1, 2]. The burden of
92 foodborne diseases is estimated to be highest in the WHO African and South-East Asia
93 Regions, mainly occurring among vulnerable populations such as infants, young children,
94 pregnant women, older people, poor people, and individuals with underlying illnesses [3]. Food
95 contamination mostly results throughout the food supply chain (from the procedures used in
96 processing the foods, inadequate storage temperatures, unhygienic practices by food handlers,
97 poor sanitation at place of cooking/vending areas, poor waste management, and inadequate
98 treatment of leftovers) [4].

99 Unsafe food has negative implications on health systems, and affects the development and
100 national economies of countries, as well as trade [3]. Therefore, eating unsafe foods poses a
101 significant public health threat. To avert the consequences of unsafe food on health systems,
102 and to sustain national economies, development, trade, and tourism [5, 6], the WHO in 2006
103 declared food safety as a global public health concern [7, 8]. Food safety consists of food
104 preparation, handling, storage, and hygienic practices aimed to prevent food contamination by
105 microbial, chemical, and physical hazards in the food production chain [5]. To reduce the
106 incidence of food-related diseases, particularly in high burden regions, the observations of food
107 safety measures/precautions at all levels of the food processing chain, including the places
108 where food is prepared and sold, are critical [9, 10].

109 Like other WHO Regions, especially in low-and-middle-income countries, food trading in the
110 Africa Region takes place at several formal and informal places, such as in the markets,
111 restaurants, streets, open spaces in academic institutions, and transport stations (taxi ranks, bus
112 stations, lorry parks), and other transport exchange sites. Food vending at public spaces serves
113 as a source of livelihood [6, 10, 11], and more than two billion people eat food sold at various
114 vending locations. including transportations stations on daily basis globally [12, 13]. To this
115 end, evidence is essential to inform in-country policies/guidelines, and further research, to
116 ensure that food prepared and sold at transport stations promotes livelihoods, nutrition, food
117 safety, and environmentally sustainable practices. This scoping review systematically mapped
118 literature focused on food safety at transport stations in Africa, to provide research evidence
119 and gaps.

120 **Methods**

121 The Arksey & O'Malley framework (research question identification; identifying relevant
122 studies; selection of study; data charting, collating, and summarising and reporting the findings
123 [14, 15]) was employed to scope and synthesise literature to answer the question - what
124 evidence exists on food safety at transport stations in Africa? This review's study protocol was
125 developed *a priori* [16]. This study included published peer-reviewed articles that reported
126 findings from any African country/countries, focused on food safety, and involved transport
127 stations. However, this study was limited to English publications (due to lack of expertise in
128 other international languages), and primary study designs [16]. We followed the Preferred
129 Reporting Items for Systematic and Meta-analysis (PRISMA) extension for Scoping Reviews
130 checklist to report this study [17].

131

132 **Identify relevant studies**

133 We searched for primary research articles relating to food safety at transport stations in
134 PubMed, Web of Science, and EBSCOhost (Academic search complete, CINAHL with Full-
135 text, and Health Source), SCOPUS, and Google Scholar from their inception to October 2020.
136 To enable the capturing of all relevant articles, a comprehensive search strategy (developed in
137 consultation with an expert librarian) consisting of keywords, Boolean terms (AND/OR), and
138 Medical Subject Heading terms, was used for the electronic database search (Supplementary
139 file 1). Syntax was modified appropriately where needed. Filters such as date and study design
140 were not applied during the literature search in the databases. DK and PG independently
141 conducted the database search and title screening, and imported all potentially eligible articles
142 onto an EndNote Library. The reference lists of all included articles were also screened for
143 potentially relevant articles using the same approach.

144

145 **Selection of articles and edibility criteria**

146 Prior to the abstract screening, the 'find duplicates' function in EndNote was used to find all
147 duplicate articles, and they were removed from the library. A screening form was developed in
148 Google forms, using this study's eligibility criteria, for the abstract and full text screening
149 phases. Two reviewers independently screened the abstracts as well as the full text articles.
150 Discrepancies that arose during the abstract stage were resolved by discussion among the
151 review team until a consensus was reached. At the full text screening phase, discrepancies were
152 resolved by a third reviewer. All the additional articles identified from the reference list of the
153 included articles equally underwent full text assessment. The PRISMA flow diagram was

154 employed to account for all the articles involved [18].

155 **Charting the data**

156 A data extraction form was designed consisting of the following: Author(s) and publication
157 details, country of study, study design, study setting, study population, sample size, sex, study
158 findings, and recommendations. To ensure consistency and reliability, two reviewers piloted
159 the data extraction sheet using a random sample of three included studies. The pilot testing of
160 the form also enabled the review team to discuss discrepancies, and to revise the data extraction
161 form prior to its final usage. Subsequently, two reviewers conducted the data extraction for the
162 remaining 15 included studies using both inductive and deductive approaches. The review team
163 resolved all discrepancies at this stage through discussion.

165 **Collating, summarizing, and reporting the results**

166 This study subsequently employed thematic analysis, and collated all the emerging themes and
167 sub-themes relating to food safety. A summary of the findings from the included studies is
168 presented narratively.

170 **Results**

171 Of the 23,852 articles obtained from the database searches (see Figure 1 flow diagram), 146
172 articles met the eligibility criteria at the title screening stage. Using EndNote “Find Duplicates”
173 function, 30 duplicates were found and removed before abstract screening was conducted.
174 Subsequently, 83 articles were removed at the abstract screening, and 18 at full text (16 of these
175 did not include transport stations/taxi ranks/bus stations, but did involve sale from market
176 centres, public places, chop bars, mini restaurants, major streets, and sidewalks, and were
177 excluded). Finally, 15 studies were included, and, from a manual search of their reference lists,
178 a further three articles were added, giving a total of 18 articles for further analysis.

180 **Characteristics of the included studies**

181 Table 1 presents a summary of the characteristics of the included studies. Of the 18 included
182 studies, nine (50%) were conducted in South Africa [19-26], three (16.7%) in Ghana [4, 27,
183 28], two (11.1%) in Ethiopia [29, 30], and one (5.6%) each in Nigeria [31], Kenya [32], Lesotho
184 [33], and Zambia [34]. Most of the studies were published in the last six years, however, no
185 published study was found in 2015 and 2020 (Figure 2). Seventeen (94.4%) of the included

186 studies were cross-sectional studies, and one (5.6%) was a mixed-method study. Of the 18
187 included studies, 44.4% reported on microbial safety of food [4, 19, 22, 23, 28-30, 34], and
188 22.2% reported hygiene practices of food handlers/vendors [6, 21, 31, 32]. One included study
189 each reported on the following: food safety risk communication [25]; knowledge of hygiene
190 practice [27]; knowledge of food safety measures [26]; occupational health and food safety risk
191 [20]; hygiene practices of food handlers/vendors and microbial safety [35]; and knowledge of
192 food safety measures and hygiene practice by food handlers/vendors [33].

193

194 **Findings from the included studies**

195 **Microbial safety of food**

196 Of the nine included studies that reported findings on microbial safety of food, 44.4% were
197 conducted in South Africa [22, 23, 35, 36], 22.2% each in Ghana [4, 28] and Ethiopia [29, 30],
198 and the last 11.1% in Zambia [34]. Seven of the eight studies reported unacceptable level of
199 microbes in the food [4, 19, 22, 23, 28-30, 34]. Table 2 presents a summary of the key findings
200 as well as the sample type, analytic approach, and the microbes reported.

201

202 **Hygiene practices of food handlers/vendors**

203 ***Food preparation***

204 Of the 18 included studies, eight reported research finding relating to food preparation. Fifty
205 percent of these eight studies were from South Africa [6, 21, 23, 35], and the remainder were
206 from Ghana [27], Nigeria [31], Kenya[32], and Lesotho [33]. The studies in South Africa
207 focused on the following: hygiene practices and implications for consumers [21]; food and
208 nutrition knowledge as well as practices related to food preparation [6], the effect of hygiene
209 practices and attitudes of meat vendors [35], and sources of food contamination [23]. The study
210 from Ghana investigated how fast food operators washed their hands [27], whilst the studies
211 from Nigeria, Kenya, and Lesotho evaluated food safety and sanitary practices [31]; food
212 vendors and hygiene practices [32]; and food safety knowledge, attitudes and practices of food
213 vendors and consumers' perceptions [33]. A summary of the key findings from these studies
214 are presented below (Table 3).

215

216 ***Knowledge of hygiene practices/food safety precautions***

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3 217 In South Africa, Qekwana et. al. [26] survey involving traditional goat slaughters revealed that
4 218 traditional and ritual slaughter includes preslaughter activities aimed to mitigate risk of
5 219 slaughtering animals that are not fit for human consumption, yet none of the study respondents
6 220 was aware of the need for a health declaration for slaughter stock [26]. Few (21%) slaughter
7 221 practitioners perform a prepurchase inspection of stock to ascertain their health status [26].
8 222 McArthur-Floyd et. al. [27] study in Ghana, revealed that the majority (94%) of fast food
9 223 operators knew food safety precautions [27]. Letuka et. al. [33] study in Lesotho, indicated that
10 224 95% of food vendors had incorrect knowledge that washing utensils with detergent leave them
11 225 free of contamination [33]. The mean knowledge (49%±11) of the food vendors included in
12 226 the study was considered as poor [33]. About 6% of the consumers that participated in the study
13 227 chose not to buy food sold at taxi ranks due to food safety issues and hygiene [33].
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229 ***Food safety risk communication***

230 Qekwana et.al. [25] study in South Africa, observed that communication technology such as
231 cell phones with e-mails, web pages, and Facebook, as well as posters and electronic media
232 (radio and television) can be employed to communicate risk associated with hygienic
233 precautions and food safety at taxi ranks [25].
234

235 ***Occupational health and food safety risk***

236 In South Africa, Qekwana et.al. [20] evaluated the occupational health and food safety risks
237 associated with the traditional slaughter of goats, and the consumption of such meat [20].
238 Approximately 63% of the practitioners were not wearing protective clothing during slaughter,
239 and about 78% of practitioners did not know their own health status [20]. Almost 83% of the
240 practitioners hung up their carcass to facilitate bleeding, flaying, and evisceration [20]. The
241 study further observed that none of the practitioners practiced meat inspection [20]. In Nigeria,
242 Aluko et al. [31] study revealed that approximately 62% of the vendors had no formal training,
243 and their medical status was also unknown [31].
244

245 **Discussion**

246 This scoping review mapped evidence on food safety at transport stations in Africa, and
247 revealed a very low number of papers that are published in this area, given many African
248 employees in both formal and informal sectors commute through these transport hubs [12, 13].
249 An average of one paper per year relating to food safety at transport hubs in Africa as revealed

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3 250 by this review is simply not enough. Nonetheless, the few papers depict an imbalance of
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5 251 research, with most focused on microbial safety [4, 19, 22, 23, 28-30, 34], and few on socio-
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7 252 economic aspects such as hygiene practices [6, 21, 31, 32], food safety risk communication
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9 253 [25], and occupational health and food safety risk [20]. Even more worrying is that no study
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11 254 looked at the nutritious aspects of meals sold, despite an established prevalence of poor
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13 255 nutrition and ill-health [37-39]. Moreover, this review revealed no study evaluated the storage
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15 256 of food or how the food is transported to the vending site.

16 257 As evidence by this review, most of the food sold at transport hubs do not meet the minimum
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18 258 standards, and is not safe for consumption due to the presence of several microbes [4, 23, 28,
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20 259 30, 34-36, 40]. There are several reasons for this such as poor practices relating to hygiene,
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22 260 storage, preparation, cooking, cleaning, and serving [4, 19, 22, 23, 28-30, 34]. However, these
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24 261 findings are similar to previous review findings involving markets [41], homes and restaurants
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26 262 [42]. A recent publication by Gizaw [41] indicated that several studies reported microbial
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28 263 contamination of foods sold in the market, with bacteria and fungi similar to those identified
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30 264 in our review [41]. Also, a review by the WHO reported that the main factors contributing to
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32 265 foodborne disease outbreaks in homes or restaurants were poor temperature control in
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34 266 preparing, cooking, and storing food [42]. Although very few papers were found by this review,
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36 267 the evidence is compelling that there should be policy interventions to address issues relating
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38 268 poor hygiene practices, including food storage, preparation, cooking, cleaning, and serving by
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40 269 food handlers at transport hubs, not only in South Africa, but across Africa.

41 270 Similar to a previous scoping review [43], most of the included papers were published within
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43 271 the last six years but, no published study was found in 2015 and 2020. Whilst the reason for
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45 272 the lack of published papers in 2015 might be difficult to determine, the COVID-19 pandemic
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47 273 which resulted in “covidisation” of research might be the reason for the lack of publication in
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49 274 this field of research in 2020. Although we cannot conclude that no primary research has been
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51 275 conducted in these countries focusing on the safety of food sold at transport stations, it suggests
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53 276 a research/publication gap. Food safety research is, perhaps, more relevant now than ever in
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55 277 Africa, since the burden of foodborne diseases is rising annually, resulting in the declaration
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57 278 of food safety as a public health concern by the WHO [7, 8]. Aside from this, most commuters
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59 279 tend to buy ready-to-eat (RTE) food from street food vendors, including those at transport hubs
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280 [44, 45]; hence, the sale of food at transport stations is rising [45, 46], particularly in Africa [6]
281 partly due to an increase in demand for RTE, and the employment opportunities it offers to
282 many individuals who otherwise would not have had any source of income [43, 47]. Even more

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3 283 worrying is the fact that most of the articles included that focused on microbial safety, reported
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5 284 high levels of food contamination with several microorganisms, especially *Salmonella* spp and
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7 285 *E. coli* [4, 23, 28, 30, 34-36, 40]. Therefore, more research is needed across African countries
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9 286 to prevent potential negative consequences.

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11 287 Our study findings have implications for practice and research. For instance, the likelihood of
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13 288 food poisoning with microbes such as *Salmonella* spp, *E. coli.*, *Shigella* spp, *Bacillus* spp, *S.*
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15 289 *aureu*, and several others, revealed by most of the included studies that focused on microbial
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17 290 contamination of food, is alarming. This, if not checked, could further worsen the already high
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19 291 burden of foodborne diseases in a continent that has several of its countries already
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21 292 experiencing many health systems and economic challenges. Aside from this, the majority
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23 293 individuals who commute through transport hubs, possible will purchase a meal from a
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25 294 transport hub/exchanges sites, which may be the only meal of the day [12, 13], and yet the food
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27 295 safety standards are poor [4, 19, 22, 23, 28-30, 34]. Thus, if not checked, the excess cases of
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29 296 foodborne diseases from any outbreak will further impact negatively on the already challenged
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31 297 public health systems in Africa. Also, poor people who are exposed to these unsafe food get
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33 298 disease, may have to pay more for healthcare, which can further exacerbate their poverty
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35 299 situation. Moreover, people who are already living in extremely poverty who get exposed to
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37 300 foodborne disease may not even make it to the hospital for care, and can end up dying at home
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39 301 [48].

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41 302 Good hygiene and sanitation practices, such as adequate hand washing, adequate washing and
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43 303 storage of pots and dishes, good waste management, observation of food preparation standards
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45 304 and serving etiquette, among others, have the potential to reduce the risk of food contamination
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47 305 from both biological and non-biological hazards, yet this study reveal fewer studies that
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49 306 focused on hygienic practices. We, therefore, recommend more research to further inform
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51 307 contextualised policy decisions aimed at improving hygiene and sanitation practices by food
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53 308 vendors at transport stations. Also, very relevant to ensuring food safety is the occupational
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55 309 health practices of the vendors. Regular food handling tests and food inspections, conducted
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57 310 by the appropriate local authorities, should be mandatory in all African countries. Food handler
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59 311 tests should seek to ensure that food vendors are fit healthwise to prepare and serve food meant
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312 for public consumption. However, our review found limited studies that evaluated occupational
313 health and food safety. Considering that two studies conducted in South Africa and Nigeria
314 found that 78% and 62% of food vendors at transport stations did not know their health status
315 [20, 31], and the increasing number of informal food sellers at various transport exchange sites,

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3 316 future studies are recommended to focus on occupational health and food safety in Africa. The
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5 317 means and manner of storing food, especially leftover RTE food, can either increase or reduce
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7 318 the risk of food contamination, but, again, this scoping review found no study that focused on
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9 319 food storage practices of the vendors at transport stations. Also essential, and yet we did not
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11 320 find any study focusing on it, is the quality of food (nutritious aspects) of the meals sold at
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13 321 transport stations. Eating a well nourishing diet or balanced meals is critical to ensure good
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15 322 health [49-51], hence, we encourage future primary studies to include the nutritious aspects.
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17 323 Such studies may help streamline guidelines or inform policies to improve the quality of the
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19 324 food sold at transport exchange sites or taxi ranks. Moreover, this review found that the
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21 325 majority (17 out of 18) of the respondents in the included studies were the vendors (mostly
22
23 326 females) or food samples taken from the vendors. The perspectives of consumers (buyers) or
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25 327 commuters regarding food safety at transport stations are also very relevant, and we
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27 328 recommend future research to involve them. A comparative study to investigate food safety
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29 329 practices among males and females food vendors at transport stations might be relevant, since
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31 330 many males are now getting involved in the business [6, 52, 53].

32
33 331 To the best of our knowledge, this study is the first scoping review that systematically mapped
34
35 332 literature relating to food safety at transport stations in Africa. A major strength of our study
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37 333 method is that it permits the inclusion of multiple study designs. Also, the choice of this study
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39 334 method permitted us to highlight literature gaps, and made recommendations for future
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41 335 research. Aside from this, we conducted a thorough search in six databases using a
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43 336 comprehensive search strategy which enabled us to capture the most relevant articles to answer
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45 337 the review question. Moreover, two independent reviewers were used to select the studies and
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47 338 perform data extraction processes which helped to prevent selection bias and ensured the
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49 339 reliability and trustworthiness of this study results. Despite this, our scoping review has many
50
51 340 limitations. This study included only original study peer reviewed papers, which resulted in the
52
53 341 exclusion of one review paper [43], and one Masters' dissertation [54]. We did not also consult
54
55 342 the websites of WHO and the Food and Agriculture Organisation websites for possible relevant
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57 343 studies. Furthermore, this study cannot be generalised since the search was limited to African
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59 344 countries only. Although date limitation was removed, we limited the publication language to
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345 English only, which perhaps eliminated relevant articles published in other languages. Despite
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347 these limitations, this study has provided essential evidence relating to food safety at transport
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stations and has shown literature gaps to guide future research.

349 **Conclusion**

350 Based on this scoping review's eligibility criteria, our study results suggest there is limited
351 research focusing on food safety at transport stations in Africa. Most of the existing published
352 studies are focused on microbial safety of food, and very few/none on other aspects such as
353 hygiene practices, food storage, occupational health and food safety, and nutrition. Hence, we
354 recommend more primary research involving community members and policy makers in these
355 areas going forward alongside improving access to clean water/hand washing facilities, and
356 undertaking of structural changes to facilitate behaviours and monitoring for unintended
357 consequences such as livelihoods of vulnerable populations.

358

359 **Abbreviations**

360 PRISMA- Preferred Reporting Items for Systematic and Meta-analysis

361 RTE- Ready-to-eat

362 WHO- World Health Organization

363

364 **Ethics and dissemination**

365 Not required. All sources of data have been adequately referenced.

366

367 **Patient and Public Involvement**

368 No patient involved

369

370 **Statements**

371 **Acknowledgments**

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374

375 **Authors' contributions**

376 BPN, DK, SED, SM, and RS conceptualized and designed the study. DK developed and
377 designed the database search strategy and conducted the search. PG contributed to the
378 screening of the studies and data extraction. DK wrote the draft manuscript and BPN, SED,
379 GM, and RS critically review it and made revisions. All the authors approved the final version
380 of the manuscript.

381

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14 391 **References**

15 392 1. The Lancet Gastroenterology H. Food safety really is everyone's business. The lancet
16 393 Gastroenterology & hepatology. 2019;4(8):571.

17 394 2. World Health Organization. Estimating the burden of foodborne diseases Geneva:
18 395 World Health Organization; 2015 [cited 2019 25/10/2019]. Available from:
19 396 <https://www.who.int/activities/estimating-the-burden-of-foodborne-diseases>.

20 397 3. World Health Organization. Food Safety Geneva: World Health Organization; 2016
21 398 [cited 2020 17/11/2020]. Available from: <https://www.afro.who.int/health-topics/food-safety>.

22 399 4. Feglo P, Sakyi K. Bacterial contamination of street vending food in Kumasi, Ghana.
23 400 Journal of Medical Biomedical Sciences. 2012;1(1):1-8.

24 401 5. Organization WH. Food Safety: What you should know Geneva: World Health
25 402 Organization; 2015 [cited 2019 25/10/2019]. Available from:
26 403 http://www.searo.who.int/entity/world_health_day/2015/whd-what-you-should-know/en/.

27 404 6. Hill J, Mchiza Z, Puoane T, Steyn NP. The development of an evidence-based street
28 405 food vending model within a socioecological framework: a guide for African countries. PloS
29 406 one. 2019;14(10):e0223535.

30 407 7. World Health Organization. Five keys to safer food manual Geneva: World Health
31 408 Organization; 2006 [cited 2019 25/10/2019]. Available from:
32 409 https://www.who.int/foodsafety/publications/consumer/manual_keys.pdf.

33 410 8. Lamin-Boima P. Knowledge, Attitude And Practice Of Street Food Vendors In
34 411 Selected Schools Within Bo City Southern Sierra Leone.

- 1
2
3 412 9. Lues JFR, Rasephei MR, Venter P, Theron MM. Assessing food safety and associated
4 413 food handling practices in street food vending. *International Journal of Environmental Health*
5 414 *Research*. 2006;16(5):319-28.
- 6
7
8
9 415 10. Abrahale K, Sousa S, Albuquerque G, Padrao P, Lunet N. Street food research
10 416 worldwide: a scoping review. *Journal of human nutrition and dietetics : the official journal of*
11 417 *the British Dietetic Association*. 2019;32(2):152-74.
- 12
13
14
15 418 11. Liu Z, Zhang G, Zhang X. Urban street foods in Shijiazhuang city, China: Current
16 419 status, safety practices and risk mitigating strategies. *Food Control*. 2014;41:212-8.
- 17
18
19 420 12. Food and Agriculture Organization. Selling street and snack foods Rome: Food and
20 421 Agriculture Organization; 2011 [cited 2019 25/10/2019]. Available from:
21 422 <http://www.fao.org/3/a-i2474e.pdf>.
- 22
23
24
25 423 13. Gelormini M, Damasceno A, Lopes SA, Malo S, Chongole C, Muholove P, et al. Street
26 424 Food Environment in Maputo (STOOD Map): a Cross-Sectional Study in Mozambique. *JMIR*
27 425 *research protocols*. 2015;4(3):e98.
- 28
29
30
31 426 14. Arksey H, O'Malley L. Scoping studies: towards a methodological framework.
32 427 *International Journal of Social Research Methodology*. 2005;8(1):19-32.
- 33
34
35 428 15. Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology.
36 429 *Implementation Science*. 2010;5(1):69.
- 37
38
39 430 16. Ncama BP, Kuupiel D, Duma SE, McHunu G, Guga P, Slotow R. Mapping evidence
40 431 of food safety at transport stations in Africa: a scoping review protocol. *BMJ Open*.
41 432 2020;10(8):e035879-e.
- 42
43
44
45 433 17. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA
46 434 extension for scoping reviews (PRISMA-ScR): checklist and explanation. *Annals of internal*
47 435 *medicine*. 2018;169(7):467-73.
- 48
49
50
51 436 18. Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. PRISMA 2009 Flow
52 437 Diagram. 2009;6(2009):1000097.
- 53
54
55 438 19. Oguttu JW, McCrindle CM, Makita K, Grace D. Investigation of the food value chain
56 439 of ready-to-eat chicken and the associated risk for staphylococcal food poisoning in Tshwane
57 440 Metropole, South Africa. *Food Control*. 2014;45:87-94.
- 58
59
60

- 1
2
3 441 20. Qekwana DN, McCrindle CM, Oguttu JW, Grace D. Assessment of the occupational
4 442 health and food safety risks associated with the traditional slaughter and consumption of goats
5 443 in Gauteng, South Africa. *International Journal of Environmental Research*. 2017;14(4):420.
6
7
8
9 444 21. Kok R, Balkaran R. Street food vending and hygiene practices and implications for
10 445 consumers. *Journal of Economics Behavioral Studies*. 2014;6(3):188-93.
11
12
13 446 22. Mafune TS, Takalani TK, Anyasi TA, Ramashia SE. Microbial Safety of Street Vended
14 447 Foods Sold in Thohoyandou, South Africa. *Journal of Human Ecology*. 2016;53(3):205-12.
15
16
17 448 23. Mazizi B, Muchenje V, Makepe M, Mutero G. Assessment of Aerobic Plate Counts,
18 449 *Staphylococcus aureus*, *Escherichia coli* and *Salmonella* in Meat Sold by Street Vendors in the
19 450 Eastern Cape Province, South Africa. *Journal of Food Nutrition Research*. 2017;5(6):436-42.
20
21
22
23 451 24. Hill J, McHiza Z, Puoane T, Steyn NP. Food sold by street-food vendors in Cape Town
24 452 and surrounding areas: a focus on food and nutrition knowledge as well as practices related to
25 453 food preparation of street-food vendors. *Journal of Hunger & Environmental Nutrition*.
26 454 2019;14(3):401-15.
27
28
29
30 455 25. Qekwana DN, McCrindle CME, Oguttu JW. Designing a risk communication strategy
31 456 for health hazards posed by traditional slaughter of goats in Tshwane, South Africa. *Journal of*
32 457 *the South African Veterinary Association*. 2014;85(1).
33
34
35
36 458 26. Qekwana ND, Oguttu JW. Assessment of Food Safety Risks Associated with
37 459 Preslaughter Activities during the Traditional Slaughter of Goats in Gauteng, South Africa.
38 460 *Journal of Food Protection*. 2014;77(6):1031-7.
39
40
41
42 461 27. McArthur-Floyd M, Commey V, Boakye NAB. Evaluation of Food Safety among Fast
43 462 Food Operators in Madina, Accra. *Evaluation*. 2016;54.
44
45
46 463 28. Abakari G, Cobbina SJ, Yeleliere E. Microbial quality of ready-to-eat vegetable salads
47 464 vended in the central business district of tamale, Ghana. *International Journal of Food*
48 465 *Contamination*. 2018;5(1).
49
50
51
52 466 29. Kibret M, Tadesse M. The bacteriological safety and antimicrobial susceptibility of
53 467 bacteria isolated from street-vended white lupin (*Lupinus albus*) in Bahir Dar, Ethiopia.
54 468 *Ethiopian Journal of Health Sciences*. 2013;23(1):19-26.
55
56
57
58
59
60

- 1
2
3 469 30. Eromo T, Tassew H, Daka D, Kibru G. Bacteriological Quality of Street Foods and
4 470 Antimicrobial Resistance of Isolates in Hawassa, Ethiopia. *Ethiopian Journal of Health*
5 471 *Sciences*. 2016;26(6):533-42.
6
7
8
9 472 31. Aluko OO, Ojeremi TT, Olaleke DA, Ajidagba EB. Evaluation of food safety and
10 473 sanitary practices among food vendors at car parks in Ile Ife, southwestern Nigeria. *Food*
11 474 *Control*. 2014;40:165-71.
12
13
14
15 475 32. Odundo A, Okemo P, Chege P. An Assessment of Food Safety Practices among Street
16 476 Vendors in Mombasa, Kenya. *International Journal of Health Sciences Research*.
17 477 2018;8(5):235-43.
18
19
20
21 478 33. Letuka P, Nkhebenyane J, Thekiso O. Assessment of Food Safety Knowledge,
22 479 Attitudes and Practices among Street Food Vendors and Consumers' Perceptions of Street
23 480 Food Vending in Maseru Lesotho. 2019.
24
25
26
27 481 34. Jermini M, Bryan FL, Schmitt R, Mwandwe C, Mwenya J, Zyuulu MH, et al. Hazards
28 482 and Critical Control Points of Food Vending Operations in a City in Zambia. *J Food Prot*.
29 483 1997;60(3):288-99.
30
31
32
33 484 35. Tshipamba M, Lubanza N, Adetunji M, Mwanza MJFMSH. Evaluation of the Effect
34 485 of Hygiene Practices and Attitudes on the Microbial Quality of Street Vended Meats Sold in
35 486 Johannesburg, South-Africa. 2018;3(137):2476-059.1000137.
36
37
38
39 487 36. Oguttu JW, McCrindle CME, Makita K, Grace D. Investigation of the food value chain
40 488 of ready-to-eat chicken and the associated risk for staphylococcal food poisoning in Tshwane
41 489 Metropole, South Africa. *Food Control*. 2014;45:87-94.
42
43
44
45 490 37. Caristia S, Filigheddu N, Barone-Adesi F, Sarro A, Testa T, Magnani C, et al. Vitamin
46 491 D as a Biomarker of Ill Health among the Over-50s: A Systematic Review of Cohort Studies.
47 492 *Nutrients*. 2019;11(10).
48
49
50
51 493 38. Huynh G, Huynh QHN, Nguyen NHT, Do QT, Khanh Tran V. Malnutrition among 6-
52 494 59-Month-Old Children at District 2 Hospital, Ho Chi Minh City, Vietnam: Prevalence and
53 495 Associated Factors. *Biomed Res Int*. 2019;2019:6921312.
54
55
56
57 496 39. Oftedal S, Glozier N, Holliday EG, Duncan MJ. Diet quality and depressive symptoms.
58 497 Assessing the direction of the association in a population-based cohort study. *Journal of*
59 498 *affective disorders*. 2020;274:347-53.
60

- 1
2
3 499 40. Kibret M, Tadesse MJEjohs. The bacteriological safety and antimicrobial susceptibility
4 500 of bacteria isolated from street-vended white lupin (*Lupinus albus*) in Bahir Dar, Ethiopia.
5 501 2013;23(1):19-26.
6
7
8
9 502 41. Gizaw Z. Public health risks related to food safety issues in the food market: a
10 503 systematic literature review. *Environmental Health and Preventive Medicine*. 2019;24(1):68.
11
12
13 504 42. Todd EC. Epidemiology of foodborne diseases: a worldwide review. *World health*
14 505 *statistics quarterly Rapport trimestriel de statistiques sanitaires mondiales*. 1997;50(1-2):30-
15 506 50.
16
17
18
19 507 43. Abrahale K, Sousa S, Albuquerque G, Padrao P, Lunet N. Street food research
20 508 worldwide: a scoping review. *Journal of Human Nutrition and Dietetics*. 2019;32(2):152-74.
21
22
23 509 44. Bellia C, Pilato M, Seraphin H. Street food and food safety: a driver for tourism?
24 510 *Calitatea*. 2016;17(S1):20.
25
26
27 511 45. Mosupye FM, Von Holy A. Microbiological hazard identification and exposure
28 512 assessment of street food vending in Johannesburg, South Africa. *International Journal of Food*
29 513 *Microbiology*
30
31 514 2000;61(2-3):137-45.
32
33
34
35 515 46. Mosupye FM, von Holy A. Microbiological quality and safety of ready-to-eat street-
36 516 vended foods in Johannesburg, South Africa. *International Journal of Food Microbiology*.
37 517 1999;62(11):1278-84.
38
39
40
41 518 47. Muzaffar AT, Huq I, Mallik BA. Entrepreneurs of the streets: An analytical work on
42 519 the street food vendors of Dhaka City. *International journal of Business*
43 520 *Management*. 2009;4(2):80-8.
44
45
46
47
48 521 48. World Health Organisation. Universal Health Coverage Geneva2020 [cited 2021
49 522 09/04/2021]. Available from: [https://www.who.int/health-topics/universal-health-](https://www.who.int/health-topics/universal-health-coverage#tab=tab_1)
50 523 [coverage#tab=tab_1](https://www.who.int/health-topics/universal-health-coverage#tab=tab_1).
51
52
53
54 524 49. Melanson K. Nutrition review: lifestyle approaches to promoting healthy eating for
55 525 children. *American journal of lifestyle medicine*. 2008;2(1):26-9.
56
57
58
59
60

- 1
2
3 526 50. Carrier N, Villalon L, Lengyel C, Slaughter SE, Duizer L, Morrison-Koechl J, et al.
4 527 Diet quality is associated with malnutrition and low calf circumference in Canadian long-term
5 528 care residents. *BMC nutrition*. 2019;5:57.
- 6
7
8
9 529 51. Freeland-Graves JH, Nitzke S. Position of the academy of nutrition and dietetics: total
10 530 diet approach to healthy eating. *Journal of the Academy of Nutrition*
11 531 *Dietetics*. 2013;113(2):307-17.
- 12
13
14
15 532 52. Okojie P, Isah E. Sanitary conditions of food vending sites and food handling practices
16 533 of street food vendors in Benin City, Nigeria: implication for food hygiene and safety. *Journal*
17 534 *of environmental public Health Reports*. 2014;2014.
- 18
19
20
21 535 53. da Silva SA, Cardoso RdCV, Góes JÂW, Santos JN, Ramos FP, de Jesus RB, et al.
22 536 Street food on the coast of Salvador, Bahia, Brazil: A study from the socioeconomic and food
23 537 safety perspectives. *Food control*. 2014;40:78-84.
- 24
25
26
27 538 54. Acheampong BE. Assessment of food hygiene practices by street food vendors and
28 539 microbial quality of selected foods sold. A Study at Dunkwa-On-Offin, Upper Denkyira East
29 540 Municipality of the Central Region 2015.
- 30
31
32
33
34
35
36
37
38
39
40
41
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542 **Table 1:** Characteristic of the included sources of evidence

Author, year	Country	City/Town	Study design	Study setting	Study population	Sample size	Sex of vendors	Outcome reported
Oguttu et. al., 2014 [19]	South Africa	Tshwane Metropole, Gauteng Province	Mixed-methods study	Taxi rank	Vendors selling Ready-to-eat chicken	100 samples of Ready-to-eat chicken	Females	Microbial safety of food
Mafune et. al., 2016 [22]	South Africa	Thohoyandou, Limpopo Province	Cross-sectional study	Taxi rank, bus station, shopping mall, and street stalls	Food samples from street vendors	28 samples	Not specified	Microbial safety of food
Kibret et. al., 2013 [29]	Ethiopia	Bahir Dar Town	Cross-sectional study	Main roads sites, bus station, groceries, taxi ranks	Ready-to-eat white lupin sample from vendors	40 samples (200 grams of white lupin)	Not specified	Microbial safety of food
Abakari et. al., 2018 [28]	Ghana	Tamale, Northern Region	Cross-sectional study	Taxi rank, bus stops, transport yard, and timber market	Ready-to-eat salad samples from food vendors	30 salad samples	Not specified	Microbial safety of food
Aluko et.al., 2014 [31]	Nigeria	Ile Ife, southwestern Nigeria	Cross-sectional study	Car parks	Food vendors	160 (118 stationary and 43 mobile vendors)	Males and females	Hygiene practices of food handlers/vendors
Odundo et. al., 2018 [32]	Kenya		Cross-sectional study	Major bus stops, markets, shopping areas, construction	Food vendors	130	Males and females	Hygiene practices of food handlers/vendors

				sites, and commercial areas				
Kok et. al., 2014 [21]	South Africa	Durban, KwaZulu-Natal Province	Cross-sectional study	Transport exchange site	Food vendors	29	Not specified	Hygiene practices of food handlers/vendors
Letuka et. al., 2019 [33]	Lesotho	Maseru	Cross-sectional study	Taxi ranks	Food vendors	141 (48 food handlers and 93 consumers)	Male and female	Knowledge of food safety measures and hygiene practice by food handlers/vendors
Eromo et. al., 2016 [30]	Ethiopia	Hawassa City	Cross-sectional study	Bus station	Food samples from street food vendors	72 samples from six food items	Not specified	Microbial safety of food
McArthur-Floyd et. al., 2016 [27]	Ghana	Madina (Accra), Greater Accra Region	Cross-sectional study	Taxi rank, and transport exchange sites	Food vendors	200	Males and females	Knowledge of hygiene practice
Hill et. al., 2019 [6]	South Africa	Cape Town	Cross-sectional study	Train, bus stations, and taxi ranks, community centers, market	Food vendors	831	Males and females	Hygiene practices of food handlers/vendors
Mazizi et. al., 2017 [23]	South Africa	Alice (Nkonkobe) and King William's Town (Buffalo City), Eastern Cape province	Cross-sectional study	Taxi rank and bus stations	Street food vendors	136 food samples cooked and raw.	Not specified	Microbial safety of food

Qekwana et.al, 2014 [26]	South Africa	Tshwane, Gauteng Province	Cross-sectional study	Taxi ranks and informal markets	Traditional goat slaughters	105 people	Males and females	Knowledge of food safety precautions
Qekwana et.al, 2014 [25]	South Africa	Tshwane, Gauteng Province	Cross-sectional study	Taxi ranks	Street food vendors	105 people	Males and females	Hygiene precautions communication channel for food safety
Qekwana et.al, 2017 [20]	South Africa	Tshwane Metropolitan Municipality, Gauteng Province	Cross-sectional study	Taxi ranks and Informal markets	Traditional goat slaughter	105 people	Males and females	Occupational health and food safety risk
Flego et. al., 2012 [4]	Ghana	Kumasi, Ashanti Region	Cross-sectional study	Bus terminals	Food samples from vendors	60 food samples	Not specified	Microbial safety of food
Tshipamba et. al., 2018 [35]	South Africa	Johannesburg	Cross-sectional study	Taxi ranks and streets	Meat samples from vendors	115 meat samples	Not specified	Hygiene practices of food handlers/vendors, and microbial safety of food
Jermine et. al., 1997 [34]	Zambia	Not specified	Cross-sectional study	bus park/station and large market	Samples of raw, processed, and cooked Foods from street food vendors	Not specified	Not specified	Microbial safety of food

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544 **Table 2:** Microbial safety of food at transport stations

Study	Type of sample	Analytical approach	Microbes reported	Key results	Key conclusion
Oguttu et. al. [19]	Ready-to-eat (RTE) chicken	3M™ Petrifilm™ plates	<i>S. aureus</i>	<ul style="list-style-type: none"> High prevalence of <i>S. aureus</i> in the sample was (44%; 90% CI: 36.1%-52.2%), with mean <i>S. aureus</i> counts of $10^{3.6}$ (90%CI: $10^{3.3}$-$10^{3.9}$). The likelihood of food poisoning with <i>S. aureus</i> from RTE chicken was estimated to be 1.3% (90% CI: 0% -2.7%) 	To reduce the levels of concentration of <i>S. aureus</i> on the RTE chicken and promote the sale of safer and affordable RTE chicken for the large urban poor population in South Africa, training of RTE chicken vendors on hygiene is still needed.
Mafune et. al. [22]	Unfermented porridge, boiled cabbage and carrots, boiled peanuts, salad, potato chips, traditional mageu, and stewed beef and grilled chicken	Standard microbiological method	<i>S. aureus</i>	<ul style="list-style-type: none"> <i>S. aureus</i> was $<2.4771 \log_{10}$ cfu/g in all samples and places. Except for fried potato chips, microbial contamination was observed in the remaining food samples using the total plate count method. 	Most of the vended foods investigated met the microbiological standard of RTE foods
Mazizi et. al. [23]	Cooked and raw beef, pork, and mutton samples, surface contact plates, and water samples	Biochemical tests according to international standards methods	<i>S. aureus</i> , <i>E. coli</i> , and <i>Salmonella</i> spp.	<ul style="list-style-type: none"> Mean score of raw beef, mutton, and pork were aerobic plate counts (4.8, 3.7 and 2.8 Log (cfu/g)), <i>S. aureus</i> (3.3, 3.7 and 2.8 Log cfu/g), and <i>E. coli</i> (1.0, 0.6 and 0.3 Log cfu/g) respectively. 	The levels of contamination in cooked meat were lower when compared to the standards set by Commission Regulation for determining the microbiological quality of RTE foods.

<p>Tshipamba et. al. [35]</p>	<p>RTE meat</p>	<p>Standard biochemical and Molecular methods</p>	<p><i>Bacillus thuringienis</i>, <i>Bacillus spp.</i>, <i>Bacillus subtilis</i>, <i>Bacillus cereus</i>, <i>Citrobacter spp.</i>, <i>Enterococcus faecium</i>, <i>Enterococcus faecalis</i>, <i>Kurthia spp.</i>, <i>Lysinibacillus spp.</i> <i>Macrocococcus caseolyticus</i>, <i>Planomicrobium glaciei</i>, <i>Planococcus antarcticus</i>, <i>S. aureus</i>, <i>S. equorum</i>, and <i>S. vitulinus</i></p>	<ul style="list-style-type: none"> • Overall mean total bacteria in the samples ranged from 4.3-6.03 cfu/ml × 10² and coliform counts ranged from 1.60-1.95 × 10² cfu/ml • Of the 15 microbes identified, <i>S. aureus</i> occurred in all the meat types and the percentage of occurrence was chicken meat (14%), beef head (43%), beef intestine (50%), and won (sausage) (20%) 	<p>Consumers RTE meat are at risk of food borne diseases due to poor hygiene practices of the vendors.</p>
<p>Kibret et. al. [29]</p>	<p>White lupin</p>	<p>Standard bacteriological techniques, and Kirby-Bauer disk</p>	<p><i>E. coli</i>, <i>Salmonella spp.</i>, and <i>Shigella spp.</i></p>	<ul style="list-style-type: none"> • Prevalence of bacteria total coliform counts were 954.2±385 at the surface and 756.2±447.3 at the core of white lupin. 	<p>Contamination of white lupin and a potential health risk to consumers revealed, and the bacteria isolated showed high rates of multiple drug resistance.</p>

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		diffusion method for antimicrobial susceptibility test		<ul style="list-style-type: none"> Pathogens isolated were as follows <i>E.coli</i> 29 (72.5%), <i>Salmonella</i> spp. 23 (57.5%) and <i>Shigella</i> spp. 8 (20%). Overall multiple antimicrobial resistances rate was 75% 	
Eromo et. al. [30]	Local bread ('ambasha' and 'kita'), raw fish, chilli ('awaze'), avocado, and cooked potato	Standard microbiological techniques	<i>E. coli</i> , <i>Salmonella</i> spp., and <i>S. aureus</i>	<ul style="list-style-type: none"> The microbiological quality in nearly 31% of RTE food samples was beyond the acceptable limits. Total colony counts detected ranged from 1.7x10⁵ to 6.7x10⁶ cfu/g. <i>E.coli</i> (29.6%), <i>Salmonella</i> spp. (12.7%), and <i>S. aureus</i> (9.9%) were the most frequent isolates. All isolates were 100% sensitive to ciprofloxacin, but 89% of <i>Salmonella</i> spp. was resistant to chloramphenicol, 14.3% of <i>S.aureus</i> was resistant to vancomycin 	Considerable rate of contamination in the foods confirmed. The identified foodborne bacteria and antibiotic resistance isolates could pose a public health problem in the study location.
Abakari et. al. [28]	Pre-cut vegetable salads	Standard microbiological methods	<i>E. coli</i> , <i>Bacillus cereus</i> , <i>Salmonella</i> spp, and <i>Shigella</i> spp.	<ul style="list-style-type: none"> <i>E. coli</i> levels ranged from 0 to 7.56 log₁₀ cfu/g; <i>Bacillus cereus</i> levels ranged from 0 to 7.44 log₁₀ cfu/g; <i>Salmonella</i> spp. ranged from 0 to 4.54 log₁₀ cfu/g, and <i>Shigella</i> spp. ranged from 5.54 log₁₀ cfu/g were detected in 96.9%, 93.3%, 73.3%, and 76.7% of the salads samples, respectively. 	Salads were revealed to be unwholesome for human consumption and could be deleterious to the health of consumers.

Flego et. al. [4]	RTE foods (ice-kenkey (15), cocoa drink (15), fufu (5), ready-to-eat red pepper for kenkey) (5), salad (10), and macaroni (10))	Standard microbiological methods	<i>Staphylococci</i> , <i>Bacillus</i> spp., <i>Klebsiella pneumoniae</i> , <i>Aeromonas pneumophila</i> , <i>E. cloacae</i> , <i>S. aureus</i> , <i>E. coli</i> , and <i>P. aeruginosa</i>	<ul style="list-style-type: none"> RTE foods were found to be contaminated with enteric bacteria and other potential food poisoning organisms with bacterial counts higher than the acceptable levels (<5.0 log₁₀ CFU/ml). Coagulate negative staphylococci (23.7%), <i>Bacillus</i> species (21.5%), <i>K. pneumoniae</i> (18.0%), <i>Aeromonas pneumophila</i> (17.7%), <i>E. cloacae</i> (6.7%), <i>S. aureus</i> (3.7%), <i>E. coli</i> (2.2%) and <i>P. aeruginosa</i> (2.2%) were the main isolates detected. 	Most RTE foods were contaminated with enteric bacteria and other potential food poisoning organisms with bacterial counts higher than the acceptable levels.
Jermini et. al. [34]	Raw foods (ground meat, chicken, and chicken intestine); and processed foods (dried “minnows” and “kapenta”)		<i>Salmonellae Spp.</i> , <i>S. aureus</i> , <i>Clostridium peifringens</i>	<ul style="list-style-type: none"> Raw foods such as ground meat, chicken, chicken intestine; and processed foods such as dried “minnows” and “kapenta” were contaminated by salmonellae or contained high populations of <i>S. aureus</i> in pasteurized milk. High populations (> 10⁵) of <i>S. aureus</i> were detected from a sample of leftover chicken, more than 10⁷ were detected in leftover rice, and 10 million <i>C. peifringens</i> per gram were detected in leftover beef stew sample 	Time-temperature exposures during reheating had variable effects in terms of killing the microorganisms that germinated from surviving spores or that reached the foods after cooking.

546 **Table 3:** Key reported findings on food preparation

Study	Key findings reported
Kok et. al. [21]	<ul style="list-style-type: none"> • Water being used for washing utensils was left unchanged, • Piles of dirty pots and dishes was left near the serving areas and RTE foods, and garbage left uncovered with many flies at the site, • RTE food was left uncovered, • Most of the food handlers were not wearing gloves, hairnets, or aprons
Hill et. al. [6]	<ul style="list-style-type: none"> • 85.5% of the vending stalls lacked soap or surface sanitizer, • 71% lacked basin for washing, • 75% did not have drying cloth, • 76.6% of vendors handled food and money concurrently, • About 57% left the food uncovered. • 39% of the vendors were using their hands to pick up food items, with only 6% wearing gloves, and • 29% of vendors had a wet clean sponge/cloth obtainable at the site
Mazizi et. al. [23]	<ul style="list-style-type: none"> • Major sources of food contamination identified were poor hygiene practices of the food vendor, holding area, and the utensils
Tshipamba et. al. [35]	<ul style="list-style-type: none"> • Approximately 90% of RTE meat vendors at the taxi rank exposed their meats to dust and flies, • 94% of them handled money whilst serving food, and • Stagnant water found in about 22% of the vending locations at the taxi-rank
McArthur-Floyd et. al. [27]	<ul style="list-style-type: none"> • 64% of food vendors washed their hands from elbow to finger and the remainder (36%) washed from their wrist to finger (the WHO recommends handwashing from elbow to fingers), and • 62% of the vendors test their meal in the palm whilst 38% of them test it with a spoon (the best way to test a meal)
Aluko et. al. [31]	<ul style="list-style-type: none"> • Approximately 17% of food vendors washed their hands always after using the toilet, • 63% of them rarely kept their fingernails short, and • Nearly 4% of them always kept their leftover cooked food in a refrigerator, despite having unstable power supply
Odundo et. al. [32]	<ul style="list-style-type: none"> • Food vendors had poor hygiene practices however, men were observed to have better hygienic practices than women (P<0.05), • Hygiene practice of the vendors was found to be significantly associated with training (those trained observe hygiene), and • Wearing of jewellery, long and unclean nails, and lack of protective clothing were observed.
Letuka et. al. [33]	<ul style="list-style-type: none"> • Observed that the food handlers operated under unhygienic environment

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549 **Figure**550 **Figure 1:** PRISMA 2009 Flow Diagram551 **Figure 2:** Trend of published studies relating to food safety at transport station in Africa

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553 **Supplementary File**554 **Supplementary file 1:** PRISMA-P Checklist

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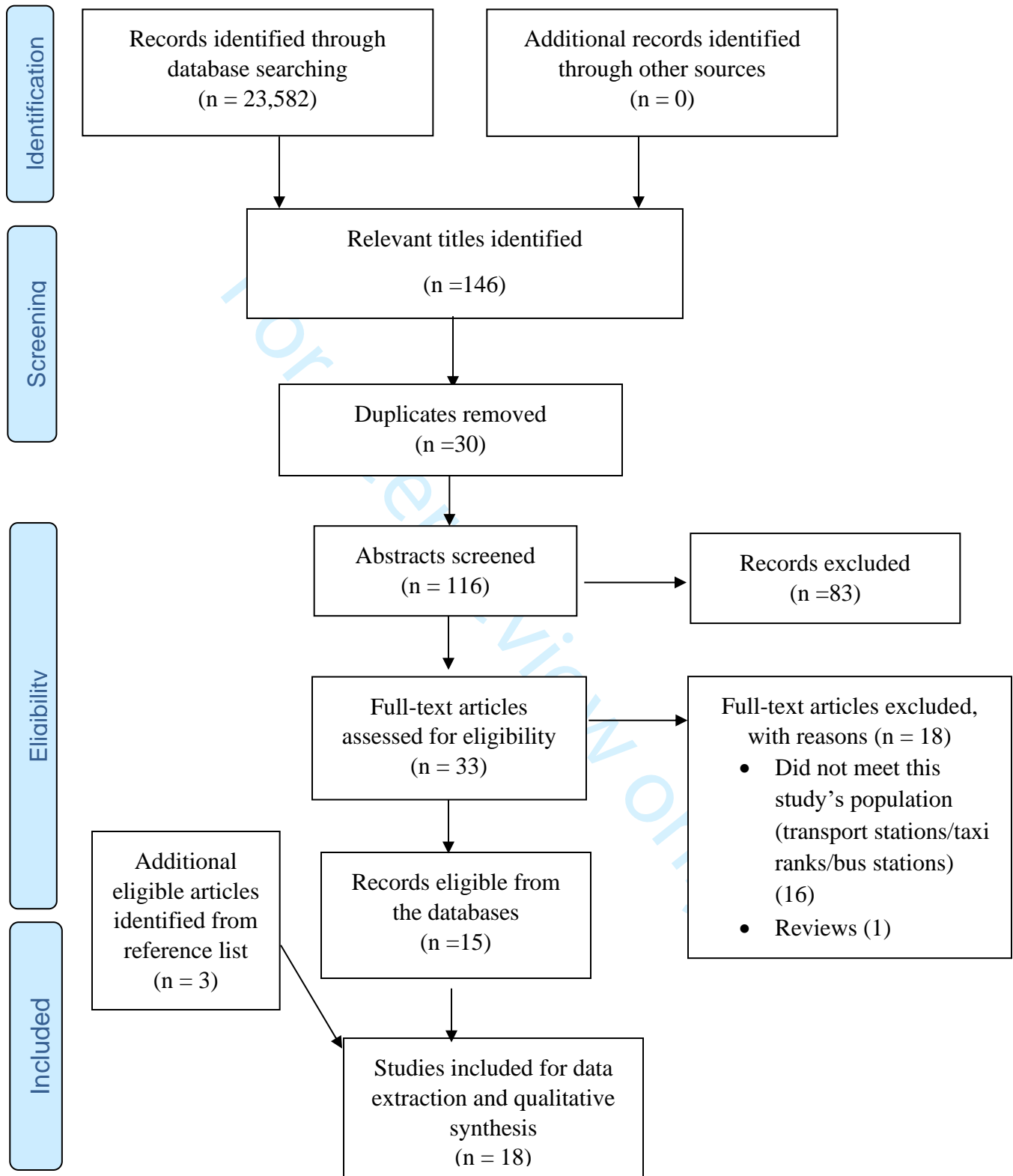


Figure 1: PRISMA 2009 Flow Diagram [18]

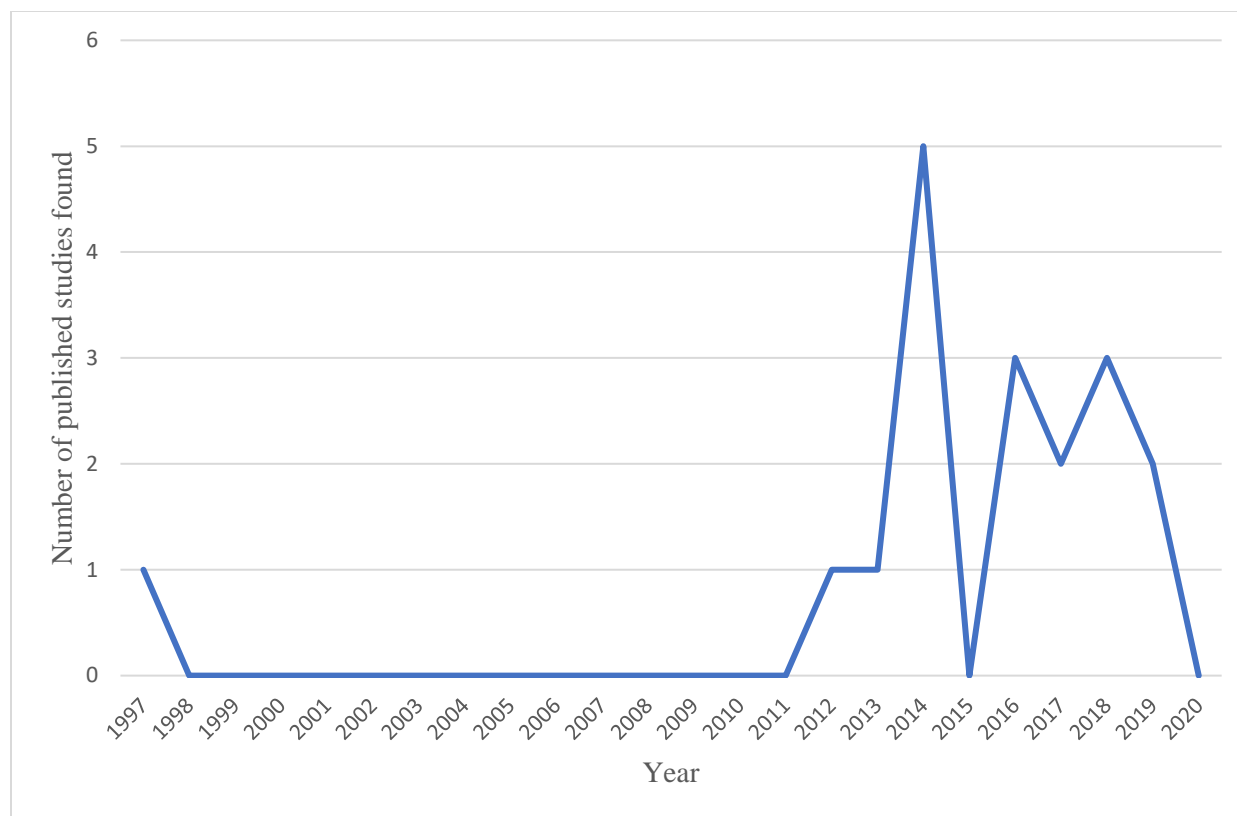


Figure 2: Trend of published studies relating to food safety at transport station in Africa

Supplementary file 1: Electronic databases search

Search date	Database	Keywords	Search results	Number eligible
09/11/2019	EBSCOhost (Academic search complete, CINAHL with Full-text, and Health Source	SU food safety AND SU (food preparation or meal preparation or cooking) OR SU food handling OR SU food storage OR hygiene practices AND (food trading or food selling or food vending or street food) AND (transport station or taxi rank or bus station or transport exchange sites or car park or lorry park) AND africa	2,549	14
10/11/2019	PubMed	"food safety"[MeSH Terms] OR ("food"[All Fields] AND "safety"[All Fields]) OR "food safety"[All Fields] OR ("food supply"[MeSH Terms] OR ("food"[All Fields] AND "supply"[All Fields]) OR "food supply"[All Fields] OR ("food"[All Fields] AND "security"[All Fields]) OR "food security"[All Fields]) AND (("food"[MeSH Terms] OR "food"[All Fields]) AND vending[All Fields]) OR (("food"[MeSH Terms] OR "food"[All Fields]) AND trading[All Fields]) AND streets[All Fields] OR (("motor vehicles"[MeSH Terms] OR ("motor"[All Fields] AND "vehicles"[All Fields]) OR "motor vehicles"[All Fields] OR "lorry"[All Fields]) AND parks[All Fields]) OR (("motor vehicles"[MeSH Terms] OR ("motor"[All Fields] AND "vehicles"[All Fields]) OR "motor vehicles"[All Fields] OR "lorry"[All Fields]) AND station[All Fields]) OR (taxi[All Fields] AND ranks[All Fields]) AND ("algeria"[MeSH Terms] OR "algeria"[All Fields]) OR ("angola"[MeSH Terms] OR "angola"[All Fields]) OR ("benin"[MeSH Terms] OR "benin"[All Fields]) OR ("botswana"[MeSH Terms] OR "botswana"[All Fields]) OR ("burkina faso"[MeSH Terms] OR ("burkina"[All Fields] AND "faso"[All Fields]) OR "burkina faso"[All Fields]) OR ("burundi"[MeSH Terms] OR "burundi"[All Fields]) OR ("cameroon"[MeSH Terms] OR "cameroon"[All Fields]) OR ("cabo verde"[MeSH Terms] OR ("cabo"[All Fields] AND "verde"[All Fields]) OR "cabo verde"[All Fields] OR ("cape"[All Fields] AND "verde"[All Fields]) OR "cape verde"[All Fields]) OR ("central african republic"[MeSH Terms]	2,834	33

OR ("central"[All Fields] AND "african"[All Fields] AND "republic"[All Fields]) OR "central african republic"[All Fields]) OR ("chad"[MeSH Terms] OR "chad"[All Fields]) OR ("democratic republic of the congo"[MeSH Terms] OR ("democratic"[All Fields] AND "republic"[All Fields] AND "congo"[All Fields]) OR "democratic republic of the congo"[All Fields]) OR ("congo"[MeSH Terms] OR "congo"[All Fields] OR ("republic"[All Fields] AND "congo"[All Fields]) OR "republic of the congo"[All Fields]) OR ("djibouti"[MeSH Terms] OR "djibouti"[All Fields]) OR ("egypt"[MeSH Terms] OR "egypt"[All Fields]) OR ("equatorial guinea"[MeSH Terms] OR ("equatorial"[All Fields] AND "guinea"[All Fields]) OR "equatorial guinea"[All Fields]) OR ("eritrea"[MeSH Terms] OR "eritrea"[All Fields]) OR ("ethiopia"[MeSH Terms] OR "ethiopia"[All Fields]) OR ("gabon"[MeSH Terms] OR "gabon"[All Fields]) OR ("gambia"[MeSH Terms] OR "gambia"[All Fields]) OR ("ghana"[MeSH Terms] OR "ghana"[All Fields]) OR ("guinea"[MeSH Terms] OR "guinea"[All Fields]) OR ("guinea-bissau"[MeSH Terms] OR "guinea-bissau"[All Fields] OR ("guinea"[All Fields] AND "bissau"[All Fields]) OR "guinea bissau"[All Fields]) OR ("cote d'ivoire"[MeSH Terms] OR ("cote"[All Fields] AND "d'ivoire"[All Fields]) OR "cote d'ivoire"[All Fields] OR ("ivory"[All Fields] AND "coast"[All Fields]) OR "ivory coast"[All Fields]) OR ("kenya"[MeSH Terms] OR "kenya"[All Fields]) OR ("lesotho"[MeSH Terms] OR "lesotho"[All Fields]) OR ("liberia"[MeSH Terms] OR "liberia"[All Fields]) OR ("libya"[MeSH Terms] OR "libya"[All Fields]) OR ("madagascar"[MeSH Terms] OR "madagascar"[All Fields]) OR ("malawi"[MeSH Terms] OR "malawi"[All Fields]) OR ("mali"[MeSH Terms] OR "mali"[All Fields]) OR ("mauritania"[MeSH Terms] OR "mauritania"[All Fields]) OR ("mauritius"[MeSH Terms] OR "mauritius"[All Fields]) OR ("morocco"[MeSH Terms] OR "morocco"[All Fields]) OR ("mozambique"[MeSH Terms] OR "mozambique"[All Fields]) OR ("namibia"[MeSH Terms] OR "namibia"[All Fields]) OR ("niger"[MeSH Terms] OR "niger"[All Fields]) OR ("nigeria"[MeSH Terms] OR "nigeria"[All Fields]) OR ("rwanda"[MeSH Terms] OR

		"rwanda"[All Fields]) OR ("sao tome and principe"[MeSH Terms] OR ("sao"[All Fields] AND "tome"[All Fields] AND "principe"[All Fields]) OR "sao tome and principe"[All Fields]) OR ("senegal"[MeSH Terms] OR "senegal"[All Fields]) OR ("seychelles"[MeSH Terms] OR "seychelles"[All Fields]) OR ("sierra leone"[MeSH Terms] OR ("sierra"[All Fields] AND "leone"[All Fields]) OR "sierra leone"[All Fields]) OR ("somalia"[MeSH Terms] OR "somalia"[All Fields]) OR (("south africa"[MeSH Terms] OR ("south"[All Fields] AND "africa"[All Fields]) OR "south africa"[All Fields]) AND South[All Fields]) OR ("sudan"[MeSH Terms] OR "sudan"[All Fields]) OR ("sudan"[MeSH Terms] OR "sudan"[All Fields]) OR ("eswatini"[MeSH Terms] OR "eswatini"[All Fields]) OR "swaziland"[All Fields]) OR ("tanzania"[MeSH Terms] OR "tanzania"[All Fields]) OR ("togo"[MeSH Terms] OR "togo"[All Fields]) OR ("tunisia"[MeSH Terms] OR "tunisia"[All Fields]) OR ("uganda"[MeSH Terms] OR "uganda"[All Fields]) OR ("zambia"[MeSH Terms] OR "zambia"[All Fields]) OR ("zimbabwe"[MeSH Terms] OR "zimbabwe"[All Fields]) Filters: Free full text, Comparative Study, Observational Study, Randomized Controlled Trial, Humans, English, MEDLINE		
11/11/2019	Web of Science	(food safety AND food preparation OR meal preparation OR cooking OR food handling OR food storage OR hygiene practices AND food trading OR food selling OR food vending or street food AND transport station OR taxi rank OR bus station OR transport exchange sites OR car park or lorry park AND africa)Refined by: Open Access: (OPEN ACCESS) AND DOCUMENT TYPES: (ARTICLE) AND DOCUMENT TYPES: (ARTICLE) AND WEB OF SCIENCE CATEGORIES: (FOOD SCIENCE TECHNOLOGY OR PUBLIC ENVIRONMENTAL OCCUPATIONAL HEALTH) AND WEB OF SCIENCE CATEGORIES: (FOOD SCIENCE TECHNOLOGY OR PUBLIC ENVIRONMENTAL OCCUPATIONAL HEALTH OR NUTRITION DIETETICS)Timespan: All years. Indexes: SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI.	8,263	36
12/11/2019	SCOPUS	food safety AND food preparation OR meal preparation OR cooking OR food handling OR food storage OR hygiene practices AND food trading OR	116	7

36/bmjopen-2021-053656 on 25 November 2021. Downloaded from <http://bmjopen.bmj.com/> on April 18, 2024 by guest. Protected by copyright.

		food selling OR food vending or street food AND transport station OR taxi rank OR bus station OR transport exchange sites OR car park or lorry park AND africa		
13/11/2019	Google Scholar	food safety AND food preparation OR meal preparation OR cooking OR food handling OR food storage OR hygiene practices AND food trading OR food selling OR food vending or street food AND transport station OR taxi rank OR bus station OR transport exchange sites OR car park or lorry park AND africa	9,820	56
			23,582	146
Duplicates				30

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Supplementary file 1: 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 #
TITLE			
Title	1	Identify the report as a scoping review.	
ABSTRACT			
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.	
INTRODUCTION			
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.	
METHODS			
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 #
RESULTS			
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.	
DISCUSSION			
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.	
FUNDING			
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.* ;169:467–473. doi: 10.7326/M18-0850



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A Scoping Review of Food Safety at Transport stations in Africa

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31 **Abstract**

32 **Background:** The World Health Organization (WHO) has declared food safety as a public
33 health concern. Transport hubs such as taxi ranks, bus stations, and other transport exchange
34 sites are major food trading/purchasing sites, particularly in Africa. Research evidence is
35 needed to improve food safety policies and ensure consumption of safe food, owing to the
36 increasing burden of foodborne diseases, particularly in the WHO Africa Region. Therefore,
37 we systematically mapped and described research evidence on food safety at transport stations
38 in Africa.

39 **Methods:** Guided by the Arksey and O'Malley framework, we searched for original research
40 articles in PubMed, Web of Science, and EBSCOhost (Academic search complete, CINAHL
41 with Full-text, and Health Source), SCOPUS, and Google Scholar from their inception to
42 October 2020. We included studies that focused on food safety, involved transport stations,
43 involved African countries, and were published in English. Two investigators independently
44 screened the articles at the abstract and full-text stages in parallel, guided by the eligibility
45 criteria, and then extracted all relevant data. Thematic analysis was used to organise the data
46 into themes and sub-themes, and a narrative summary of the findings is presented.

47 **Results:** Of the total 23,852 articles obtained from the database searches, 16 studies published
48 in six countries met the inclusion criteria. These 16 studies were published between 1997 and
49 2019, with the most (5) in 2014. Of the 16 studies, 43.8% (7) were conducted in South Africa,
50 three studies in Ghana, two in Ethiopia, and one study each in Nigeria, Kenya, Lesotho, and
51 Zambia. Most (44.4%) of the included studies focused on microbial safety of food; few studies
52 (22.2%) focused on hygienic practices, and one study investigated the perspective of
53 consumers or buyers. Microbes detected in the foods samples were *Salmonella* spp, *E. coli*,
54 *Shigella* spp, *Bacillus* sp, *Staphylococcus aureus*, which resulted mainly from poor hygiene
55 practices.

56 **Discussion:** There is limited research that focused on food safety at transport stations in Africa,
57 especially on aspects such as hygiene practices, food storage, and occupational health and food
58 safety. Therefore, we recommend more research in these areas, using various primary study
59 designs, to inform and improve food safety policies and practices for transport stations in
60 African countries alongside improving access to clean water/handwashing facilities, and
61 undertaking structural changes to facilitate behaviours and monitoring for unintended
62 consequences such as livelihoods of vulnerable populations.

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2
3 63 **Funding:** Funding for this work was provided by the Sustainable and Healthy Food Systems
4 (SHEFS) Programme.
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10 66 **Article summary**

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12 67 **Strengths and limitations of this study**

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15 68 • To the best of our knowledge, this is the first scoping review to systematically explore
16 literature and describe research evidence on food safety at transport stations as well as
17 identify gaps for future research in Africa.
18 69
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22 71 • This scoping review's evidence sources were searched using a systematic approach,
23 and duplicate screening.
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25 72
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27 73 • This review is limited to Africa as well as English language publications.
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87 **Background**

88 The World Health Organisation (WHO) estimates that more than 600 million people fall sick
89 (almost 1 in 10 people) with foodborne diseases annually, of which nearly 420 000 people die,
90 and about 33 million years of healthy lives are lost every year worldwide [1, 2]. The burden of
91 foodborne diseases is estimated to be highest in the WHO African and South-East Asia
92 Regions, mainly occurring among vulnerable populations such as infants, young children,
93 pregnant women, older people, poor people, and individuals with underlying illnesses [3]. Food
94 contamination mostly results throughout the food supply chain (from the procedures used in
95 processing the foods, inadequate storage temperatures, unhygienic practices by food handlers,
96 poor sanitation at cooking places/vending areas, poor waste management, and inadequate
97 treatment of leftovers) [4].

98 Unsafe food has negative implications on health systems, and affects the development and
99 national economies of countries, as well as trade [3]. Therefore, eating unsafe foods poses a
100 significant public health threat. To avert the consequences of unsafe food on health systems,
101 and to sustain national economies, development, trade, and tourism [5, 6], the WHO in 2006
102 declared food safety as a global public health concern [7, 8]. “Food safety refers to routines in
103 the preparation, handling and storage of food meant to prevent foodborne illness and injury”
104 [5]. To reduce the incidence of food-related diseases, particularly in high burden regions, the
105 observations of food safety measures/precautions at all levels of the food processing chain,
106 including the places where food is prepared and sold, are critical [9, 10].

107 Like other WHO Regions, especially in low-and-middle-income countries, food trading in the
108 Africa Region takes place at several formal and informal places, such as in the markets,
109 restaurants, streets, open spaces in academic institutions, and transport stations (taxi ranks, bus
110 stations, lorry parks), and other transport exchange sites. Food vending at public spaces serves
111 as a source of livelihood [6, 10, 11], and more than two billion people eat food sold at various
112 vending locations. including transportations stations on daily basis globally [12, 13]. To this
113 end, evidence is essential to inform in-country policies/guidelines, and further research, to
114 ensure that food prepared and sold at transport stations promotes livelihoods, nutrition, food
115 safety, and environmentally sustainable practices. This scoping review systematically mapped
116 literature focused on food safety at transport stations in Africa, to summarise evidence and
117 identify gaps.

118

119 **Methods**

120 **Scope of the review**

121 The Arksey & O'Malley framework (research question identification; identifying relevant
122 studies; selection of study; data charting, collating, and summarising and reporting the findings
123 [14, 15]) was employed to scope and synthesise literature to answer the question - what
124 evidence exists on food safety at transport stations in Africa? This review's study protocol was
125 developed *a priori* [16]. This study included published peer-reviewed articles that reported
126 findings from any African country/countries, focused on food safety, and involved transport
127 stations. However, this study was limited to English publications (due to lack of expertise in
128 other international languages), and primary study designs [16]. A detailed description of this
129 scoping review study eligibility criteria is captured in the published protocol [16]. We followed
130 the Preferred Reporting Items for Systematic and Meta-analysis (PRISMA) extension for
131 Scoping Reviews checklist to report this study [17].

133 **Identify relevant studies**

134 We searched for primary research articles relating to food safety at transport stations in
135 PubMed, Web of Science, and EBSCOhost (Academic search complete, CINAHL with Full-
136 text, and Health Source), SCOPUS, and Google Scholar from their inception to October 2020.
137 To enable the capturing of all relevant articles, a comprehensive search strategy (developed in
138 consultation with an expert librarian) consisting of keywords, Boolean terms (AND/OR), and
139 Medical Subject Heading terms, was used for the electronic database search (Supplementary
140 file 1). Syntax was modified appropriately where needed. Filters such as date and study design
141 were not applied during the literature search in the databases. DK and PG independently
142 conducted the database search and title screening, and imported all potentially eligible articles
143 onto an EndNote Library. The reference lists of all included articles were also screened for
144 potentially relevant articles using the same approach.

146 **Selection of articles**

147 Prior to the abstract screening, the 'find duplicates' function in EndNote was used to find all
148 duplicate articles, and they were removed from the library. A screening form was developed in
149 Google forms, using this study's eligibility criteria, for the abstract and full text screening
150 phases. Two reviewers (co-authors) independently screened the abstracts as well as the full text
151 articles. Discrepancies that arose during the abstract stage were resolved by discussion among

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3 152 the review team until a consensus was reached. At the full text screening phase, discrepancies
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5 153 were resolved by a third reviewer. All the additional articles identified from the reference list
6
7 154 of the included articles equally underwent full text assessment. The PRISMA flow diagram
8
9 155 was employed to account for all the articles involved [18].

11 156 **Charting the data**

12
13 157 A data extraction form was designed consisting of the following: Author(s) and publication
14
15 158 details, country of study, study design, study setting, study population, sample size, sex, study
16
17 159 findings, and recommendations. To ensure consistency and reliability, two reviewers piloted
18
19 160 the data extraction sheet using a random sample of three included studies. The pilot testing of
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21 161 the form also enabled the review team to discuss discrepancies, and to revise the data extraction
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23 162 form prior to its final usage. Subsequently, two reviewers conducted the data extraction for the
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25 163 remaining 15 included studies using both inductive and deductive approaches. The review team
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27 164 resolved all discrepancies at this stage through discussion.

28 165 29 166 **Collating, summarizing, and reporting the results**

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31 167 This study subsequently employed thematic analysis, and collated all the emerging themes and
32
33 168 sub-themes relating to food safety. A summary of the findings from the included studies is
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35 169 presented narratively.

36 170 37 38 171 **Patient and Public Involvement**

39 172 No patient involved

40 173 41 42 43 174 **Results**

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45 175 Of the 23,852 articles obtained from the database searches (see Figure 1 flow diagram), 146
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47 176 articles met the eligibility criteria at the title screening stage. Using EndNote “Find Duplicates”
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49 177 function, 30 duplicates were found and removed before abstract screening was conducted.
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51 178 Subsequently, 83 articles were removed at the abstract screening, and 20 at full text (17 of these
52
53 179 did not include transport stations/taxi ranks/bus stations, but did involve sale from market
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55 180 centres, public places, chop bars, mini restaurants, major streets, and sidewalks, and were
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57 181 excluded). Finally, 13 studies were included, and, from a manual search of their reference lists,
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59 182 a further three articles were added, giving a total of 16 articles for further analysis.

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184 **Characteristics of the included studies**

185 Table 1 presents a summary of the characteristics of the included studies. Of the 16 included
186 studies, about forty-four (43.8%) were conducted in South Africa [19-25], three (18.8%) in
187 Ghana [4, 26, 27], two (12.5%) in Ethiopia [28, 29], and one (6.2%) each in Nigeria [30],
188 Kenya [31], Lesotho [32], and Zambia [33]. Most of the studies were published in the last six
189 years, however, no published study was found in 2015 and 2020 (Figure 2). Fifteen (93.8%) of
190 the included studies were cross-sectional studies, and one (6.2%) was a mixed-method study.
191 Of the 16 included studies, 50.0% reported on microbial safety of food [4, 20, 23, 27-29, 33,
192 34], and 25.0% reported hygiene practices of food handlers/vendors [6, 21, 30, 31]. One
193 included study each reported on the following: occupational health and food safety risk [24];
194 knowledge of hygiene practice [26]; hygiene practices of food handlers/vendors and microbial
195 safety [25]; and knowledge of food safety measures and hygiene practice by food
196 handlers/vendors [32].

198 **Findings from the included studies**

199 **Microbial safety of food**

200 Of the nine included studies that reported findings on microbial safety of food, 44.4% were
201 conducted in South Africa [19, 20, 23, 25], 22.2% each in Ghana [4, 27] and Ethiopia [28, 29],
202 and the last 11.1% in Zambia [33]. Seven of the eight studies reported unacceptable levels of
203 microbes in the food [4, 20, 23, 27-29, 33, 34]. Table 2 presents a summary of the key findings
204 as well as the sample type, analytic approach, and the microbes reported.

206 **Hygiene practices of food handlers/vendors**

207 *Food preparation*

208 Of the 16 included studies, eight reported research findings relating to food preparation. Fifty
209 percent of these eight studies were from South Africa [6, 21, 23, 25], and the remainder were
210 from Ghana [26], Nigeria [30], Kenya[31], and Lesotho [32]. The studies in South Africa
211 focused on the following: hygiene practices and implications for consumers [21]; food and
212 nutrition knowledge as well as practices related to food preparation [6], the effect of hygiene
213 practices and attitudes of meat vendors [25], and sources of food contamination [23]. The study
214 from Ghana investigated how fast food operators washed their hands [26], whilst the studies
215 from Nigeria, Kenya, and Lesotho evaluated food safety and sanitary practices [30]; food

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3 216 vendors and hygiene practices [31]; and food safety knowledge, attitudes and practices of food
4 217 vendors and consumers' perceptions [32]. A summary of the key findings from these studies is
5 218 presented below (Table 3).
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10 220 ***Knowledge of hygiene practices/food safety precautions***

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12 221 In Ghana, McArthur-Floyd et. al. study [26], revealed that the majority (94%) of fast food
13 222 operators knew food safety precautions [26]. Letuka et. al. study [32] in Lesotho, indicated that
14 223 95% of food vendors did not know washing utensils with detergents helps reduce
15 224 contamination [32]. The mean knowledge (49%±11) of the food vendors included in the study
16 225 was considered poor [32]. About 6% of the consumers that participated in the study chose not
17 226 to buy food sold at taxi ranks due to food safety issues and hygiene [32].
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25 228 ***Occupational health and food safety risk***

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27 229 In South Africa, Qekwana et.al. [24]evaluated the occupational health and food safety risks
28 230 associated with the traditional slaughter of goats, and the consumption of such meat [24].
29 231 Approximately 63% of the practitioners were not wearing protective clothing during slaughter,
30 232 and about 78% of practitioners did not know their health status [24]. Almost 83% of the
31 233 practitioners hung up their carcass to facilitate bleeding, flaying, and evisceration [24]. The
32 234 study further observed that none of the practitioners practiced meat inspection [24]. In Nigeria,
33 235 Aluko et al. [30] study revealed that approximately 62% of the vendors had no formal training,
34 236 and their medical status was also unknown [30].
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43 238 **Discussion**

44 239 This scoping review mapped evidence on food safety at transport stations in Africa, and
45 240 revealed a very low number of papers that are published in this area, given many African
46 241 employees in both formal and informal sectors commute through these transport hubs [12, 13].
47 242 An average of one paper per year relating to food safety at transport hubs in Africa as revealed
48 243 by this review is simply not enough. Nonetheless, the few papers depict an imbalance of
49 244 research, with most focused on microbial safety [4, 20, 23, 27-29, 33, 34], and few on socio-
50 245 economic aspects such as hygiene practices [6, 21, 30, 31], and occupational health and food
51 246 safety risk [24]. Moreover, this review revealed no study evaluated the storage of food or how
52 247 the food is transported to the vending site.
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3 248 As evidence by this review, most of the food sold at transport hubs does not meet the minimum
4 standards and is not safe for consumption due to the presence of several microbes [4, 19, 23,
5 249 25, 27, 29, 33, 35]. There are several reasons for this such as poor practices relating to hygiene,
6 250 25, 27, 29, 33, 35]. There are several reasons for this such as poor practices relating to hygiene,
7 251 storage, preparation, cooking, cleaning, and serving [4, 20, 23, 27-29, 33, 34]. However, these
8 252 findings are similar to previous review findings involving markets [36], homes and restaurants
9 253 [37]. A recent publication by Gizaw [36] indicated that several studies reported microbial
10 254 contamination of foods sold in the market, with bacteria and fungi similar to those identified
11 255 in our review [36]. Also, a review by the WHO reported that the main factors contributing to
12 256 foodborne disease outbreaks in homes or restaurants were poor temperature control in
13 257 preparing, cooking, and storing food [37]. Although very few papers were found by this review,
14 258 the evidence is compelling that there should be policy interventions to address issues relating
15 259 poor hygiene practices, including food storage, preparation, cooking, cleaning, and serving by
16 260 food handlers at transport hubs, not only in South Africa but across Africa.

17 261 Similar to a previous scoping review [38], most of the included papers were published within
18 262 the last six years but, no published study was found in 2015 and 2020. Whilst the reason for
19 263 the lack of published papers in 2015 might be difficult to determine, the COVID-19 pandemic
20 264 which resulted in “covidisation” of research might be the reason for the lack of publication in
21 265 this field of research in 2020. Although we cannot conclude that no primary research has been
22 266 conducted in these countries focusing on the safety of food sold at transport stations, it suggests
23 267 a research/publication gap. Food safety research is, perhaps, more relevant now than ever in
24 268 Africa, since the burden of foodborne diseases is rising annually, resulting in the declaration
25 269 of food safety as a public health concern by the WHO [7, 8]. Aside from this, most commuters
26 270 tend to buy ready-to-eat (RTE) food from street food vendors, including those at transport hubs
27 271 [39, 40]; hence, the sale of food at transport stations is rising [40, 41], particularly in Africa [6]
28 272 partly due to an increase in demand for RTE, and the employment opportunities it offers to
29 273 many individuals who otherwise would not have had any source of income [38, 42]. Even more
30 274 worrying is the fact that most of the articles included that focused on microbial safety, reported
31 275 high levels of food contamination with several microorganisms, especially *Salmonella* spp and
32 276 *E. coli* [4, 19, 23, 25, 27, 29, 33, 35]. Therefore, more research is needed across African
33 277 countries to prevent potential negative consequences.

34 278 Our study findings have implications for practice and research. For instance, the likelihood of
35 279 food poisoning with microbes such as *Salmonella* spp, *E. coli.*, *Shigella* spp, *Bacillus* spp, *S.*
36 280 *aureus*, and several others, revealed by most of the included studies that focused on microbial

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3 281 contamination of food, is alarming. This, if not checked, could further worsen the already high
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5 282 burden of foodborne diseases in a continent that has several of its countries already
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7 283 experiencing many health systems and economic challenges. Aside from this, the majority of
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9 284 individuals who commute through transport hubs, possible will purchase a meal from a
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11 285 transport hub/exchanges site, which may be the only meal of the day [12, 13], and yet the food
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13 286 safety standards are poor [4, 20, 23, 27-29, 33, 34]. Thus, if not checked, the excess cases of
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15 287 foodborne diseases from any outbreak will further impact negatively on the already challenged
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17 288 public health systems in Africa. Also, poor people who are exposed to these unsafe foods get
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19 289 an infection, may have to pay more for healthcare, which can further exacerbate their poverty
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21 290 situation. Moreover, people who are already living in extreme poverty who get exposed to
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23 291 foodborne disease may not even make it to the hospital for care and can end up dying at home
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25 292 [43].

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27 293 Good hygiene and sanitation practices, such as adequate hand washing, adequate washing and
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29 294 storage of pots and dishes, good waste management, observation of food preparation standards
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31 295 and serving etiquette, among others, have the potential to reduce the risk of food contamination
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33 296 from both biological and non-biological hazards, yet this study reveals fewer studies that
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35 297 focused on hygienic practices. We, therefore, recommend more research to further inform
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37 298 contextualised policy decisions aimed at improving hygiene and sanitation practices by food
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39 299 vendors at transport stations. Also, very relevant to ensuring food safety is the occupational
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41 300 health practices of the vendors. Regular food handling tests and food inspections, conducted
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43 301 by the appropriate local authorities, should be mandatory in all African countries. Food handler
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45 302 tests should seek to ensure that food vendors are fit healthwise to prepare and serve food meant
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47 303 for public consumption. However, our review found limited studies that evaluated occupational
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49 304 health and food safety. Considering that evidence from South Africa and Nigeria suggests
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51 305 about 78% and 62% of food vendors do not know their health status [30, 44], and the increasing
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53 306 number of informal food sellers at various transport exchange sites, future studies are
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55 307 recommended to focus on occupational health and food safety in Africa. The means and manner
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57 308 of storing food, especially leftover RTE food, can either increase or reduce the risk of food
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59 309 contamination, but, again, this scoping review found no study that focused on food storage
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310 practices of the vendors at transport stations. Also essential, and yet we did not find any study
311 focusing on it, is the quality of food (nutritious aspects) of the meals sold at transport stations.
312 Eating a well nourishing diet or balanced meals is critical to ensure good health [45-47], hence,
313 we encourage future primary studies to include the nutritious aspects. Such studies may help

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3 314 streamline guidelines or inform policies to improve the quality of the food sold at transport
4 315 exchange sites or taxi ranks. Moreover, this review found that the majority (17 out of 18) of
5 316 the respondents in the included studies were the vendors (mostly females) or food samples
6 317 taken from the vendors. The perspectives of consumers (buyers) or commuters regarding food
7 318 safety at transport stations are also very relevant, and we recommend future research to involve
8 319 them. A comparative study to investigate food safety practices among males and females food
9 320 vendors at transport stations might be relevant since many males are now getting involved in
10 321 the business [6, 48, 49].

11 322 To the best of our knowledge, this study is the first scoping review that systematically mapped
12 323 literature relating to food safety at transport stations in Africa. A major strength of our study
13 324 method is that it permits the inclusion of multiple study designs. Also, the choice of this study
14 325 method permitted us to highlight literature gaps, and made recommendations for future
15 326 research. Aside from this, we conducted a thorough search in six databases using a
16 327 comprehensive search strategy which enabled us to capture the most relevant articles to answer
17 328 the review question. Moreover, two independent reviewers were used to select the studies and
18 329 perform data extraction processes which helped to prevent selection bias and ensured the
19 330 reliability and trustworthiness of this study results. Despite this, our scoping review has many
20 331 limitations. This study included only original study peer reviewed papers, which resulted in the
21 332 exclusion of one review paper [38], and one Masters' dissertation [50]. We did not also consult
22 333 the websites of WHO and the Food and Agriculture Organisation websites for possible relevant
23 334 studies. Furthermore, this study cannot be generalised since the search was limited to African
24 335 countries only. Although date limitation was removed, we limited the publication language to
25 336 English only, which perhaps eliminated relevant articles published in other languages. Despite
26 337 these limitations, this study has provided essential evidence relating to food safety at transport
27 338 stations and has shown literature gaps to guide future research.

28 339

29 340 **Conclusion**

30 341 Based on this scoping review's eligibility criteria, our study results suggest there is limited
31 342 research focusing on food safety at transport stations in Africa. Most of the existing published
32 343 studies are focused on microbial safety of food, and very few/none on other aspects such as
33 344 hygiene practices, food storage, occupational health and food safety, and nutrition. Hence, we
34 345 recommend more primary research involving community members and policy makers in these
35 346 areas going forward alongside improving access to clean water/handwashing facilities, and

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3 347 undertaking structural changes to facilitate behaviours and monitoring for unintended
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5 348 consequences such as livelihoods of vulnerable populations.
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8 350 **Abbreviations**

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10 351 PRISMA- Preferred Reporting Items for Systematic and Meta-analysis

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12 352 RTE- Ready-to-eat

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14 353 WHO- World Health Organization

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16 17 355 **Ethics and dissemination**

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19 356 Not required. This study did not include human participants.

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22 358 **Data availability statement**

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24 359 Not applicable. All sources of data have been adequately referenced

25 360

26 27 361 **Patient and Public Involvement**

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29 362 No patient involved

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32 33 364 **Statements**

34 365 **Acknowledgments**

35
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38 367 Programme, supported through the Wellcome Trust's Our Planet, Our Health Programme

39
40 368

41 369 **Authors' contributions**

42
43 370 BPN, DK, SED, SM, and RS conceptualized and designed the study. DK developed and

44
45 371 designed the database search strategy and conducted the search. PG contributed to the

46
47 372 screening of the studies and data extraction. DK wrote the draft manuscript and BPN, SED,

48
49 373 GM, and RS critically review it and made revisions. All the authors approved the final version

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51 374 of the manuscript.

52 375

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380 of the manuscript.

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3 381 **Competing interests**

4
5 382 None declared

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7 383 **References**

8
9 384 1. The Lancet Gastroenterology H. Food safety really is everyone's business. The lancet
10 Gastroenterology & hepatology. 2019;4(8):571.

11
12
13 386 2. World Health Organization. Estimating the burden of foodborne diseases Geneva:
14 World Health Organization; 2015 [cited 2019 25/10/2019]. Available from:
15 387 <https://www.who.int/activities/estimating-the-burden-of-foodborne-diseases>.

16
17 388
18
19 389 3. World Health Organization. Food Safety Geneva: World Health Organization; 2016
20 [cited 2020 17/11/2020]. Available from: <https://www.afro.who.int/health-topics/food-safety>.

21
22
23 391 4. Feglo P, Sakyi K. Bacterial contamination of street vending food in Kumasi, Ghana.
24 Journal of Medical Biomedical Sciences. 2012;1(1):1-8.

25
26
27 393 5. Organization WH. Food Safety: What you should know Geneva: World Health
28 Organization; 2015 [cited 2019 25/10/2019]. Available from:
29 394 http://www.searo.who.int/entity/world_health_day/2015/whd-what-you-should-know/en/.

30
31 395
32
33 396 6. Hill J, Mchiza Z, Puoane T, Steyn NP. The development of an evidence-based street
34 food vending model within a socioecological framework: a guide for African countries. PloS
35 397 one. 2019;14(10):e0223535.

36
37
38
39 399 7. World Health Organization. Five keys to safer food manual Geneva: World Health
40 Organization; 2006 [cited 2019 25/10/2019]. Available from:
41 400 https://www.who.int/foodsafety/publications/consumer/manual_keys.pdf.

42
43 401
44
45 402 8. Lamin-Boima P. Knowledge, Attitude And Practice Of Street Food Vendors In
46 403 Selected Schools Within Bo City Southern Sierra Leone.

47
48
49 404 9. Lues JFR, Rasephei MR, Venter P, Theron MM. Assessing food safety and associated
50 405 food handling practices in street food vending. International Journal of Environmental Health
51 406 Research. 2006;16(5):319-28.

52
53
54
55 407 10. Abrahale K, Sousa S, Albuquerque G, Padrao P, Lunet N. Street food research
56 408 worldwide: a scoping review. Journal of human nutrition and dietetics : the official journal of
57 409 the British Dietetic Association. 2019;32(2):152-74.

- 1
2
3 410 11. Liu Z, Zhang G, Zhang X. Urban street foods in Shijiazhuang city, China: Current
4 411 status, safety practices and risk mitigating strategies. *Food Control*. 2014;41:212-8.
5
6
7 412 12. Food and Agriculture Organization. Selling street and snack foods Rome: Food and
8 413 Agriculture Organization; 2011 [cited 2019 25/10/2019]. Available from:
9 414 <http://www.fao.org/3/a-i2474e.pdf>.
10
11
12
13 415 13. Gelormini M, Damasceno A, Lopes SA, Malo S, Chongole C, Muholove P, et al. Street
14 416 Food Environment in Maputo (STOOD Map): a Cross-Sectional Study in Mozambique. *JMIR*
15 417 *research protocols*. 2015;4(3):e98.
16
17
18
19 418 14. Arksey H, O'Malley L. Scoping studies: towards a methodological framework.
20 419 *International Journal of Social Research Methodology*. 2005;8(1):19-32.
21
22
23 420 15. Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology.
24 421 *Implementation Science*. 2010;5(1):69.
25
26
27 422 16. Ncama BP, Kuupiel D, Duma SE, McHunu G, Guga P, Slotow R. Mapping evidence
28 423 of food safety at transport stations in Africa: a scoping review protocol. *BMJ Open*.
29 424 2020;10(8):e035879-e.
30
31
32
33 425 17. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA
34 426 extension for scoping reviews (PRISMA-ScR): checklist and explanation. *Annals of internal*
35 427 *medicine*. 2018;169(7):467-73.
36
37
38
39 428 18. Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. PRISMA 2009 Flow
40 429 Diagram. 2009;6(2009):1000097.
41
42
43 430 19. Oguttu JW, McCrindle CME, Makita K, Grace D. Investigation of the food value chain
44 431 of ready-to-eat chicken and the associated risk for staphylococcal food poisoning in Tshwane
45 432 Metropole, South Africa. *Food Control*. 2014;45:87-94.
46
47
48
49 433 20. Mafune TS, Takalani TK, Anyasi TA, Ramashia SE. Microbial Safety of Street Vended
50 434 Foods Sold in Thohoyandou, South Africa. *Journal of Human Ecology*. 2016;53(3):205-12.
51
52
53 435 21. Kok R, Balkaran R. Street food vending and hygiene practices and implications for
54 436 consumers. *Journal of Economics Behavioral Studies*. 2014;6(3):188-93.
55
56
57 437 22. Hill J, McHiza Z, Puoane T, Steyn NP. Food sold by street-food vendors in Cape Town
58 438 and surrounding areas: a focus on food and nutrition knowledge as well as practices related to
59
60

- 1
2
3 439 food preparation of street-food vendors. *Journal of Hunger & Environmental Nutrition*.
4 440 2019;14(3):401-15.
5
6
7 441 23. Mazizi B, Muchenje V, Makepe M, Mutero G. Assessment of Aerobic Plate Counts,
8 442 *Staphylococcus aureus*, *Escherichia coli* and *Salmonella* in Meat Sold by Street Vendors in the
9 443 Eastern Cape Province, South Africa. *Journal of Food Nutrition Research*. 2017;5(6):436-42.
10
11
12
13 444 24. Qekwana DN, McCrindle CM, Oguttu JW, Grace D. Assessment of the occupational
14 445 health and food safety risks associated with the traditional slaughter and consumption of goats
15 446 in Gauteng, South Africa. *International journal of environmental research and public health*.
16 447 2017;14(4):420.
17
18
19
20
21 448 25. Tshipamba M, Lubanza N, Adetunji M, Mwanza MJFMSH. Evaluation of the Effect
22 449 of Hygiene Practices and Attitudes on the Microbial Quality of Street Vended Meats Sold in
23 450 Johannesburg, South-Africa. 2018;3(137):2476-059.1000137.
24
25
26
27 451 26. McArthur-Floyd M, Commey V, Boakye NAB. Evaluation of Food Safety among Fast
28 452 Food Operators in Madina, Accra. *Evaluation*. 2016;54.
29
30
31 453 27. Abakari G, Cobbina SJ, Yeleliere E. Microbial quality of ready-to-eat vegetable salads
32 454 vended in the central business district of tamale, Ghana. *International Journal of Food*
33 455 *Contamination*. 2018;5(1).
34
35
36
37 456 28. Kibret M, Tadesse M. The bacteriological safety and antimicrobial susceptibility of
38 457 bacteria isolated from street-vended white lupin (*Lupinus albus*) in Bahir Dar, Ethiopia.
39 458 *Ethiopian Journal of Health Sciences*. 2013;23(1):19-26.
40
41
42
43 459 29. Eromo T, Tassew H, Daka D, Kibru G. Bacteriological quality of street foods and
44 460 antimicrobial resistance of isolates in Hawassa, Ethiopia. *Ethiopian journal of health sciences*.
45 461 2016;26(6):533-42.
46
47
48
49 462 30. Aluko OO, Ojeremi TT, Olaleke DA, Ajidagba EB. Evaluation of food safety and
50 463 sanitary practices among food vendors at car parks in Ile Ife, southwestern Nigeria. *Food*
51 464 *Control*. 2014;40:165-71.
52
53
54
55 465 31. Odundo A, Okemo P, Chege P. An Assessment of Food Safety Practices among Street
56 466 Vendors in Mombasa, Kenya. *International Journal of Health Sciences Research*.
57 467 2018;8(5):235-43.
58
59
60

- 1
2
3 468 32. Letuka P, Nkhebenyane J, Thekiso O. Assessment of Food Safety Knowledge,
4 469 Attitudes and Practices among Street Food Vendors and Consumers' Perceptions of Street
5 470 Food Vending in Maseru Lesotho. 2019.
- 6
7
8
9 471 33. Jermini M, Bryan FL, Schmitt R, Mwandwe C, Mwenya J, Zyuulu MH, et al. Hazards
10 472 and Critical Control Points of Food Vending Operations in a City in Zambia. *J Food Prot.*
11 473 1997;60(3):288-99.
- 12
13
14
15 474 34. Oguttu JW, McCrindle CM, Makita K, Grace D. Investigation of the food value chain
16 475 of ready-to-eat chicken and the associated risk for staphylococcal food poisoning in Tshwane
17 476 Metropole, South Africa. *Food Control.* 2014;45:87-94.
- 18
19
20
21 477 35. Kibret M, Tadesse MJEjohs. The bacteriological safety and antimicrobial susceptibility
22 478 of bacteria isolated from street-vended white lupin (*Lupinus albus*) in Bahir Dar, Ethiopia.
23 479 2013;23(1):19-26.
- 24
25
26
27 480 36. Gizaw Z. Public health risks related to food safety issues in the food market: a
28 481 systematic literature review. *Environmental Health and Preventive Medicine.* 2019;24(1):68.
- 29
30
31 482 37. Todd EC. Epidemiology of foodborne diseases: a worldwide review. *World health*
32 483 *statistics quarterly Rapport trimestriel de statistiques sanitaires mondiales.* 1997;50(1-2):30-
33 484 50.
- 34
35
36
37 485 38. Abrahale K, Sousa S, Albuquerque G, Padrao P, Lunet N. Street food research
38 486 worldwide: a scoping review. *Journal of Human Nutrition and Dietetics.* 2019;32(2):152-74.
- 39
40
41 487 39. Bellia C, Pilato M, Seraphin H. Street food and food safety: a driver for tourism?
42 488 *Calitatea.* 2016;17(S1):20.
- 43
44
45 489 40. Mosupye FM, Von Holy A. Microbiological hazard identification and exposure
46 490 assessment of street food vending in Johannesburg, South Africa. *International Journal of Food*
47 491 *Microbiology*
48 492 2000;61(2-3):137-45.
- 49
50
51
52
53 493 41. Mosupye FM, von Holy A. Microbiological quality and safety of ready-to-eat street-
54 494 vended foods in Johannesburg, South Africa. *International Journal of Food Microbiology.*
55 495 1999;62(11):1278-84.
- 56
57
58
59
60

- 1
2
3 496 42. Muzaffar AT, Huq I, Mallik BA. Entrepreneurs of the streets: An analytical work on
4 497 the street food vendors of Dhaka City. *International journal of Business Management*.
5 498 2009;4(2):80-8.
6
7
8
9 499 43. World Health Organisation. Universal Health Coverage Geneva2020 [cited 2021
10 500 09/04/2021]. Available from: [https://www.who.int/health-topics/universal-health-](https://www.who.int/health-topics/universal-health-coverage#tab=tab_1)
11 501 [coverage#tab=tab_1](https://www.who.int/health-topics/universal-health-coverage#tab=tab_1).
12
13
14
15 502 44. Qekwana DN, McCrindle CM, Oguttu JW, Grace D. Assessment of the occupational
16 503 health and food safety risks associated with the traditional slaughter and consumption of goats
17 504 in Gauteng, South Africa. *International Journal of Environmental Research*. 2017;14(4):420.
18
19
20
21 505 45. Melanson K. Nutrition review: lifestyle approaches to promoting healthy eating for
22 506 children. *American journal of lifestyle medicine*. 2008;2(1):26-9.
23
24
25 507 46. Carrier N, Villalon L, Lengyel C, Slaughter SE, Duizer L, Morrison-Koechl J, et al.
26 508 Diet quality is associated with malnutrition and low calf circumference in Canadian long-term
27 509 care residents. *BMC nutrition*. 2019;5:57.
28
29
30
31 510 47. Freeland-Graves JH, Nitzke S. Position of the academy of nutrition and dietetics: total
32 511 diet approach to healthy eating. *Journal of the Academy of Nutrition Dietetics*.
33 512 2013;113(2):307-17.
34
35
36
37 513 48. Okojie P, Isah E. Sanitary conditions of food vending sites and food handling practices
38 514 of street food vendors in Benin City, Nigeria: implication for food hygiene and safety. *Journal*
39 515 *of environmental public Health Reports*. 2014;2014.
40
41
42
43 516 49. da Silva SA, Cardoso RdCV, Góes JÂW, Santos JN, Ramos FP, de Jesus RB, et al.
44 517 Street food on the coast of Salvador, Bahia, Brazil: A study from the socioeconomic and food
45 518 safety perspectives. *Food control*. 2014;40:78-84.
46
47
48
49 519 50. Acheampong BE. Assessment of food hygiene practices by street food vendors and
50 520 microbial quality of selected foods sold. A Study at Dunkwa-On-Offin, Upper Denkyira East
51 521 Municipality of the Central Region 2015.
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523 **Table 1:** Characteristic of the included sources of evidence

Author, year	Country	City/Town	Study design	Study setting	Study population	Sample size	Sex of vendors	Outcome reported
Oguttu et. al., 2014 [34]	South Africa	Tshwane Metropole, Gauteng Province	Mixed-methods study	Taxi rank	Vendors selling Ready-to-eat chicken	100 samples of Ready-to-eat chicken	Females	Microbial safety of food
Mafune et. al., 2016 [20]	South Africa	Thohoyandou, Limpopo Province	Cross-sectional study	Taxi rank, bus station, shopping mall, and street stalls	Food samples from street vendors	28 samples	Not specified	Microbial safety of food
Kibret et. al., 2013 [28]	Ethiopia	Bahir Dar Town	Cross-sectional study	Main roads sites, bus station, groceries, taxi ranks	Ready-to-eat white lupin sample from vendors	40 samples (200 grams of white lupin)	Not specified	Microbial safety of food
Abakari et. al., 2018 [27]	Ghana	Tamale, Northern Region	Cross-sectional study	Taxi rank, bus stops, transport yard, and timber Market	Ready-to-eat salad samples from food vendors	30 salad samples	Not specified	Microbial safety of food
Aluko et.al., 2014 [30]	Nigeria	Ile Ife, southwestern Nigeria	Cross-sectional study	Car parks	Food vendors	160 (112 stationary and 43 mobile vendors)	Males and females	Hygiene practices of food handlers/vendors
Odundo et. al., 2018 [31]	Kenya		Cross-sectional study	Major bus stops, markets, shopping areas, construction	Food vendors	130	Males and females	Hygiene practices of food handlers/vendors

				sites, and commercial areas				
Kok et. al., 2014 [21]	South Africa	Durban, KwaZulu-Natal Province	Cross-sectional study	Transport exchange site	Food vendors	29	Not specified	Hygiene practices of food handlers/vendors
Letuka et. al., 2019 [32]	Lesotho	Maseru	Cross-sectional study	Taxi ranks	Food vendors	141 (48 food handlers and 93 consumers)	Male and female	Knowledge of food safety measures and hygiene practice by food handlers/vendors
Eromo et. al., 2016 [29]	Ethiopia	Hawassa City	Cross-sectional study	Bus station	Food samples from street food vendors	72 samples from six food items	Not specified	Microbial safety of food
McArthur-Floyd et. al., 2016 [26]	Ghana	Madina (Accra), Greater Accra Region	Cross-sectional study	Taxi rank, and transport exchange sites	Food vendors	200	Males and females	Knowledge of hygiene practice
Hill et. al., 2019 [6]	South Africa	Cape Town	Cross-sectional study	Train, bus stations, and taxi ranks, community centers, market	Food vendors	831	Males and females	Hygiene practices of food handlers/vendors
Mazizi et. al., 2017 [23]	South Africa	Alice (Nkonkobe) and King William's Town (Buffalo City), Eastern Cape province	Cross-sectional study	Taxi rank and bus stations	Street food vendors	136 food samples cooked and raw.	Not specified	Microbial safety of food

Qekwana et.al, 2017 [24]	South Africa	Tshwane Metropolitan Municipality, Gauteng Province	Cross-sectional study	Taxi ranks and Informal markets	Traditional goat slaughter	105 people	Males and females	Occupational health and food safety risk
Flego et. al., 2012 [4]	Ghana	Kumasi, Ashanti Region	Cross-sectional study	Bus terminals	Food samples from vendors	60 food samples	Not specified	Microbial safety of food
Tshipamba et. al., 2018 [25]	South Africa	Johannesburg	Cross-sectional study	Taxi ranks and streets	Meat samples from vendors	115 meat samples	Not specified	Hygiene practices of food handlers/vendors, and microbial safety of food
Jermini et. al., 1997 [33]	Zambia	Not specified	Cross-sectional study	bus park/station and large market	Samples of raw, processed, and cooked Foods from street food vendors	Not specified	Not specified	Microbial safety of food

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525 **Table 2:** Microbial safety of food at transport stations

Study	Type of sample	Analytical approach	Microbes reported	Key results	Key conclusion
Oguttu et. al. [34]	Ready-to-eat (RTE) chicken	3M™ Petrifilm™ plates	<i>S. aureus</i>	<ul style="list-style-type: none"> High prevalence of <i>S. aureus</i> in the sample was (44%; 90% CI: 36.1%-52.2%), with mean <i>S. aureus</i> counts of $10^{3.6}$ (90%CI: $10^{3.3}$-$10^{3.9}$). 	To reduce the levels of concentration of <i>S. aureus</i> on the RTE chicken and promote the sale of safer and

				<ul style="list-style-type: none"> The likelihood of food poisoning with <i>S. aureus</i> from RTE chicken was estimated to be 1.3% (90% CI: 0% -2.7%) 	affordable RTE chicken for the large urban poor population in South Africa, training of RTE chicken vendors on hygiene is still needed.
Mafune et. al. [20]	Unfermented porridge, boiled cabbage and carrots, boiled peanuts, salad, potato chips, traditional mageu, and stewed beef and grilled chicken	Standard microbiological method	<i>S. aureus</i>	<ul style="list-style-type: none"> <i>S. aureus</i> was <2.4771 log10 cfu/g in all samples and places. Except for fried potato chips, microbial contamination was observed in the remaining food samples using the total plate count method. 	Most of the vended foods investigated met the microbiological standard of RTE foods
Mazizi et. al. [23]	Cooked and raw beef, pork, and mutton samples, surface contact plates, and water samples	Biochemical tests according to international standards methods	<i>S. aureus</i> , <i>E. coli</i> , and <i>Salmonella spp.</i>	<ul style="list-style-type: none"> Mean score of raw beef, mutton, and pork were aerobic plate counts (4.8, 3.7 and 2.8 Log (cfu/g)), <i>S. aureus</i> (3.3, 3.7 and 2.8 Log cfu/g), and <i>E. coli</i> (1.0, 0.6 and 0.3 Log cfu/g) respectively. 	The levels of contamination in cooked meat were lower when compared to the standards set by Commission Regulation for determining the microbiological quality of RTE foods.
Tshipamba et. al. [25]	RTE meat	Standard biochemical and Molecular methods	<i>Bacillus thuringiensis</i> , <i>Bacillus spp.</i> , <i>Bacillus subtilis</i> , <i>Bacillus cereus</i> , <i>Citrobacter spp.</i> , <i>Enterococcus faecium</i> ,	<ul style="list-style-type: none"> Overall mean total bacteria in the samples ranged from 4.3-6.03 cfu/ml × 10² and coliform counts ranged from 1.60-1.95 × 10² cfu/ml Of the 15 microbes identified, <i>S. aureus</i> occurred in all the meat types and the percentage of occurrence was chicken meat (14%), beef head 	Consumers RTE meat are at risk of food borne diseases due to poor hygiene practices of the vendors.

bmjopen-2021-053856 on 25 November 2021. Downloaded from http://bmjopen.bmj.com/ on April 18, 2024 by guest. Protected by copyright.

			<p><i>Enterococcus faecalis</i>, <i>Kurthia spp.</i>, <i>Lysinibacillus spp.</i> <i>Macrocooccus caseolyticus</i>, <i>Planomicrobium glaciei</i>, <i>Planococcus antarcticus</i>, <i>S. aureus</i>, <i>S. equorum</i>, and <i>S. vitulinus</i></p>	<p>(43%), beef intestine (50%), and work (sausage) (20%)</p>	
Kibret et. al. [28]	White lupin	Standard bacteriological techniques, and Kirby-Bauer disk diffusion method for antimicrobial susceptibility test	<i>E. coli</i> , <i>Salmonella spp.</i> , and <i>Shigella spp.</i>	<ul style="list-style-type: none"> • Prevalence of bacteria total coliform counts were 954.2±385 at the surface and 756.2±147.3 at the core of white lupin. • Pathogens isolated were as follows <i>E. coli</i> 29 (72.5%), <i>Salmonella spp.</i> 23 (57.5%) and <i>Shigella spp.</i> 8 (20%). • Overall multiple antimicrobial resistance rate was 75% 	Contamination of white lupin and a potential health risk to consumers revealed, and the bacteria isolated showed high rates of multiple drug resistance.
Eromo et. al. [29]	Local bread ('ambasha' and 'kita'),	Standard microbiological techniques	<i>E. coli</i> , <i>Salmonella spp.</i> , and <i>S. aureus</i>	<ul style="list-style-type: none"> • The microbiological quality in nearly 31% of RTE food samples was beyond the acceptable limits. 	Considerable rate of contamination in the foods confirmed. The identified foodborne bacteria and antibiotic resistance isolates could pose a

	raw fish, chilli ('awaze'), avocado, and cooked potato			<ul style="list-style-type: none"> Total colony counts detected ranged from 1.7x10⁵ to 6.7x10⁶ cfu/g. <i>E.coli</i> (29.6%), <i>Salmonella</i> spp. (12.7%), and <i>S. aureus</i> (9.9%) were the most frequent isolates. All isolates were 100% sensitive to ciprofloxacin, but 89% of <i>Salmonella</i> spp. was resistant to chloramphenicol, 14.3% of <i>S.aureus</i> was resistant to vancomycin 	public health problem in the study location.
Abakari et. al. [27]	Pre-cut vegetable salads	Standard microbiological methods	<i>E. coli</i> , <i>Bacillus cereus</i> , <i>Salmonella</i> spp, and <i>Shigella</i> spp.	<ul style="list-style-type: none"> <i>E. coli</i> levels ranged from 0 to 7.56 log₁₀ cfu/g; <i>Bacillus cereus</i> levels ranged from 0 to 7.44 log₁₀ cfu/g; <i>Salmonella</i> spp. ranged from 0 to 4.54 log₁₀ cfu/g, and <i>Shigella</i> spp. ranged from 5.54 log₁₀ cfu/g were detected in 96.0%, 93.3%, 73.3%, and 76.7% of the salads samples, respectively. 	Salads were revealed to be unwholesome for human consumption and could be deleterious to the health of consumers.
Flego et. al. [4]	RTE foods (ice-kenkey (15), cocoa drink (15), fufu (5), ready-to-eat red pepper for kenkey (5), salad (10), and macaroni (10))	Standard microbiological methods	<i>Staphylococci</i> , <i>Bacillus</i> spp., <i>Klebsiella pneumoniae</i> , <i>Aeromonas pneumophila</i> , <i>E. cloacae</i> , <i>S. aureus</i> , <i>E. coli</i> , and <i>P. aeruginosa</i>	<ul style="list-style-type: none"> RTE foods were found to be contaminated with enteric bacteria and other potential food poisoning organisms with bacterial counts higher than the acceptable levels (<5.0 log₁₀ CFU/ml). Coagulate negative staphylococci (23.7%), <i>Bacillus</i> species (21.5%), <i>K. pneumoniae</i> (18.0%), <i>Aeromonas pneumophila</i> (15.7%), <i>E. cloacae</i> (6.7%), <i>S. aureus</i> (3.7%), <i>E. coli</i> (2.2%) and <i>P. aeruginosa</i> (2.2%) were the main isolates detected. 	Most RTE foods were contaminated with enteric bacteria and other potential food poisoning organisms with bacterial counts higher than the acceptable levels.

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Jermini et. al. [33]	Raw foods (ground meat, chicken, and chicken intestine); and processed foods (dried “minnows” and “kapenta”)		<i>Salmonellae Spp.</i> , <i>S. aureus</i> , <i>Clostridium peifringens</i>	<ul style="list-style-type: none"> • Raw foods such as ground meat, chicken, chicken intestine; and processed foods such as dried “minnows” and “kapenta” were contaminated by salmonellae or contained high populations of <i>S. aureus</i> in pasteurized milk. • High populations (> 10⁵) of <i>S. aureus</i> were detected from a sample of leftover chicken, more than 10⁷ were detected in leftover rice, and 10 million <i>C. peifringens</i> per gram were detected in leftover beef stew sample 	Time-temperature exposures during reheating had variable effects in terms of killing the microorganisms that germinated from surviving spores or that reached the foods after cooking.
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For peer review only

527 **Table 3:** Key reported findings on food preparation

Study	Key findings reported
Kok et. al. [21]	<ul style="list-style-type: none"> • Water being used for washing utensils was left unchanged, • Piles of dirty pots and dishes was left near the serving areas and RTE foods, and garbage left uncovered with many flies at the site, • RTE food was left uncovered, • Most of the food handlers were not wearing gloves, hairnets, or aprons
Hill et. al. [6]	<ul style="list-style-type: none"> • 85.5% of the vending stalls lacked soap or surface sanitizer, • 71% lacked basin for washing, • 75% did not have drying cloth, • 76.6% of vendors handled food and money concurrently, • About 57% left the food uncovered. • 39% of the vendors were using their hands to pick up food items, with only 6% wearing gloves, and • 29% of vendors had a wet clean sponge/cloth obtainable at the site
Mazizi et. al. [23]	<ul style="list-style-type: none"> • Major sources of food contamination identified were poor hygiene practices of the food vendor, holding area, and the utensils
Tshipamba et. al. [25]	<ul style="list-style-type: none"> • Approximately 90% of RTE meat vendors at the taxi rank exposed their meats to dust and flies, • 94% of them handled money whilst serving food, and • Stagnant water found in about 22% of the vending locations at the taxi-rank
McArthur-Floyd et. al. [26]	<ul style="list-style-type: none"> • 64% of food vendors washed their hands from elbow to finger and the remainder (36%) washed from their wrist to finger (the WHO recommends handwashing from elbow to fingers), and • 62% of the vendors test their meal in the palm whilst 38% of them test it with a spoon (the best way to test a meal)
Aluko et. al. [30]	<ul style="list-style-type: none"> • Approximately 17% of food vendors washed their hands always after using the toilet, • 63% of them rarely kept their fingernails short, and • Nearly 4% of them always kept their leftover cooked food in a refrigerator, despite having unstable power supply
Odundo et. al. [31]	<ul style="list-style-type: none"> • Food vendors had poor hygiene practices however, men were observed to have better hygienic practices than women ($P < 0.05$), • Hygiene practice of the vendors was found to be significantly associated with training (those trained observe hygiene), and • Wearing of jewellery, long and unclean nails, and lack of protective clothing were observed.
Letuka et. al. [32]	<ul style="list-style-type: none"> • Observed that the food handlers operated under unhygienic environment

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530 **Figure**531 **Figure 1:** PRISMA 2009 Flow Diagram532 **Figure 2:** Trend of published studies relating to food safety at transport station in Africa

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534 **Supplementary File**535 **Supplementary file 1:** PRISMA-P Checklist

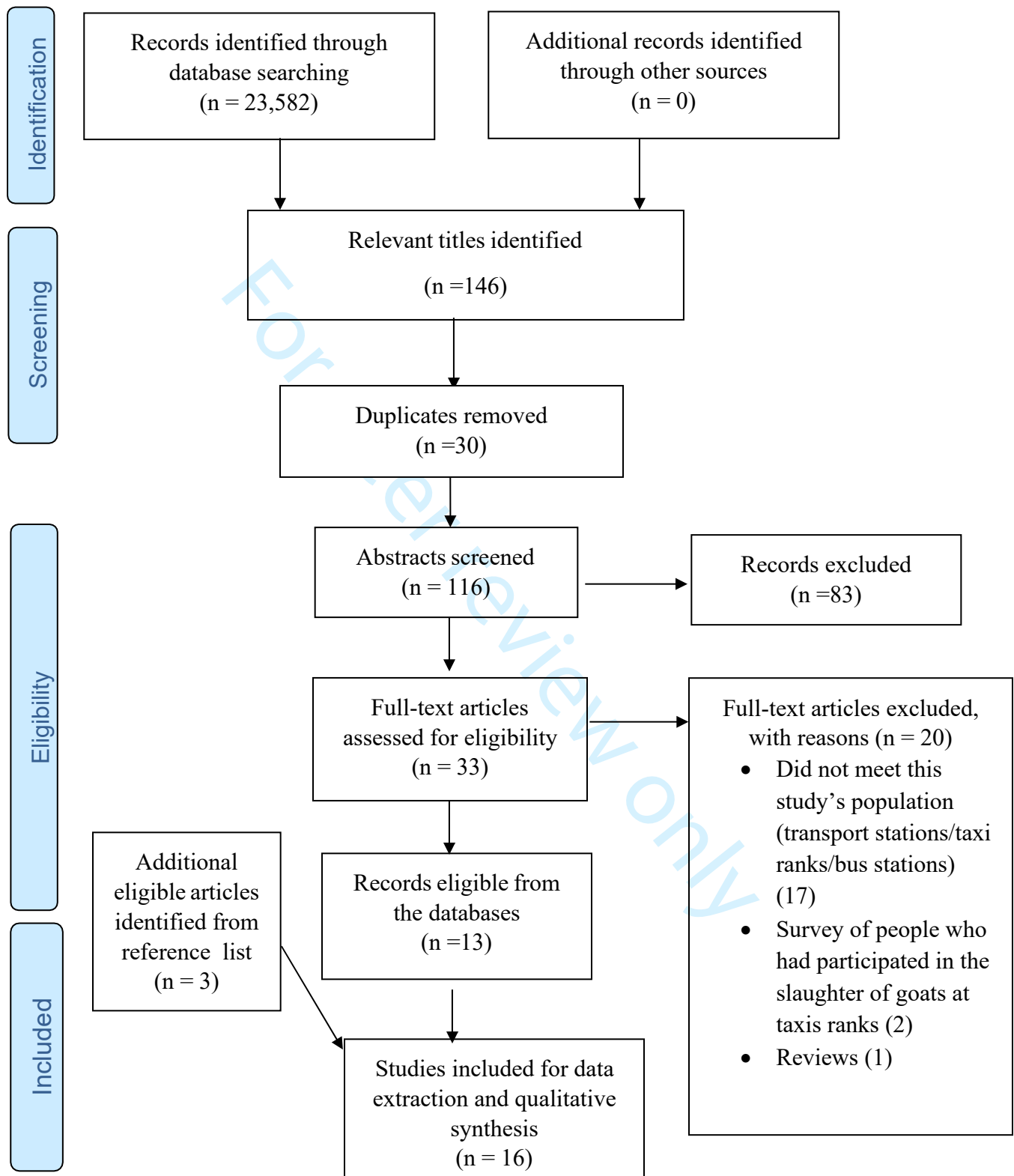


Figure 1: PRISMA 2009 Flow Diagram [18]

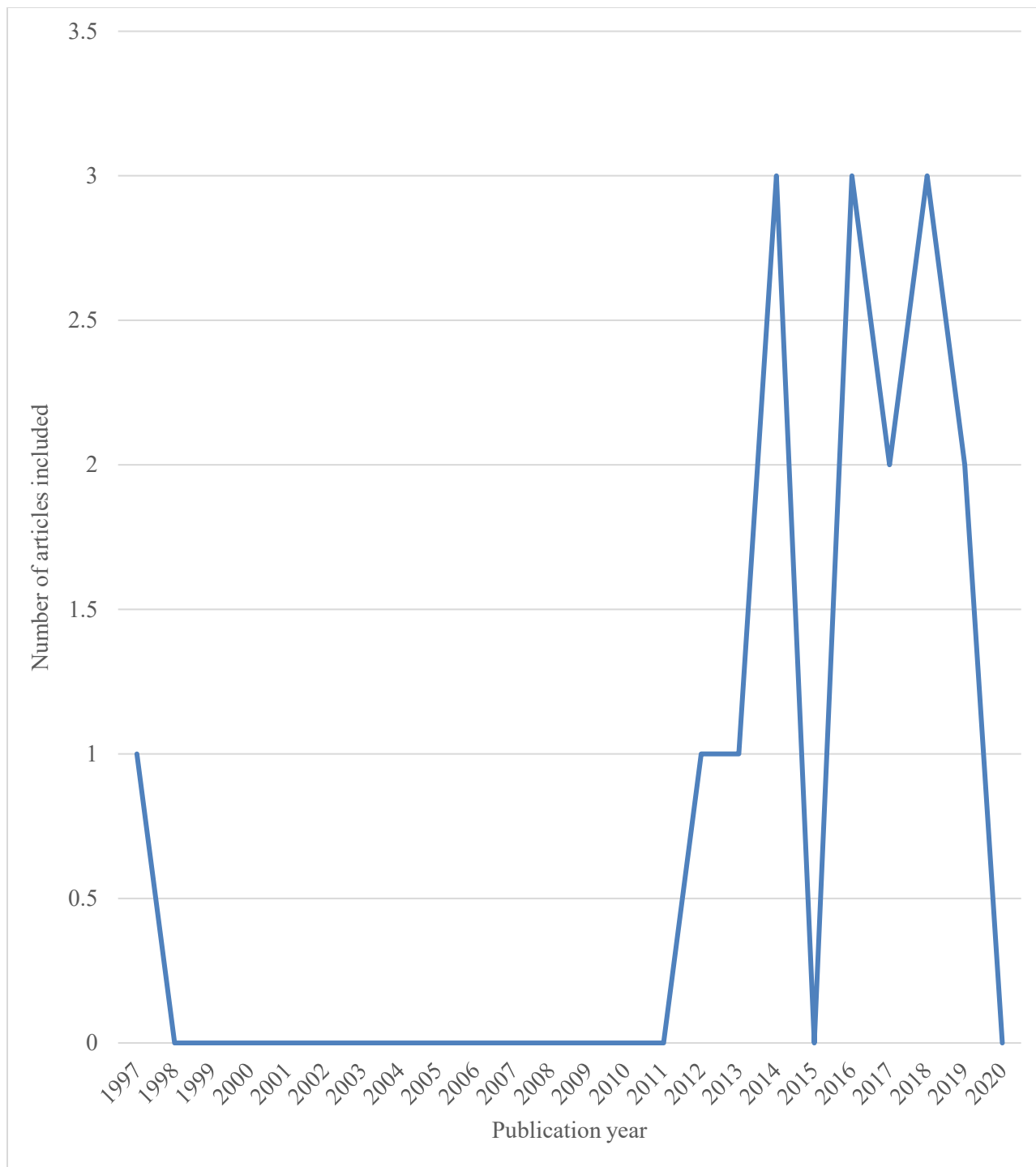


Figure 2: Trend of published studies relating to food safety at transport stations in Africa

Supplementary file 1: Electronic databases search

Search date	Database	Keywords	Search results	Number eligible
09/11/2019	EBSCOhost (Academic search complete, CINAHL with Full-text, and Health Source	SU food safety AND SU (food preparation or meal preparation or cooking) OR SU food handling OR SU food storage OR hygiene practices AND (food trading or food selling or food vending or street food) AND (transport station or taxi rank or bus station or transport exchange sites or car park or lorry park) AND africa	2,549	14
10/11/2019	PubMed	"food safety"[MeSH Terms] OR ("food"[All Fields] AND "safety"[All Fields]) OR "food safety"[All Fields] OR ("food supply"[MeSH Terms] OR ("food"[All Fields] AND "supply"[All Fields]) OR "food supply"[All Fields] OR ("food"[All Fields] AND "security"[All Fields]) OR "food security"[All Fields]) AND (("food"[MeSH Terms] OR "food"[All Fields]) AND vending[All Fields]) OR (("food"[MeSH Terms] OR "food"[All Fields]) AND trading[All Fields]) AND streets[All Fields] OR (("motor vehicles"[MeSH Terms] OR ("motor"[All Fields] AND "vehicles"[All Fields]) OR "motor vehicles"[All Fields] OR "lorry"[All Fields]) AND parks[All Fields]) OR (("motor vehicles"[MeSH Terms] OR ("motor"[All Fields] AND "vehicles"[All Fields]) OR "motor vehicles"[All Fields] OR "lorry"[All Fields]) AND station[All Fields]) OR (taxi[All Fields] AND ranks[All Fields]) AND ("algeria"[MeSH Terms] OR "algeria"[All Fields]) OR ("angola"[MeSH Terms] OR "angola"[All Fields]) OR ("benin"[MeSH Terms] OR "benin"[All Fields]) OR ("botswana"[MeSH Terms] OR "botswana"[All Fields]) OR ("burkina faso"[MeSH Terms] OR ("burkina"[All Fields] AND "faso"[All Fields]) OR "burkina faso"[All Fields]) OR ("burundi"[MeSH Terms] OR "burundi"[All Fields]) OR ("cameroon"[MeSH Terms] OR "cameroon"[All Fields]) OR ("cabo verde"[MeSH Terms] OR ("cabo"[All Fields] AND "verde"[All Fields]) OR "cabo verde"[All Fields] OR ("cape"[All Fields] AND "verde"[All Fields]) OR "cape verde"[All Fields]) OR ("central african republic"[MeSH Terms]	2,834	33

OR ("central"[All Fields] AND "african"[All Fields] AND "republic"[All Fields]) OR "central african republic"[All Fields]) OR ("chad"[MeSH Terms] OR "chad"[All Fields]) OR ("democratic republic of the congo"[MeSH Terms] OR ("democratic"[All Fields] AND "republic"[All Fields] AND "congo"[All Fields]) OR "democratic republic of the congo"[All Fields]) OR ("congo"[MeSH Terms] OR "congo"[All Fields] OR ("republic"[All Fields] AND "congo"[All Fields]) OR "republic of the congo"[All Fields]) OR ("djibouti"[MeSH Terms] OR "djibouti"[All Fields]) OR ("egypt"[MeSH Terms] OR "egypt"[All Fields]) OR ("equatorial guinea"[MeSH Terms] OR ("equatorial"[All Fields] AND "guinea"[All Fields]) OR "equatorial guinea"[All Fields]) OR ("eritrea"[MeSH Terms] OR "eritrea"[All Fields]) OR ("ethiopia"[MeSH Terms] OR "ethiopia"[All Fields]) OR ("gabon"[MeSH Terms] OR "gabon"[All Fields]) OR ("gambia"[MeSH Terms] OR "gambia"[All Fields]) OR ("ghana"[MeSH Terms] OR "ghana"[All Fields]) OR ("guinea"[MeSH Terms] OR "guinea"[All Fields]) OR ("guinea-bissau"[MeSH Terms] OR "guinea-bissau"[All Fields] OR ("guinea"[All Fields] AND "bissau"[All Fields]) OR "guinea bissau"[All Fields]) OR ("cote d'ivoire"[MeSH Terms] OR ("cote"[All Fields] AND "d'ivoire"[All Fields]) OR "cote d'ivoire"[All Fields] OR ("ivory"[All Fields] AND "coast"[All Fields]) OR "ivory coast"[All Fields]) OR ("kenya"[MeSH Terms] OR "kenya"[All Fields]) OR ("lesotho"[MeSH Terms] OR "lesotho"[All Fields]) OR ("liberia"[MeSH Terms] OR "liberia"[All Fields]) OR ("libya"[MeSH Terms] OR "libya"[All Fields]) OR ("madagascar"[MeSH Terms] OR "madagascar"[All Fields]) OR ("malawi"[MeSH Terms] OR "malawi"[All Fields]) OR ("mali"[MeSH Terms] OR "mali"[All Fields]) OR ("mauritania"[MeSH Terms] OR "mauritania"[All Fields]) OR ("mauritus"[MeSH Terms] OR "mauritus"[All Fields]) OR ("morocco"[MeSH Terms] OR "morocco"[All Fields]) OR ("mozambique"[MeSH Terms] OR "mozambique"[All Fields]) OR ("namibia"[MeSH Terms] OR "namibia"[All Fields]) OR ("niger"[MeSH Terms] OR "niger"[All Fields]) OR ("nigeria"[MeSH Terms] OR "nigeria"[All Fields]) OR ("rwanda"[MeSH Terms] OR

		<p>"rwanda"[All Fields]) OR ("sao tome and principe"[MeSH Terms] OR ("sao"[All Fields] AND "tome"[All Fields] AND "principe"[All Fields]) OR "sao tome and principe"[All Fields]) OR ("senegal"[MeSH Terms] OR "senegal"[All Fields]) OR ("seychelles"[MeSH Terms] OR "seychelles"[All Fields]) OR ("sierra leone"[MeSH Terms] OR ("sierra"[All Fields] AND "leone"[All Fields]) OR "sierra leone"[All Fields]) OR ("somalia"[MeSH Terms] OR "somalia"[All Fields]) OR (("south africa"[MeSH Terms] OR ("south"[All Fields] AND "africa"[All Fields]) OR "south africa"[All Fields]) AND South[All Fields]) OR ("sudan"[MeSH Terms] OR "sudan"[All Fields]) OR ("sudan"[MeSH Terms] OR "sudan"[All Fields]) OR ("eswatini"[MeSH Terms] OR "eswatini"[All Fields]) OR "swaziland"[All Fields]) OR ("tanzania"[MeSH Terms] OR "tanzania"[All Fields]) OR ("togo"[MeSH Terms] OR "togo"[All Fields]) OR ("tunisia"[MeSH Terms] OR "tunisia"[All Fields]) OR ("uganda"[MeSH Terms] OR "uganda"[All Fields]) OR ("zambia"[MeSH Terms] OR "zambia"[All Fields]) OR ("zimbabwe"[MeSH Terms] OR "zimbabwe"[All Fields]) Filters: Free full text, Comparative Study, Observational Study, Randomized Controlled Trial, Humans, English, MEDLINE</p>	
11/11/2019	Web of Science	<p>(food safety AND food preparation OR meal preparation OR cooking OR food handling OR food storage OR hygiene practices AND food trading OR food selling OR food vending or street food AND transport station OR taxi rank OR bus station OR transport exchange sites OR car park or lorry park AND africa)Refined by: Open Access: (OPEN ACCESS) AND DOCUMENT TYPES: (ARTICLE) AND DOCUMENT TYPES: (ARTICLE) AND WEB OF SCIENCE CATEGORIES: (FOOD SCIENCE TECHNOLOGY OR PUBLIC ENVIRONMENTAL OCCUPATIONAL HEALTH) AND WEB OF SCIENCE CATEGORIES: (FOOD SCIENCE TECHNOLOGY OR PUBLIC ENVIRONMENTAL OCCUPATIONAL HEALTH OR NUTRITION DIETETICS)Timespan: All years. Indexes: SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI.</p>	8,263 36
12/11/2019	SCOPUS	<p>food safety AND food preparation OR meal preparation OR cooking OR food handling OR food storage OR hygiene practices AND food trading OR</p>	116 7

36/bmjopen-2021-053656 on 25 November 2021. Downloaded from <http://bmjopen.bmj.com/> on April 18, 2024 by guest. Protected by copyright.

		food selling OR food vending or street food AND transport station OR taxi rank OR bus station OR transport exchange sites OR car park or lorry park AND africa		
13/11/2019	Google Scholar	food safety AND food preparation OR meal preparation OR cooking OR food handling OR food storage OR hygiene practices AND food trading OR food selling OR food vending or street food AND transport station OR taxi rank OR bus station OR transport exchange sites OR car park or lorry park AND africa	9,820	56
			23,582	146
Duplicates				30

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Supplementary file 1: 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 #
TITLE			
Title	1	Identify the report as a scoping review.	
ABSTRACT			
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.	
INTRODUCTION			
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.	
METHODS			
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 #
RESULTS			
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.	
DISCUSSION			
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.	
FUNDING			
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).

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A Scoping Review of Food Safety at Transport stations in Africa

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31 Abstract

32 **Objective:** The World Health Organization (WHO) has declared food safety as a public health
33 concern. Transport hubs such as taxi ranks, bus stations, and other transport exchange sites are
34 major food trading/purchasing sites, particularly in Africa. Research evidence is needed to
35 improve food safety policies and ensure consumption of safe food, owing to the increasing
36 burden of foodborne diseases, particularly in the WHO Africa Region. We systematically
37 mapped and described research evidence on food safety at transport stations in Africa.

38 **Design:** A scoping review guided by the Arksey and O'Malley framework.

39 **Data sources:** We searched for original research articles in PubMed, Web of Science, and
40 EBSCOhost (Academic search complete, CINAHL with Full-text, and Health Source),
41 SCOPUS, and Google Scholar from their inception to 25th October 2020.

42 **Eligibility criteria for selecting studies:** We included studies that focused on food safety,
43 involved transport stations, involved African countries, and were published in English.

44 **Data extraction and synthesis:** Data extraction was performed by two reviewers using a
45 piloted-tested form. Thematic analysis was used to organise the data into themes and sub-
46 themes, and a narrative summary of the findings is presented.

47 **Results:** Of the total 23,852 articles obtained from the database searches, 16 studies published
48 in six countries met the inclusion criteria. These 16 studies were published between 1997 and
49 2019, with the most (5) in 2014. Of the 16 studies, 43.8% (7) were conducted in South Africa,
50 three studies in Ghana, two in Ethiopia, and one study each in Nigeria, Kenya, Lesotho, and
51 Zambia. Most (44.4%) of the included studies focused on microbial safety of food; few studies
52 (22.2%) focused on hygienic practices, and one study investigated the perspective of
53 consumers or buyers. Microbes detected in the foods samples were *Salmonella* spp, *E. coli*,
54 *Shigella* spp, *Bacillus* sp, *Staphylococcus aureus*, which resulted mainly from poor hygiene
55 practices.

56 **Conclusions:** There is limited research that focused on food safety at transport stations in
57 Africa, especially on aspects such as hygiene practices, food storage, and occupational health
58 and food safety. Therefore, we recommend more research in these areas, using various primary
59 study designs, to inform and improve food safety policies and practices for transport stations
60 in African countries alongside improving access to clean water/handwashing facilities, and
61 undertaking structural changes to facilitate behaviours and monitoring for unintended
62 consequences such as livelihoods of vulnerable populations.

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3 63 **Article summary**
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6 64 **Strengths and limitations of this study**
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- 9 65 • To the best of our knowledge, this is the first scoping review to systematically explore
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11 66 literature and describe research evidence on food safety at transport stations as well as
12
13 identify gaps for future research in Africa.
14 67
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16 68 • This scoping review's evidence sources were searched using a systematic approach,
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18 69 and duplicate screening.
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21 70 • This review is limited to Africa as well as English language publications.
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87 **Background**

88 The World Health Organisation (WHO) estimates that more than 600 million people fall sick
89 (almost 1 in 10 people) with foodborne diseases annually, of which nearly 420 000 people die,
90 and about 33 million years of healthy lives are lost every year worldwide [1, 2]. The burden of
91 foodborne diseases is estimated to be highest in the WHO African and South-East Asia
92 Regions, mainly occurring among vulnerable populations such as infants, young children,
93 pregnant women, older people, poor people, and individuals with underlying illnesses [3]. Food
94 contamination mostly results throughout the food supply chain (from the procedures used in
95 processing the foods, inadequate storage temperatures, unhygienic practices by food handlers,
96 poor sanitation at cooking places/vending areas, poor waste management, and inadequate
97 treatment of leftovers) [4].

98 Unsafe food has negative implications on health systems, and affects the development and
99 national economies of countries, as well as trade [3]. Therefore, eating unsafe foods poses a
100 significant public health threat. To avert the consequences of unsafe food on health systems,
101 and to sustain national economies, development, trade, and tourism [5, 6], the WHO in 2006
102 declared food safety as a global public health concern [7, 8]. “Food safety refers to routines in
103 the preparation, handling and storage of food meant to prevent foodborne illness and injury”
104 [5]. To reduce the incidence of food-related diseases, particularly in high burden regions, the
105 observations of food safety measures/precautions at all levels of the food processing chain,
106 including the places where food is prepared and sold, are critical [9, 10].

107 Like other WHO Regions, especially in low-and-middle-income countries, food trading in the
108 Africa Region takes place at several formal and informal places, such as in the markets,
109 restaurants, streets, open spaces in academic institutions, and transport stations (taxi ranks, bus
110 stations, lorry parks), and other transport exchange sites. Food vending at public spaces serves
111 as a source of livelihood [6, 10, 11], and more than two billion people eat food sold at various
112 vending locations. including transportations stations on daily basis globally [12, 13]. To this
113 end, evidence is essential to inform in-country policies/guidelines, and further research, to
114 ensure that food prepared and sold at transport stations promotes livelihoods, nutrition, food
115 safety, and environmentally sustainable practices. This scoping review systematically mapped
116 literature focused on food safety at transport stations in Africa, to summarise evidence and
117 identify gaps.

118

119 **Methods**

120 **Scope of the review**

121 The Arksey & O'Malley framework (research question identification; identifying relevant
122 studies; selection of study; data charting, collating, and summarising and reporting the findings
123 [14, 15]) was employed to scope and synthesise literature to answer the question - what
124 evidence exists on food safety at transport stations in Africa? This review's study protocol was
125 developed *a priori* [16]. This study included published peer-reviewed articles that reported
126 findings from any African country/countries, focused on food safety, and involved transport
127 stations. However, this study was limited to English publications (due to lack of expertise in
128 other international languages), and primary study designs [16]. A detailed description of this
129 scoping review study eligibility criteria is captured in the published protocol [16]. We followed
130 the Preferred Reporting Items for Systematic and Meta-analysis (PRISMA) extension for
131 Scoping Reviews checklist to report this study [17].

133 **Identify relevant studies**

134 We searched for primary research articles relating to food safety at transport stations in
135 PubMed, Web of Science, and EBSCOhost (Academic search complete, CINAHL with Full-
136 text, and Health Source), SCOPUS, and Google Scholar from their inception to 25th October
137 2020. To enable the capturing of all relevant articles, a comprehensive search strategy
138 (developed in consultation with an expert librarian) consisting of keywords, Boolean terms
139 (AND/OR), and Medical Subject Heading terms, was used for the electronic database search
140 (Supplementary file 1). Syntax was modified appropriately where needed. Filters such as date
141 and study design were not applied during the literature search in the databases. DK and PG
142 independently conducted the database search and title screening, and imported all potentially
143 eligible articles onto an EndNote Library. The reference lists of all included articles were also
144 screened for potentially relevant articles using the same approach.

146 **Selection of articles**

147 Prior to the abstract screening, the 'find duplicates' function in EndNote was used to find all
148 duplicate articles, and they were removed from the library. A screening form was developed in
149 Google forms, using this study's eligibility criteria, for the abstract and full text screening
150 phases. Two reviewers (co-authors) independently screened the abstracts as well as the full text
151 articles. Discrepancies that arose during the abstract stage were resolved by discussion among

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3 152 the review team until a consensus was reached. At the full text screening phase, discrepancies
4
5 153 were resolved by a third reviewer. All the additional articles identified from the reference list
6
7 154 of the included articles equally underwent full text assessment. The PRISMA flow diagram
8
9 155 was employed to account for all the articles involved [18].

11 156 **Charting the data**

13 157 A data extraction form was designed consisting of the following: Author(s) and publication
14
15 158 details, country of study, study design, study setting, study population, sample size, sex, study
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17 159 findings, and recommendations. To ensure consistency and reliability, two reviewers piloted
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19 160 the data extraction sheet using a random sample of three included studies. The pilot testing of
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21 161 the form also enabled the review team to discuss discrepancies, and to revise the data extraction
22
23 162 form prior to its final usage. Subsequently, two reviewers conducted the data extraction for the
24
25 163 remaining 15 included studies using both inductive and deductive approaches. The review team
26
27 164 resolved all discrepancies at this stage through discussion.

28 165 29 166 **Collating, summarizing, and reporting the results**

31 167 This study subsequently employed thematic analysis, and collated all the emerging themes and
32
33 168 sub-themes relating to food safety. A summary of the findings from the included studies is
34
35 169 presented narratively.

36 170 37 38 171 **Patient and Public Involvement**

39 172 No patient involved

40 173 41 42 43 174 **Results**

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45 175 Of the 23,852 articles obtained from the database searches (see Figure 1 flow diagram), 146
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47 176 articles met the eligibility criteria at the title screening stage. Using EndNote “Find Duplicates”
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49 177 function, 30 duplicates were found and removed before abstract screening was conducted.
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51 178 Subsequently, 83 articles were removed at the abstract screening, and 20 at full text (17 of these
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53 179 did not include transport stations/taxi ranks/bus stations, but did involve sale from market
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55 180 centres, public places, chop bars, mini restaurants, major streets, and sidewalks, and were
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57 181 excluded). Finally, 13 studies were included, and, from a manual search of their reference lists,
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59 182 a further three articles were added, giving a total of 16 articles for further analysis.

60 183

184 **Characteristics of the included studies**

185 Table 1 A & B present a summary of the characteristics of the included studies. Of the 16
186 included studies, about forty-four (43.8%) were conducted in South Africa [19-25], three
187 (18.8%) in Ghana [4, 26, 27], two (12.5%) in Ethiopia [28, 29], and one (6.2%) each in Nigeria
188 [30], Kenya [31], Lesotho [32], and Zambia [33]. Most of the studies were published in the last
189 six years, however, no published study was found in 2015 and 2020 (Figure 2). Fifteen (93.8%)
190 of the included studies were cross-sectional studies, and one (6.2%) was a mixed-method study.
191 Of the 16 included studies, 50.0% reported on microbial safety of food [4, 20, 23, 27-29, 33,
192 34], and 25.0% reported hygiene practices of food handlers/vendors [6, 21, 30, 31]. One
193 included study each reported on the following: occupational health and food safety risk [24];
194 knowledge of hygiene practice [26]; hygiene practices of food handlers/vendors and microbial
195 safety [25]; and knowledge of food safety measures and hygiene practice by food
196 handlers/vendors [32].

198 **Findings from the included studies**

199 **Microbial safety of food**

200 Of the nine included studies that reported findings on microbial safety of food, 44.4% were
201 conducted in South Africa [19, 20, 23, 25], 22.2% each in Ghana [4, 27] and Ethiopia [28, 29],
202 and the last 11.1% in Zambia [33]. Seven of the eight studies reported unacceptable levels of
203 microbes in the food [4, 20, 23, 27-29, 33, 34]. Table 2 A, B & C present a summary of the key
204 findings as well as the sample type, analytic approach, and the microbes reported.

206 **Hygiene practices of food handlers/vendors**

207 *Food preparation*

208 Of the 16 included studies, eight reported research findings relating to food preparation. Fifty
209 percent of these eight studies were from South Africa [6, 21, 23, 25], and the remainder were
210 from Ghana [26], Nigeria [30], Kenya[31], and Lesotho [32]. The studies in South Africa
211 focused on the following: hygiene practices and implications for consumers [21]; food and
212 nutrition knowledge as well as practices related to food preparation [6], the effect of hygiene
213 practices and attitudes of meat vendors [25], and sources of food contamination [23]. The study
214 from Ghana investigated how fast food operators washed their hands [26], whilst the studies
215 from Nigeria, Kenya, and Lesotho evaluated food safety and sanitary practices [30]; food

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3 216 vendors and hygiene practices [31]; and food safety knowledge, attitudes and practices of food
4 217 vendors and consumers' perceptions [32]. A summary of the key findings from these studies is
5 218 presented below (Table 3).
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10 220 *Knowledge of hygiene practices/food safety precautions*

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12 221 In Ghana, McArthur-Floyd et. al. study [26], revealed that the majority (94%) of fast food
13 222 operators knew food safety precautions [26]. Letuka et. al. study [32] in Lesotho, indicated that
14 223 95% of food vendors did not know washing utensils with detergents helps reduce
15 224 contamination [32]. The mean knowledge (49%±11) of the food vendors included in the study
16 225 was considered poor [32]. About 6% of the consumers that participated in the study chose not
17 226 to buy food sold at taxi ranks due to food safety issues and hygiene [32].
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25 228 *Occupational health and food safety risk*

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27 229 In South Africa, Qekwana et.al. [24]evaluated the occupational health and food safety risks
28 230 associated with the traditional slaughter of goats, and the consumption of such meat [24].
29 231 Approximately 63% of the practitioners were not wearing protective clothing during slaughter,
30 232 and about 78% of practitioners did not know their health status [24]. Almost 83% of the
31 233 practitioners hung up their carcass to facilitate bleeding, flaying, and evisceration [24]. The
32 234 study further observed that none of the practitioners practiced meat inspection [24]. In Nigeria,
33 235 Aluko et al. [30] study revealed that approximately 62% of the vendors had no formal training,
34 236 and their medical status was also unknown [30].
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43 238 **Discussion**

44 239 This scoping review mapped evidence on food safety at transport stations in Africa, and
45 240 revealed a very low number of papers that are published in this area, given many African
46 241 employees in both formal and informal sectors commute through these transport hubs [12, 13].
47 242 An average of one paper per year relating to food safety at transport hubs in Africa as revealed
48 243 by this review is simply not enough. Nonetheless, the few papers depict an imbalance of
49 244 research, with most focused on microbial safety [4, 20, 23, 27-29, 33, 34], and few on socio-
50 245 economic aspects such as hygiene practices [6, 21, 30, 31], and occupational health and food
51 246 safety risk [24]. Moreover, this review revealed no study evaluated the storage of food or how
52 247 the food is transported to the vending site.
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3 248 As evidence by this review, most of the food sold at transport hubs does not meet the minimum
4 standards and is not safe for consumption due to the presence of several microbes [4, 19, 23,
5 249 25, 27, 29, 33, 35]. There are several reasons for this such as poor practices relating to hygiene,
6 250 25, 27, 29, 33, 35]. There are several reasons for this such as poor practices relating to hygiene,
7 251 storage, preparation, cooking, cleaning, and serving [4, 20, 23, 27-29, 33, 34]. However, these
8 252 findings are similar to previous review findings involving markets [36], homes and restaurants
9 253 [37]. A recent publication by Gizaw [36] indicated that several studies reported microbial
10 254 contamination of foods sold in the market, with bacteria and fungi similar to those identified
11 255 in our review [36]. Also, a review by the WHO reported that the main factors contributing to
12 256 foodborne disease outbreaks in homes or restaurants were poor temperature control in
13 257 preparing, cooking, and storing food [37]. Although very few papers were found by this review,
14 258 the evidence is compelling that there should be policy interventions to address issues relating
15 259 poor hygiene practices, including food storage, preparation, cooking, cleaning, and serving by
16 260 food handlers at transport hubs, not only in South Africa but across Africa.

17 261 Similar to a previous scoping review [38], most of the included papers were published within
18 262 the last six years but, no published study was found in 2015 and 2020. Whilst the reason for
19 263 the lack of published papers in 2015 might be difficult to determine, the COVID-19 pandemic
20 264 which resulted in “covidisation” of research might be the reason for the lack of publication in
21 265 this field of research in 2020. Although we cannot conclude that no primary research has been
22 266 conducted in these countries focusing on the safety of food sold at transport stations, it suggests
23 267 a research/publication gap. Food safety research is, perhaps, more relevant now than ever in
24 268 Africa, since the burden of foodborne diseases is rising annually, resulting in the declaration
25 269 of food safety as a public health concern by the WHO [7, 8]. Aside from this, most commuters
26 270 tend to buy ready-to-eat (RTE) food from street food vendors, including those at transport hubs
27 271 [39, 40]; hence, the sale of food at transport stations is rising [40, 41], particularly in Africa [6]
28 272 partly due to an increase in demand for RTE, and the employment opportunities it offers to
29 273 many individuals who otherwise would not have had any source of income [38, 42]. Even more
30 274 worrying is the fact that most of the articles included that focused on microbial safety, reported
31 275 high levels of food contamination with several microorganisms, especially *Salmonella* spp and
32 276 *E. coli* [4, 19, 23, 25, 27, 29, 33, 35]. Therefore, more research is needed across African
33 277 countries to prevent potential negative consequences.

34 278 Our study findings have implications for practice and research. For instance, the likelihood of
35 279 food poisoning with microbes such as *Salmonella* spp, *E. coli.*, *Shigella* spp, *Bacillus* spp, *S.*
36 280 *aureus*, and several others, revealed by most of the included studies that focused on microbial

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3 281 contamination of food, is alarming. This, if not checked, could further worsen the already high
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5 282 burden of foodborne diseases in a continent that has several of its countries already
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7 283 experiencing many health systems and economic challenges. Aside from this, the majority of
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9 284 individuals who commute through transport hubs, possible will purchase a meal from a
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11 285 transport hub/exchanges site, which may be the only meal of the day [12, 13], and yet the food
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13 286 safety standards are poor [4, 20, 23, 27-29, 33, 34]. Thus, if not checked, the excess cases of
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15 287 foodborne diseases from any outbreak will further impact negatively on the already challenged
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17 288 public health systems in Africa. Also, poor people who are exposed to these unsafe foods get
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19 289 an infection, may have to pay more for healthcare, which can further exacerbate their poverty
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21 290 situation. Moreover, people who are already living in extreme poverty who get exposed to
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23 291 foodborne disease may not even make it to the hospital for care and can end up dying at home
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25 292 [43].

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27 293 Good hygiene and sanitation practices, such as adequate hand washing, adequate washing and
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29 294 storage of pots and dishes, good waste management, observation of food preparation standards
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31 295 and serving etiquette, among others, have the potential to reduce the risk of food contamination
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33 296 from both biological and non-biological hazards, yet this study reveals fewer studies that
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35 297 focused on hygienic practices. We, therefore, recommend more research to further inform
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37 298 contextualised policy decisions aimed at improving hygiene and sanitation practices by food
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39 299 vendors at transport stations. Also, very relevant to ensuring food safety is the occupational
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41 300 health practices of the vendors. Regular food handling tests and food inspections, conducted
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43 301 by the appropriate local authorities, should be mandatory in all African countries. Food handler
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45 302 tests should seek to ensure that food vendors are fit healthwise to prepare and serve food meant
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47 303 for public consumption. However, our review found limited studies that evaluated occupational
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49 304 health and food safety. Considering that evidence from South Africa and Nigeria suggests
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51 305 about 78% and 62% of food vendors do not know their health status [30, 44], and the increasing
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53 306 number of informal food sellers at various transport exchange sites, future studies are
54
55 307 recommended to focus on occupational health and food safety in Africa. The means and manner
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57 308 of storing food, especially leftover RTE food, can either increase or reduce the risk of food
58
59 309 contamination, but, again, this scoping review found no study that focused on food storage
60
310 practices of the vendors at transport stations. Also essential, and yet we did not find any study
311 focusing on it, is the quality of food (nutritious aspects) of the meals sold at transport stations.
312 Eating a well nourishing diet or balanced meals is critical to ensure good health [45-47], hence,
313 we encourage future primary studies to include the nutritious aspects. Such studies may help

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3 314 streamline guidelines or inform policies to improve the quality of the food sold at transport
4 315 exchange sites or taxi ranks. Moreover, this review found that the majority (17 out of 18) of
5 316 the respondents in the included studies were the vendors (mostly females) or food samples
6 317 taken from the vendors. The perspectives of consumers (buyers) or commuters regarding food
7 318 safety at transport stations are also very relevant, and we recommend future research to involve
8 319 them. A comparative study to investigate food safety practices among males and females food
9 320 vendors at transport stations might be relevant since many males are now getting involved in
10 321 the business [6, 48, 49].

11 322 To the best of our knowledge, this study is the first scoping review that systematically mapped
12 323 literature relating to food safety at transport stations in Africa. A major strength of our study
13 324 method is that it permits the inclusion of multiple study designs. Also, the choice of this study
14 325 method permitted us to highlight literature gaps, and made recommendations for future
15 326 research. Aside from this, we conducted a thorough search in six databases using a
16 327 comprehensive search strategy which enabled us to capture the most relevant articles to answer
17 328 the review question. Moreover, two independent reviewers were used to select the studies and
18 329 perform data extraction processes which helped to prevent selection bias and ensured the
19 330 reliability and trustworthiness of this study results. Despite this, our scoping review has many
20 331 limitations. This study included only original study peer reviewed papers, which resulted in the
21 332 exclusion of one review paper [38], and one Masters' dissertation [50]. We did not also consult
22 333 the websites of WHO and the Food and Agriculture Organisation websites for possible relevant
23 334 studies. Furthermore, this study cannot be generalised since the search was limited to African
24 335 countries only. Although date limitation was removed, we limited the publication language to
25 336 English only, which perhaps eliminated relevant articles published in other languages. Despite
26 337 these limitations, this study has provided essential evidence relating to food safety at transport
27 338 stations and has shown literature gaps to guide future research.

28 339

29 340 **Conclusion**

30 341 Based on this scoping review's eligibility criteria, our study results suggest there is limited
31 342 research focusing on food safety at transport stations in Africa. Most of the existing published
32 343 studies are focused on microbial safety of food, and very few/none on other aspects such as
33 344 hygiene practices, food storage, occupational health and food safety, and nutrition. Hence, we
34 345 recommend more primary research involving community members and policy makers in these
35 346 areas going forward alongside improving access to clean water/handwashing facilities, and

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3 347 undertaking structural changes to facilitate behaviours and monitoring for unintended
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5 348 consequences such as livelihoods of vulnerable populations.
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7 349

8 350 **Abbreviations**

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10 351 PRISMA- Preferred Reporting Items for Systematic and Meta-analysis

11
12 352 RTE- Ready-to-eat

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14 353 WHO- World Health Organization

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17 355 **Ethics and dissemination**

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19 356 Not required. This study did not include human participants.

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22 358 **Data availability statement**

23
24 359 Not applicable. All sources of data have been adequately referenced

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26 360

27 361 **Patient and Public Involvement**

28
29 362 No patient involved

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31 363

32 364 **Statements**

33 365 **Acknowledgments**

34
35 366 Support for this work was provided by the Sustainable and Healthy Food Systems (SHEFS)

36
37 367 Programme, supported through the Wellcome Trust's Our Planet, Our Health Programme

38
39 368

40 41 369 **Authors' contributions**

42
43 370 BPN, DK, SED, SM, and RS conceptualized and designed the study. DK developed and

44
45 371 designed the database search strategy and conducted the search. PG contributed to the

46
47 372 screening of the studies and data extraction. DK wrote the draft manuscript and BPN, SED,

48
49 373 GM, and RS critically review it and made revisions. All the authors approved the final version

50
51 374 of the manuscript.

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53 375

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9 384 **References**10
11 385 1. The Lancet Gastroenterology H. Food safety really is everyone's business. The lancet
12 Gastroenterology & hepatology. 2019;4(8):571.13
14
15 387 2. World Health Organization. Estimating the burden of foodborne diseases Geneva:
16 World Health Organization; 2015 [cited 2019 25/10/2019]. Available from:
17 388 <https://www.who.int/activities/estimating-the-burden-of-foodborne-diseases>.18
19
20
21 390 3. World Health Organization. Food Safety Geneva: World Health Organization; 2016
22 [cited 2020 17/11/2020]. Available from: <https://www.afro.who.int/health-topics/food-safety>.23
24
25 392 4. Feglo P, Sakyi K. Bacterial contamination of street vending food in Kumasi, Ghana.
26 Journal of Medical Biomedical Sciences. 2012;1(1):1-8.27
28
29 394 5. Organization WH. Food Safety: What you should know Geneva: World Health
30 Organization; 2015 [cited 2019 25/10/2019]. Available from:
31 395 http://www.searo.who.int/entity/world_health_day/2015/whd-what-you-should-know/en/.32
33
34
35 397 6. Hill J, Mchiza Z, Puoane T, Steyn NP. The development of an evidence-based street
36 food vending model within a socioecological framework: a guide for African countries. PloS
37 398 one. 2019;14(10):e0223535.38
39
40
41 400 7. World Health Organization. Five keys to safer food manual Geneva: World Health
42 Organization; 2006 [cited 2019 25/10/2019]. Available from:
43 401 https://www.who.int/foodsafety/publications/consumer/manual_keys.pdf.44
45
46 403 8. Lamin-Boima P. Knowledge, Attitude And Practice Of Street Food Vendors In
47 Selected Schools Within Bo City Southern Sierra Leone.48
49
50
51 405 9. Lues JFR, Rasephei MR, Venter P, Theron MM. Assessing food safety and associated
52 food handling practices in street food vending. International Journal of Environmental Health
53 Research. 2006;16(5):319-28.54
55
56 408 10. Abrahale K, Sousa S, Albuquerque G, Padrao P, Lunet N. Street food research
57 worldwide: a scoping review. Journal of human nutrition and dietetics : the official journal of
58 409 the British Dietetic Association. 2019;32(2):152-74.59
60

- 1
2
3 411 11. Liu Z, Zhang G, Zhang X. Urban street foods in Shijiazhuang city, China: Current
4 412 status, safety practices and risk mitigating strategies. *Food Control*. 2014;41:212-8.
- 5
6
7 413 12. Food and Agriculture Organization. Selling street and snack foods Rome: Food and
8 414 Agriculture Organization; 2011 [cited 2019 25/10/2019]. Available from:
9 415 <http://www.fao.org/3/a-i2474e.pdf>.
- 10
11
12
13 416 13. Gelormini M, Damasceno A, Lopes SA, Malo S, Chongole C, Muholove P, et al. Street
14 417 Food Environment in Maputo (STOOD Map): a Cross-Sectional Study in Mozambique. *JMIR*
15 418 *research protocols*. 2015;4(3):e98.
- 16
17
18
19 419 14. Arksey H, O'Malley L. Scoping studies: towards a methodological framework.
20 420 *International Journal of Social Research Methodology*. 2005;8(1):19-32.
- 21
22
23 421 15. Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology.
24 422 *Implementation Science*. 2010;5(1):69.
- 25
26
27 423 16. Ncama BP, Kuupiel D, Duma SE, McHunu G, Guga P, Slotow R. Mapping evidence
28 424 of food safety at transport stations in Africa: a scoping review protocol. *BMJ Open*.
29 425 2020;10(8):e035879-e.
- 30
31
32
33 426 17. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA
34 427 extension for scoping reviews (PRISMA-ScR): checklist and explanation. *Annals of internal*
35 428 *medicine*. 2018;169(7):467-73.
- 36
37
38
39 429 18. Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. PRISMA 2009 Flow
40 430 Diagram. 2009;6(2009):1000097.
- 41
42
43 431 19. Oguttu JW, McCrindle CME, Makita K, Grace D. Investigation of the food value chain
44 432 of ready-to-eat chicken and the associated risk for staphylococcal food poisoning in Tshwane
45 433 Metropole, South Africa. *Food Control*. 2014;45:87-94.
- 46
47
48
49 434 20. Mafune TS, Takalani TK, Anyasi TA, Ramashia SE. Microbial Safety of Street Vended
50 435 Foods Sold in Thohoyandou, South Africa. *Journal of Human Ecology*. 2016;53(3):205-12.
- 51
52
53 436 21. Kok R, Balkaran R. Street food vending and hygiene practices and implications for
54 437 consumers. *Journal of Economics Behavioral Studies*. 2014;6(3):188-93.
- 55
56
57 438 22. Hill J, McHiza Z, Puoane T, Steyn NP. Food sold by street-food vendors in Cape Town
58 439 and surrounding areas: a focus on food and nutrition knowledge as well as practices related to
60

- 1
2
3 440 food preparation of street-food vendors. *Journal of Hunger & Environmental Nutrition*.
4 441 2019;14(3):401-15.
5
6
7 442 23. Mazizi B, Muchenje V, Makepe M, Mutero G. Assessment of Aerobic Plate Counts,
8 443 *Staphylococcus aureus*, *Escherichia coli* and *Salmonella* in Meat Sold by Street Vendors in the
9 444 Eastern Cape Province, South Africa. *Journal of Food Nutrition Research*. 2017;5(6):436-42.
10
11
12
13 445 24. Qekwana DN, McCrindle CM, Oguttu JW, Grace D. Assessment of the occupational
14 446 health and food safety risks associated with the traditional slaughter and consumption of goats
15 447 in Gauteng, South Africa. *International journal of environmental research and public health*.
16 448 2017;14(4):420.
17
18
19
20
21 449 25. Tshipamba M, Lubanza N, Adetunji M, Mwanza MJFMSH. Evaluation of the Effect
22 450 of Hygiene Practices and Attitudes on the Microbial Quality of Street Vended Meats Sold in
23 451 Johannesburg, South-Africa. 2018;3(137):2476-059.1000137.
24
25
26 452 26. McArthur-Floyd M, Commey V, Boakye NAB. Evaluation of Food Safety among Fast
27 453 Food Operators in Madina, Accra. *Evaluation*. 2016;54.
28
29
30
31 454 27. Abakari G, Cobbina SJ, Yeleliere E. Microbial quality of ready-to-eat vegetable salads
32 455 vended in the central business district of tamale, Ghana. *International Journal of Food*
33 456 *Contamination*. 2018;5(1).
34
35
36 457 28. Kibret M, Tadesse M. The bacteriological safety and antimicrobial susceptibility of
37 458 bacteria isolated from street-vended white lupin (*Lupinus albus*) in Bahir Dar, Ethiopia.
38 459 *Ethiopian Journal of Health Sciences*. 2013;23(1):19-26.
39
40
41
42 460 29. Eromo T, Tassew H, Daka D, Kibru G. Bacteriological quality of street foods and
43 461 antimicrobial resistance of isolates in Hawassa, Ethiopia. *Ethiopian journal of health sciences*.
44 462 2016;26(6):533-42.
45
46
47
48 463 30. Aluko OO, Ojeremi TT, Olaleke DA, Ajidagba EB. Evaluation of food safety and
49 464 sanitary practices among food vendors at car parks in Ile Ife, southwestern Nigeria. *Food*
50 465 *Control*. 2014;40:165-71.
51
52
53
54 466 31. Odundo A, Okemo P, Chege P. An Assessment of Food Safety Practices among Street
55 467 Vendors in Mombasa, Kenya. *International Journal of Health Sciences Research*.
56 468 2018;8(5):235-43.
57
58
59
60

- 1
2
3 469 32. Letuka P, Nkhebenyane J, Thekiso O. Assessment of Food Safety Knowledge,
4 470 Attitudes and Practices among Street Food Vendors and Consumers' Perceptions of Street
5 471 Food Vending in Maseru Lesotho. 2019.
- 6
7
8
9 472 33. Jermini M, Bryan FL, Schmitt R, Mwandwe C, Mwenya J, Zyuulu MH, et al. Hazards
10 473 and Critical Control Points of Food Vending Operations in a City in Zambia. *J Food Prot.*
11 474 1997;60(3):288-99.
- 12
13
14
15 475 34. Oguttu JW, McCrindle CM, Makita K, Grace D. Investigation of the food value chain
16 476 of ready-to-eat chicken and the associated risk for staphylococcal food poisoning in Tshwane
17 477 Metropole, South Africa. *Food Control.* 2014;45:87-94.
- 18
19
20
21 478 35. Kibret M, Tadesse MJEjohs. The bacteriological safety and antimicrobial susceptibility
22 479 of bacteria isolated from street-vended white lupin (*Lupinus albus*) in Bahir Dar, Ethiopia.
23 480 2013;23(1):19-26.
- 24
25
26
27 481 36. Gizaw Z. Public health risks related to food safety issues in the food market: a
28 482 systematic literature review. *Environmental Health and Preventive Medicine.* 2019;24(1):68.
- 29
30
31 483 37. Todd EC. Epidemiology of foodborne diseases: a worldwide review. *World health*
32 484 *statistics quarterly Rapport trimestriel de statistiques sanitaires mondiales.* 1997;50(1-2):30-
33 485 50.
- 34
35
36
37 486 38. Abrahale K, Sousa S, Albuquerque G, Padrao P, Lunet N. Street food research
38 487 worldwide: a scoping review. *Journal of Human Nutrition and Dietetics.* 2019;32(2):152-74.
- 39
40
41 488 39. Bellia C, Pilato M, Seraphin H. Street food and food safety: a driver for tourism?
42 489 *Calitatea.* 2016;17(S1):20.
- 43
44
45 490 40. Mosupye FM, Von Holy A. Microbiological hazard identification and exposure
46 491 assessment of street food vending in Johannesburg, South Africa. *International Journal of Food*
47 492 *Microbiology*
48
49
50 493 2000;61(2-3):137-45.
- 51
52
53 494 41. Mosupye FM, von Holy A. Microbiological quality and safety of ready-to-eat street-
54 495 vended foods in Johannesburg, South Africa. *International Journal of Food Microbiology.*
55 496 1999;62(11):1278-84.
- 56
57
58
59
60

- 1
2
3 497 42. Muzaffar AT, Huq I, Mallik BA. Entrepreneurs of the streets: An analytical work on
4 498 the street food vendors of Dhaka City. International journal of Business Management.
5 499 2009;4(2):80-8.
6
7
8
9 500 43. World Health Organisation. Universal Health Coverage Geneva2020 [cited 2021
10 501 09/04/2021]. Available from: [https://www.who.int/health-topics/universal-health-](https://www.who.int/health-topics/universal-health-coverage#tab=tab_1)
11 502 [coverage#tab=tab_1](https://www.who.int/health-topics/universal-health-coverage#tab=tab_1).
12
13
14
15 503 44. Qekwana DN, McCrindle CM, Oguttu JW, Grace D. Assessment of the occupational
16 504 health and food safety risks associated with the traditional slaughter and consumption of goats
17 505 in Gauteng, South Africa. International Journal of Environmental Research. 2017;14(4):420.
18
19
20
21 506 45. Melanson K. Nutrition review: lifestyle approaches to promoting healthy eating for
22 507 children. American journal of lifestyle medicine. 2008;2(1):26-9.
23
24
25 508 46. Carrier N, Villalon L, Lengyel C, Slaughter SE, Duizer L, Morrison-Koechl J, et al.
26 509 Diet quality is associated with malnutrition and low calf circumference in Canadian long-term
27 510 care residents. BMC nutrition. 2019;5:57.
28
29
30
31 511 47. Freeland-Graves JH, Nitzke S. Position of the academy of nutrition and dietetics: total
32 512 diet approach to healthy eating. Journal of the Academy of Nutrition Dietetics.
33 513 2013;113(2):307-17.
34
35
36
37 514 48. Okojie P, Isah E. Sanitary conditions of food vending sites and food handling practices
38 515 of street food vendors in Benin City, Nigeria: implication for food hygiene and safety. Journal
39 516 of environmental public Health Reports. 2014;2014.
40
41
42 517 49. da Silva SA, Cardoso RdCV, Góes JÂW, Santos JN, Ramos FP, de Jesus RB, et al.
43 518 Street food on the coast of Salvador, Bahia, Brazil: A study from the socioeconomic and food
44 519 safety perspectives. Food control. 2014;40:78-84.
45
46
47
48 520 50. Acheampong BE. Assessment of food hygiene practices by street food vendors and
49 521 microbial quality of selected foods sold. A Study at Dunkwa-On-Offin, Upper Denkyira East
50 522 Municipality of the Central Region 2015.
51
52
53
54
55
56
57
58
59
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524 **Table 1 A:** Characteristic of the included sources of evidence

Author, year	Country	City/Town	Study design	Study setting	Study population	Sample size	Sex of vendors	Outcome reported
Oguttu et. al., 2014 [34]	South Africa	Tshwane Metropole, Gauteng Province	Mixed-methods study	Taxi rank	Vendors selling Ready-to-eat chicken	100 samples of Ready-to-eat chicken	Females	Microbial safety of food
Mafune et. al., 2016 [20]	South Africa	Thohoyandou, Limpopo Province	Cross-sectional study	Taxi rank, bus station, shopping mall, and street stalls	Food samples from street vendors	28 samples	Not specified	Microbial safety of food
Kibret et. al., 2013 [28]	Ethiopia	Bahir Dar Town	Cross-sectional study	Main roads sites, bus station, groceries, taxi ranks	Ready-to-eat white lupin sample from vendors	40 samples (200 grams of white lupin)	Not specified	Microbial safety of food
Abakari et. al., 2018 [27]	Ghana	Tamale, Northern Region	Cross-sectional study	Taxi rank, bus stops, transport yard, and timber Market	Ready-to-eat salad samples from food vendors	30 salad samples	Not specified	Microbial safety of food
Aluko et.al., 2014 [30]	Nigeria	Ile Ife, southwestern Nigeria	Cross-sectional study	Car parks	Food vendors	160 (117 stationery and 43 mobile vendors)	Males and females	Hygiene practices of food handlers/vendors
Odundo et. al., 2018 [31]	Kenya	Not specified	Cross-sectional study	Major bus stops, markets, shopping areas, construction sites, and commercial areas	Food vendors	130	Males and females	Hygiene practices of food handlers/vendors
Kok et. al., 2014 [21]	South Africa	Durban, KwaZulu-Natal Province	Cross-sectional study	Transport exchange site	Food vendors	29	Not specified	Hygiene practices of food handlers/vendors
Letuka et. al., 2019 [32]	Lesotho	Maseru	Cross-sectional study	Taxi ranks	Food vendors	141 (48 food handlers and 93 consumers)	Male and female	Knowledge of food safety measures and hygiene practice by food handlers/vendors
Eromo et. al., 2016 [29]	Ethiopia	Hawassa City	Cross-sectional study	Bus station	Food samples from street food vendors	72 samples from six food items	Not specified	Microbial safety of food

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526 **Table 1B:** Characteristic of the included sources of evidence

Author, year	Country	City/Town	Study design	Study setting	Study population	Sample size	Sex of vendors	Outcome reported
McArthur-Floyd et. al., 2016 [26]	Ghana	Madina (Accra), Greater Accra Region	Cross-sectional study	Taxi rank, and transport exchange sites	Food vendors	200	Males and females	Knowledge of hygiene practice
Hill et. al., 2019 [6]	South Africa	Cape Town	Cross-sectional study	Train, bus stations, and taxi ranks, community centers, market	Food vendors	831	Males and females	Hygiene practices of food handlers/vendors
Mazizi et. al., 2017 [23]	South Africa	Alice (Nkonkobe) and King William's Town (Buffalo City), Eastern Cape province	Cross-sectional study	Taxi rank and bus stations	Street food vendors	136 food samples—cooked and raw.	Not specified	Microbial safety of food
Qekwana et.al, 2017 [24]	South Africa	Tshwane Metropolitan Municipality, Gauteng Province	Cross-sectional study	Taxi ranks and Informal markets	Traditional goat slaughter	105 people	Males and females	Occupational health and food safety risk
Flego et. al., 2012 [4]	Ghana	Kumasi, Ashanti Region	Cross-sectional study	Bus terminals	Food samples from vendors	60 food samples	Not specified	Microbial safety of food
Tshipamba et. al., 2018 [25]	South Africa	Johannesburg	Cross-sectional study	Taxi ranks and streets	Meat samples from vendors	115 meat samples	Not specified	Hygiene practices of food handlers/vendors, and microbial safety of food
Jermini et. al., 1997 [33]	Zambia	Not specified	Cross-sectional study	bus park/station and large market	Samples of raw, processed, and cooked Foods from street food vendors	Not specified	Not specified	Microbial safety of food

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529 **Table 2 A:** Microbial safety of food at transport stations

Study	Type of sample	Analytical approach	Microbes reported	Key results	Key conclusion
Oguttu et. al. [34]	Ready-to-eat (RTE) chicken	3M™ Petrifilm™ plates	<i>S. aureus</i>	<ul style="list-style-type: none"> High prevalence of <i>S. aureus</i> in the sample was (44%; 90% CI: 36.1%-52.2%), with mean <i>S. aureus</i> counts of $10^{3.6}$ (90%CI: $10^{3.3}$-$10^{3.9}$). The likelihood of food poisoning with <i>S. aureus</i> from RTE chicken was estimated to be 1.3% (90% CI: 0% -2.7%) 	To reduce the levels of concentration of <i>S. aureus</i> on the RTE chicken and promote the sale of safer and affordable RTE chicken for the large urban poor population in South Africa, training of RTE chicken vendors on hygiene is still needed.
Mafune et. al. [20]	Unfermented porridge, boiled cabbage and carrots, boiled peanuts, salad, potato chips, traditional mageu, and stewed beef and grilled chicken	Standard microbiological method	<i>S. aureus</i>	<ul style="list-style-type: none"> <i>S. aureus</i> was $<2.4771 \log_{10} \text{cfu/g}$ in all samples and places. Except for fried potato chips, microbial contamination was observed in the remaining food samples using the total plate count method. 	Most of the vended foods investigated met the microbiological standard of RTE foods
Mazizi et. al. [23]	Cooked and raw beef, pork, and mutton samples, surface contact plates, and water samples	Biochemical tests according to international standards methods	<i>S. aureus</i> , <i>E. coli</i> , and <i>Salmonella spp.</i>	<ul style="list-style-type: none"> Mean score of raw beef, mutton, and pork were aerobic plate counts (4.8, 3.7 and 2.8 Log cfu/g), <i>S. aureus</i> (3.3, 3.7 and 2.8 Log cfu/g), and <i>E. coli</i> (1.0, 0.6 and 0.3 Log cfu/g) respectively. 	The levels of contamination in cooked meat were lower when compared to the standards set by Commission Regulation for determining the microbiological quality of RTE foods.
Tshipamba et. al. [25]	RTE meat	Standard biochemical and Molecular methods	<i>Bacillus thuringiensis</i> , <i>Bacillus spp.</i> , <i>Bacillus subtilis</i> , <i>Bacillus cereus</i> , <i>Citrobacter spp.</i> , <i>Enterococcus faecium</i> , <i>Enterococcus faecalis</i> , <i>Kurthia spp.</i> , <i>Lysinibacillus spp.</i> , <i>Macrocooccus caseolyticus</i> , <i>Planomicrobium glaciei</i> , <i>Planococcus antarcticus</i> , <i>S. aureus</i> , <i>S. equorum</i> , and <i>S. vitulinus</i>	<ul style="list-style-type: none"> Overall mean total bacteria in the samples ranged from $4.3\text{-}6.03 \text{ cfu/ml} \times 10^2$ and coliform counts ranged from $1.60\text{-}1.95 \times 10^2 \text{ cfu/ml}$ Of the 15 microbes identified, <i>S. aureus</i> occurred in all the meat types and the percentage of occurrence was chicken meat (14%), beef head (43%), beef intestine (50%), and wors (sausage) (20%) 	Consumers RTE meat are at risk of food borne diseases due to poor hygiene practices of the vendors.

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533 **Table 2 B:** Microbial safety of food at transport stations

Study	Type of sample	Analytical approach	Microbes reported	Key results	Key conclusion
Kibret et. al. [28]	White lupin	Standard bacteriological techniques, and Kirby-Bauer disk diffusion method for antimicrobial susceptibility test	<i>E. coli</i> , <i>Salmonella spp.</i> , and <i>Shigella spp.</i>	<ul style="list-style-type: none"> Prevalence of bacteria total coliform counts were 954.2±385 at the surface and 756.2±447.3 at the core of white lupin. Pathogens isolated were as follows: <i>E. coli</i> 29 (72.5%), <i>Salmonella spp.</i> 23 (57.5%) and <i>Shigella spp.</i> 8 (20%). Overall multiple antimicrobial resistances rate was 75% 	Contamination of white lupin and a potential health risk to consumers revealed, and the bacteria isolated showed high rates of multiple drug resistance.
Eromo et. al. [29]	Local bread ('ambasha' and 'kita'), raw fish, chilli ('awaze'), avocado, and cooked potato	Standard microbiological techniques	<i>E. coli</i> , <i>Salmonella spp.</i> , and <i>S. aureus</i>	<ul style="list-style-type: none"> The microbiological quality in nearly 31% of RTE food samples was beyond the acceptable limits. Total colony counts detected ranged from 1.7x10⁵ to 6.7x10⁶ cfu/g. <i>E. coli</i> (29.6%), <i>Salmonella spp.</i> (18.7%), and <i>S. aureus</i> (9.9%) were the most frequent isolates. All isolates were 100% sensitive to ciprofloxacin, but 89% of <i>Salmonella spp.</i> was resistant to chloramphenicol, 14.3% of <i>S. aureus</i> was resistant to vancomycin 	Considerable rate of contamination in the foods confirmed. The identified foodborne bacteria and antibiotic resistance isolates could pose a public health problem in the study location.
Abakari et. al. [27]	Pre-cut vegetable salads	Standard microbiological methods	<i>E. coli</i> , <i>Bacillus cereus</i> , <i>Salmonella spp.</i> , and <i>Shigella spp.</i>	<ul style="list-style-type: none"> <i>E. coli</i> levels ranged from 0 to 7.56 log₁₀ cfu/g; <i>Bacillus cereus</i> levels ranged from 0 to 7.44 log₁₀ cfu/g; <i>Salmonella spp.</i> ranged from 0 to 4.44 log₁₀ cfu/g, and <i>Shigella spp.</i> ranged from 5.54 log₁₀ cfu/g were detected in 96.7%, 93.3%, 73.3%, and 76.7% of the salads samples, respectively. 	Salads were revealed to be unwholesome for human consumption and could be deleterious to the health of consumers.

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538 **Table 2 C:** Microbial safety of food at transport stations

Study	Type of sample	Analytical approach	Microbes reported	Key results	Key conclusion
Flego et. al. [4]	RTE foods (ice-kenkey (15), cocoa drink (15), fufu (5), ready-to-eat red pepper for kenkey) (5), salad (10), and macaroni (10))	Standard microbiological methods	<i>Staphylococci</i> , <i>Bacillus</i> spp., <i>Klebsiella pneumoniae</i> , <i>Aeromonas pneumophila</i> , <i>E. cloacae</i> , <i>S. aureus</i> , <i>E. coli</i> , and <i>P. aeruginosa</i>	<ul style="list-style-type: none"> RTE foods were found to be contaminated with enteric bacteria and other potential food poisoning organisms with bacterial counts higher than the acceptable levels (<5.0 log₁₀ CFU/ml). Coagulate negative staphylococci (3.7%), <i>Bacillus</i> species (21.5%), <i>K. pneumoniae</i> (100%), <i>Aeromonas pneumophila</i> (17.7%), <i>E. cloacae</i> (6.7%), <i>S. aureus</i> (3.7%), <i>E. coli</i> (2.2%) and <i>P. aeruginosa</i> (2.2%) were the main isolates detected. 	Most RTE foods were contaminated with enteric bacteria and other potential food poisoning organisms with bacterial counts higher than the acceptable levels.
Jermi et. al. [33]	Raw foods (ground meat, chicken, and chicken intestine); and processed foods (dried “minnows” and “kapenta”)		<i>Salmonellae Spp.</i> , <i>S. aureus</i> , <i>Clostridium peifringens</i>	<ul style="list-style-type: none"> Raw foods such as ground meat, chicken, chicken intestine; and processed foods such as dried “minnows” and “kapenta” were contaminated with salmonellae or contained high populations of <i>S. aureus</i> in pasteurized milk. High populations (> 10⁵) of <i>S. aureus</i> were detected from a sample of leftover chicken, more than 10⁷ were detected in leftover rice, and 10 million <i>C. peifringens</i> per gram were detected in leftover beef stew sample 	Time-temperature exposures during reheating had variable effects in terms of killing the microorganisms that germinated from surviving spores or that reached the foods after cooking.

540 **Table 3:** Key reported findings on food preparation

Study	Key findings reported
Kok et. al. [21]	<ul style="list-style-type: none"> • Water being used for washing utensils was left unchanged, • Piles of dirty pots and dishes was left near the serving areas and RTE foods, and garbage left uncovered with many flies at the site, • RTE food was left uncovered, • Most of the food handlers were not wearing gloves, hairnets, or aprons
Hill et. al. [6]	<ul style="list-style-type: none"> • 85.5% of the vending stalls lacked soap or surface sanitizer, • 71% lacked basin for washing, • 75% did not have drying cloth, • 76.6% of vendors handled food and money concurrently, • About 57% left the food uncovered. • 39% of the vendors were using their hands to pick up food items, with only 6% wearing gloves, and • 29% of vendors had a wet clean sponge/cloth obtainable at the site
Mazizi et. al. [23]	<ul style="list-style-type: none"> • Major sources of food contamination identified were poor hygiene practices of the food vendor, holding area, and the utensils
Tshipamba et. al. [25]	<ul style="list-style-type: none"> • Approximately 90% of RTE meat vendors at the taxi rank exposed their meats to dust and flies, • 94% of them handled money whilst serving food, and • Stagnant water found in about 22% of the vending locations at the taxi-rank
McArthur-Floyd et. al. [26]	<ul style="list-style-type: none"> • 64% of food vendors washed their hands from elbow to finger and the remainder (36%) washed from their wrist to finger (the WHO recommends handwashing from elbow to fingers), and • 62% of the vendors test their meal in the palm whilst 38% of them test it with a spoon (the best way to test a meal)
Aluko et. al. [30]	<ul style="list-style-type: none"> • Approximately 17% of food vendors washed their hands always after using the toilet, • 63% of them rarely kept their fingernails short, and • Nearly 4% of them always kept their leftover cooked food in a refrigerator, despite having unstable power supply
Odundo et. al. [31]	<ul style="list-style-type: none"> • Food vendors had poor hygiene practices however, men were observed to have better hygienic practices than women (P<0.05), • Hygiene practice of the vendors was found to be significantly associated with training (those trained observe hygiene), and • Wearing of jewellery, long and unclean nails, and lack of protective clothing were observed.
Letuka et. al. [32]	<ul style="list-style-type: none"> • Observed that the food handlers operated under unhygienic environment

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543 **Figure**544 **Figure 1:** PRISMA 2009 Flow Diagram545 **Figure 2:** Trend of published studies relating to food safety at transport station in Africa

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547 **Supplementary File**548 **Supplementary file 1:** Electronic databases search

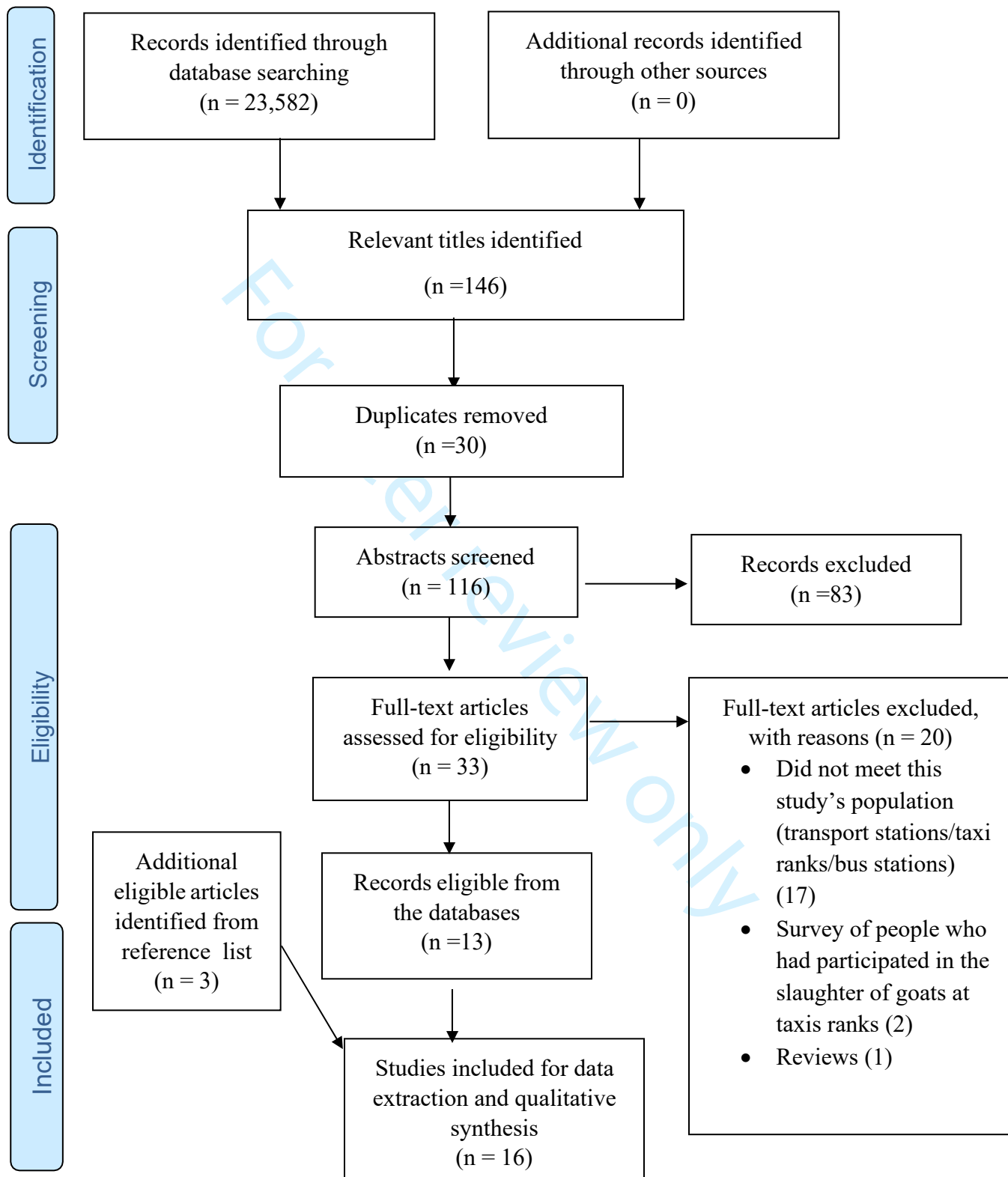


Figure 1: PRISMA 2009 Flow Diagram [18]

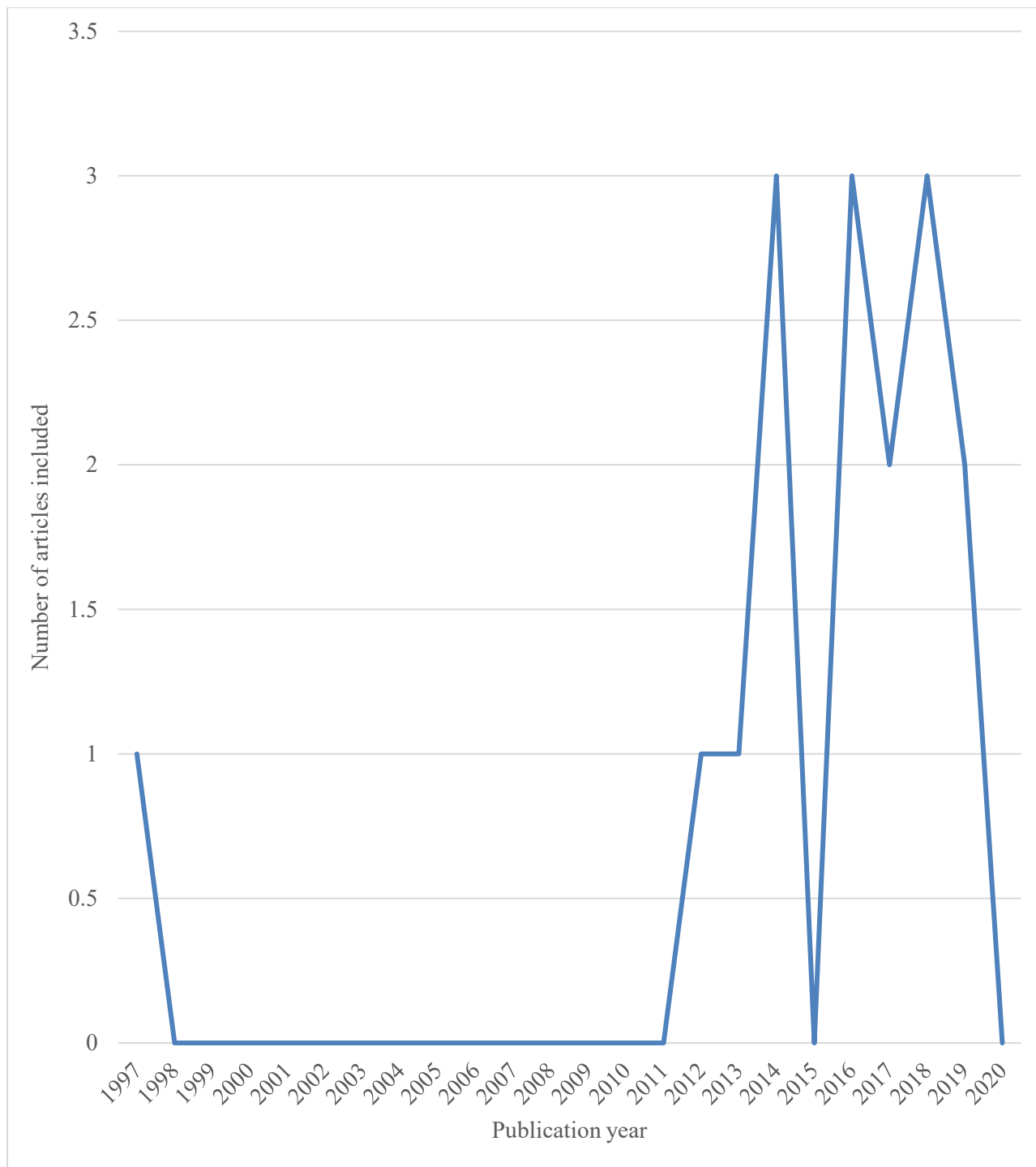


Figure 2: Trend of published studies relating to food safety at transport stations in Africa

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Supplementary file 1: Electronic databases search

Search date	Database	Keywords	Search results	Number eligible
05/10/2020	EBSCOhost (Academic search complete, CINAHL with Full-text, and Health Source	SU food safety AND SU (food preparation or meal preparation or cooking) OR SU food handling OR SU food storage OR hygiene practices AND (food trading or food selling or food vending or street food) AND (transport station or taxi rank or bus station or transport exchange sites or car park or lorry park) AND africa	2,549	14
07/10/2020	PubMed	"food safety"[MeSH Terms] OR ("food"[All Fields] AND "safety"[All Fields]) OR "food safety"[All Fields] OR ("food supply"[MeSH Terms] OR ("food"[All Fields] AND "supply"[All Fields]) OR "food supply"[All Fields] OR ("food"[All Fields] AND "security"[All Fields]) OR "food security"[All Fields]) AND (("food"[MeSH Terms] OR "food"[All Fields]) AND vending[All Fields]) OR (("food"[MeSH Terms] OR "food"[All Fields]) AND trading[All Fields]) AND streets[All Fields] OR (("motor vehicles"[MeSH Terms] OR ("motor"[All Fields] AND "vehicles"[All Fields]) OR "motor vehicles"[All Fields] OR "lorry"[All Fields]) AND parks[All Fields]) OR (("motor vehicles"[MeSH Terms] OR ("motor"[All Fields] AND "vehicles"[All Fields]) OR "motor vehicles"[All Fields] OR "lorry"[All Fields]) AND station[All Fields]) OR (taxi[All Fields] AND ranks[All Fields]) AND ("algeria"[MeSH Terms] OR "algeria"[All Fields]) OR ("angola"[MeSH Terms] OR "angola"[All Fields]) OR ("benin"[MeSH Terms] OR "benin"[All Fields]) OR ("botswana"[MeSH Terms] OR "botswana"[All Fields]) OR ("burkina faso"[MeSH Terms] OR ("burkina"[All Fields] AND "faso"[All Fields]) OR "burkina faso"[All Fields]) OR ("burundi"[MeSH Terms] OR "burundi"[All Fields]) OR ("cameroon"[MeSH Terms] OR "cameroon"[All Fields]) OR ("cabo verde"[MeSH Terms] OR ("cabo"[All Fields] AND "verde"[All Fields]) OR "cabo verde"[All Fields] OR ("cape"[All Fields] AND "verde"[All Fields]) OR "cape verde"[All Fields]) OR ("central african republic"[MeSH Terms]	2,834	33

OR ("central"[All Fields] AND "african"[All Fields] AND "republic"[All Fields]) OR "central african republic"[All Fields]) OR ("chad"[MeSH Terms] OR "chad"[All Fields]) OR ("democratic republic of the congo"[MeSH Terms] OR ("democratic"[All Fields] AND "republic"[All Fields] AND "congo"[All Fields]) OR "democratic republic of the congo"[All Fields]) OR ("congo"[MeSH Terms] OR "congo"[All Fields] OR ("republic"[All Fields] AND "congo"[All Fields]) OR "republic of the congo"[All Fields]) OR ("djibouti"[MeSH Terms] OR "djibouti"[All Fields]) OR ("egypt"[MeSH Terms] OR "egypt"[All Fields]) OR ("equatorial guinea"[MeSH Terms] OR ("equatorial"[All Fields] AND "guinea"[All Fields]) OR "equatorial guinea"[All Fields]) OR ("eritrea"[MeSH Terms] OR "eritrea"[All Fields]) OR ("ethiopia"[MeSH Terms] OR "ethiopia"[All Fields]) OR ("gabon"[MeSH Terms] OR "gabon"[All Fields]) OR ("gambia"[MeSH Terms] OR "gambia"[All Fields]) OR ("ghana"[MeSH Terms] OR "ghana"[All Fields]) OR ("guinea"[MeSH Terms] OR "guinea"[All Fields]) OR ("guinea-bissau"[MeSH Terms] OR "guinea-bissau"[All Fields] OR ("guinea"[All Fields] AND "bissau"[All Fields]) OR "guinea bissau"[All Fields]) OR ("cote d'ivoire"[MeSH Terms] OR ("cote"[All Fields] AND "d'ivoire"[All Fields]) OR "cote d'ivoire"[All Fields] OR ("ivory"[All Fields] AND "coast"[All Fields]) OR "ivory coast"[All Fields]) OR ("kenya"[MeSH Terms] OR "kenya"[All Fields]) OR ("lesotho"[MeSH Terms] OR "lesotho"[All Fields]) OR ("liberia"[MeSH Terms] OR "liberia"[All Fields]) OR ("libya"[MeSH Terms] OR "libya"[All Fields]) OR ("madagascar"[MeSH Terms] OR "madagascar"[All Fields]) OR ("malawi"[MeSH Terms] OR "malawi"[All Fields]) OR ("mali"[MeSH Terms] OR "mali"[All Fields]) OR ("mauritania"[MeSH Terms] OR "mauritania"[All Fields]) OR ("mauritus"[MeSH Terms] OR "mauritus"[All Fields]) OR ("morocco"[MeSH Terms] OR "morocco"[All Fields]) OR ("mozambique"[MeSH Terms] OR "mozambique"[All Fields]) OR ("namibia"[MeSH Terms] OR "namibia"[All Fields]) OR ("niger"[MeSH Terms] OR "niger"[All Fields]) OR ("nigeria"[MeSH Terms] OR "nigeria"[All Fields]) OR ("rwanda"[MeSH Terms] OR

		"rwanda"[All Fields]) OR ("sao tome and principe"[MeSH Terms] OR ("sao"[All Fields] AND "tome"[All Fields] AND "principe"[All Fields]) OR "sao tome and principe"[All Fields]) OR ("senegal"[MeSH Terms] OR "senegal"[All Fields]) OR ("seychelles"[MeSH Terms] OR "seychelles"[All Fields]) OR ("sierra leone"[MeSH Terms] OR ("sierra"[All Fields] AND "leone"[All Fields]) OR "sierra leone"[All Fields]) OR ("somalia"[MeSH Terms] OR "somalia"[All Fields]) OR (("south africa"[MeSH Terms] OR ("south"[All Fields] AND "africa"[All Fields]) OR "south africa"[All Fields]) AND South[All Fields]) OR ("sudan"[MeSH Terms] OR "sudan"[All Fields]) OR ("sudan"[MeSH Terms] OR "sudan"[All Fields]) OR ("eswatini"[MeSH Terms] OR "eswatini"[All Fields]) OR "swaziland"[All Fields]) OR ("tanzania"[MeSH Terms] OR "tanzania"[All Fields]) OR ("togo"[MeSH Terms] OR "togo"[All Fields]) OR ("tunisia"[MeSH Terms] OR "tunisia"[All Fields]) OR ("uganda"[MeSH Terms] OR "uganda"[All Fields]) OR ("zambia"[MeSH Terms] OR "zambia"[All Fields]) OR ("zimbabwe"[MeSH Terms] OR "zimbabwe"[All Fields]) Filters: Free full text, Comparative Study, Observational Study, Randomized Controlled Trial, Humans, English, MEDLINE		
09/10/2020	Web of Science	(food safety AND food preparation OR meal preparation OR cooking OR food handling OR food storage OR hygiene practices AND food trading OR food selling OR food vending or street food AND transport station OR taxi rank OR bus station OR transport exchange sites OR car park or lorry park AND africa)Refined by: Open Access: (OPEN ACCESS) AND DOCUMENT TYPES: (ARTICLE) AND DOCUMENT TYPES: (ARTICLE) AND WEB OF SCIENCE CATEGORIES: (FOOD SCIENCE TECHNOLOGY OR PUBLIC ENVIRONMENTAL OCCUPATIONAL HEALTH) AND WEB OF SCIENCE CATEGORIES: (FOOD SCIENCE TECHNOLOGY OR PUBLIC ENVIRONMENTAL OCCUPATIONAL HEALTH OR NUTRITION DIETETICS)Timespan: All years. Indexes: SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI.	8,263	36
18/10/2020	SCOPUS	food safety AND food preparation OR meal preparation OR cooking OR food handling OR food storage OR hygiene practices AND food trading OR	116	7

36/bmjopen-2021-053656 on 25 November 2021. Downloaded from <http://bmjopen.bmj.com/> on April 18, 2024 by guest. Protected by copyright.

		food selling OR food vending or street food AND transport station OR taxi rank OR bus station OR transport exchange sites OR car park or lorry park AND africa		
25/10/2020	Google Scholar	food safety AND food preparation OR meal preparation OR cooking OR food handling OR food storage OR hygiene practices AND food trading OR food selling OR food vending or street food AND transport station OR taxi rank OR bus station OR transport exchange sites OR car park or lorry park AND africa	9,820	56
			23,582	146
Duplicates				30

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Supplementary file 1: 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 #
TITLE			
Title	1	Identify the report as a scoping review.	
ABSTRACT			
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.	
INTRODUCTION			
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.	
METHODS			
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 #
RESULTS			
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.	
DISCUSSION			
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.	
FUNDING			
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.* ;169:467–473. doi: 10.7326/M18-0850

