



BMJ Open COVID-19 pandemic unmasking cardiovascular risk factors and non-communicable diseases among migrant workers: a cross-sectional study in Singapore

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ABSTRACT

Objectives This study aims to report the prevalence of cardiovascular risk factors (CVRFs) and other non-communicable diseases among migrant workers in Singapore admitted for COVID-19 infection, to highlight disease burden and the need for changes in health screening and healthcare delivery in this unique population.

Setting The study was conducted in the largest tertiary hospital in Singapore.

Design Retrospective cross-sectional study.

Participants 883 migrant workers who had mild or asymptomatic COVID-19 infection admitted to three isolation wards between 6 April 2020 and 31 May 2020 were included in this study.

Outcome measures The outcome measures were the prevalence of pre-existing and newly diagnosed comorbid conditions and the prevalence of CVRFs—diabetes mellitus, hypertension and hyperlipidaemia—and non-communicable diseases at the time of discharge. The OR of having specific CVRFs depending on country of origin was generated via multivariate logistic regression analysis.

Results The median age of our study population was 45 years. 17.0% had pre-existing conditions and 25.9% received new diagnoses. Of the new diagnoses, 15.7% were acute medical conditions and 84.3% chronic medical conditions. The prevalence of CVRFs was higher in Southeast Asian and South Asian migrant workers compared with Chinese. The prevalence of non-communicable diseases on discharge was highest among Southeast Asians (49.4%).

Conclusions The COVID-19 outbreak in a large number of migrant workers in Singapore unmasked a significant disease burden among them, increasing stakeholders' interests in their welfare. Moving forward, system-level changes are necessary to deliver healthcare sustainably and effect improvements in migrant workers' health.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ To our knowledge, this is the largest cohort study to explore the prevalence of cardiovascular risk factors (CVRFs) and non-communicable diseases in the dormitory-dwelling male migrant worker population in Singapore.
- ⇒ Limitations include the study's retrospective methodology, with further room for standardisation of methods of screening and diagnosis of CVRFs between internal medicine physicians to enhance disease detection.
- ⇒ As the majority of our study subjects spoke Bengali or Tamil as their first language, with limited English, language barriers between healthcare workers and migrant workers posed a significant challenge despite efforts of translators.

INTRODUCTION

Globally, migrants are particularly vulnerable to the direct and indirect impact of COVID-19, with their living conditions limiting their ability to practise social distancing, receive adequate healthcare, and cope with the economic, social and psychological impact of the pandemic.¹ This has been illustrated by a large outbreak of COVID-19 infections among low-wage, male migrant workers who live in dormitories or shared-living facilities (hereon referred to as 'migrant workers') in Singapore, who constitute approximately 323 000 out of the country's total population of 5.45 million.²

As of 2 June 2021, Singapore had recorded 62 069 laboratory-confirmed COVID-19 cases, of which 87.8% were in migrant workers. The migrant worker outbreak did not involve foreign domestic workers or foreign workers who are PMETs (professionals, managers,

executives and technicians) who do not stay in dormitories. The prevalence of COVID-19 infection of 16.9% in this population greatly exceeded that of 0.1% in the non-imported Singaporean population.³ The disparity in infection rates is attributable to communal living in high-density and unhygienic settings, as well as the unequal access to health services and inclusive protection systems, such as healthcare policies and social safety nets.^{4,5}

During the early phase of the COVID-19 outbreak from April to July 2020, Singapore had adequate healthcare resources to test anyone with symptoms and rigorously screened close contacts of COVID-19-positive patients. All patients with COVID-19 infection, majority of whom were migrant workers who were asymptomatic or had mild symptoms, were admitted to public hospitals for medical assessment prior to transfer to community isolation facilities for recovery. During their hospitalisation, many migrant workers were diagnosed with concurrent medical problems.

Currently, healthcare quality for migrant workers in Singapore is limited to meeting compliance standards of immigration procedures and occupational safety.⁵ The mandatory medical examination for all new foreign workers in Singapore involves self-declaration of medical history, physical examination with blood pressure (BP) recording and compulsory investigations including a urine test for albumin and sugar.⁶ This process may identify cardiovascular risk factors (CVRFs) such as diabetes mellitus (DM) and hypertension (HTN). However, other common CVRFs such as hyperlipidaemia (HLD) would remain undiagnosed, and pre-existing medical conditions could have been under-reported as many labour migrants seek to improve chances of obtaining and retaining employability by providing false reports.⁷

Mandatory employer-purchased insurance coverage for migrant workers does not routinely cover outpatient medical expenses such as health screening and follow-up for CVRF control.⁸ Migrant workers may have continued to work in Singapore for many years, and without any regular health screening offered to migrant workers CVRFs that are more likely to develop with increasing age may remain undetected. Underdiagnosis and lack of access to healthcare in this population lead to disease complications with increased morbidity and healthcare cost.

Data on non-communicable diseases among migrant workers are limited. Studies among migrant workers in the Middle East estimated the prevalence of HTN to be 31.0%–58.0% and that of DM to be 9.0%–16.7%.^{9,10} A recent study on a small cohort of migrant workers in Singapore reported the prevalence of metabolic disease to be 4.6%–8.8%.¹¹ Other studies on health issues in migrant workers in Singapore had largely focused on workplace accidents and infectious diseases.¹²

With the pandemic unmasking a significant disease in this population, this study aimed to report the prevalence of CVRFs, in particular DM, HTN and HLD, and other non-communicable diseases in a cohort of migrant

workers admitted to Singapore's largest hospital for COVID-19 infection.

METHODS

Inclusion and exclusion criteria

The study was conducted in Singapore General Hospital, the largest public hospital in Singapore. All low-wage, dormitory-dwelling migrant workers who were affected by this outbreak were male. Migrant workers who had mild or asymptomatic COVID-19 infection admitted to three other isolation wards between 6 April 2020 and 31 May 2020 were included in this study. Patients with severe COVID-19 infections and complications were admitted to an isolation ward colocated with an intensive care unit and were excluded from this study. The time frame chosen reflected the period when the number of COVID-19 cases exceeded the capacity of infectious disease physicians, and internal medicine specialists were activated to help manage patients with COVID-19 infection. Singapore citizens and permanent residents admitted to these wards were excluded.

Definitions

A comorbid condition was defined as all diseases other than COVID-19 infection, categorised into 'pre-existing' and 'newly diagnosed' diseases. Migrant workers were considered to have a pre-existing disease if the medical condition was diagnosed prior to hospital admission. Migrant workers were considered to have CVRFs if they had DM, HTN or HLD.

Disease detection

On admission, all patients were asked about current symptoms and details of pre-existing medical conditions and treatments. Language barrier was mitigated by use of translators, translation aids and applications. The electronic medical records of migrant workers who had previously received care in Singapore public healthcare institutions were reviewed for details of medical history. Physical examination and routine baseline investigations comprising complete blood count, renal panel and chest X-ray were performed for every patient. Vital signs including temperature, BP, pulse rate and oxygen saturation were recorded at least three times per day.

Additional investigations were performed at the managing physician's discretion. Patients with elevated random plasma glucose on routine renal panel were screened with capillary blood glucose monitoring, fasting plasma glucose level and glycated haemoglobin testing for diagnosis of DM, in accordance with the American Diabetes Association criteria.¹³ The diagnosis of HTN was made in patients with persistently elevated BP of systolic BP above 140 mm Hg and/or diastolic BP above 90 mm Hg. HLD was diagnosed based on lipid panel abnormalities. Other laboratory or imaging investigations, specialist referrals and procedures were directed by each patient's clinical condition.

Details of all pre-existing and newly diagnosed medical conditions, treatment and follow-up plans were documented on patients' electronic discharge summary at the time of discharge from the hospital.

Data collection

Data collection was performed by the study team via a retrospective review of each patient's electronic discharge summaries. Patient demographics, pre-existing diseases, new diagnoses and postdischarge follow-up plans were extracted from discharge summaries. Duplicates from readmissions were deleted. Data were subsequently de-identified by the hospital's health services research unit and statistical analysis was performed on the de-identified data.

Statistical analysis

Differences in the median age between migrant workers originating from China, South Asia (Bangladesh and India) and Southeast Asia (Malaysia, Myanmar, Philippines, Thailand and Vietnam) were compared using the Mann-Whitney U test as the distribution of age was non-normal. Differences in the overall prevalence of comorbid conditions, CVRFs and non-communicable diseases were compared between migrant workers originating from China, South Asia and Southeast Asia using the χ^2 test. The χ^2 test was selected to determine if there was an association between region of origin and presence or absence of each individual comorbid condition, CVRF or non-communicable disease. A subgroup analysis of the differences in prevalence of chronic disease was performed for those above the age of 40 years old. This age cut-off was chosen in line with Singapore's Ministry of Health and Health Promotion Board recommendation of population-wide health screening for chronic diseases for all above the age of 40 years old. Multivariate regression was used to determine the association between age and region of origin (China, South Asia or Southeast Asia) and the prevalence of chronic diseases at the time of discharge. Chinese were used as a reference, as in general the Chinese in our study population had the lowest prevalence of CVRFs. All tests were two-sided with significance level of 0.05. All analyses were performed using Stata V.16.

Patient or public involvement

Patients or the public were not involved in the design, or conduct, or reporting or dissemination plans of our research.

RESULTS

Demographics

A total of 883 male migrant workers were recruited into the study. The majority (77.9%) were from South Asia. Migrant workers from China and Southeast Asia made up 22.1% of the cohort (table 1). The median age of the cohort was 45 years.

Table 1 Overview of the demographic characteristics of 883 migrant workers in Singapore admitted to hospital with COVID-19 between 6 April and 31 May 2020

Place of origin	Median age (IQR)	n	%
By country			
Bangladesh	37 (30–27)	379	42.9
India	45 (31–49)	309	35.0
China	50 (48–51)	118	13.4
Malaysia	49 (30–55)	10	1.1
Myanmar	34 (31–43)	21	2.4
Philippines	33 (33–33)	1	0.1
Thailand	51 (49–54)	43	4.9
Vietnam	37	2	0.2
By region			
South Asia	40 (31–48)	688	77.9
China	50 (48–51)	118	13.4
Southeast Asia	49 (37–53)	77	8.7
Total	45 (32–49)	883	100
P=0.0001 for differences in median age across countries and across regions: South Asia: Bangladesh and India; Southeast Asia: Malaysia, Myanmar, Philippines, Thailand and Vietnam.			

Prevalence of diseases

Apart from having COVID-19 infection, 333 (37.7%) patients were found to have comorbid conditions. Of the patients, 150 (17.0%) had pre-existing conditions and 229 (25.9%) received new diagnoses during their admission. At the time of discharge, 306 (34.7%) patients had CVRFs and other non-communicable diseases requiring ongoing care and follow-up appointments. CVRFs were common, afflicting 189 (21.4%) patients. HTN was the most common CVRF at discharge, with a prevalence of 15.9%. The prevalence of DM and HLD at discharge was 7.1% and 5.9%, respectively (table 2). A list of other non-communicable diseases diagnosed in our study population on discharge can be found the online supplemental annex.

Health disparities between countries of origin

The prevalence of CVRFs was highest among the Southeast Asians (49.4%). South Asians had the highest prevalence of DM (8.3%) (figure 1A). These differences were consistent in a subgroup analysis of migrant workers above the age of 40 ($p < 0.010$). Among those aged 40 and above, 15.3% of South Asians had DM compared with 7.3% of Southeast Asians and 0.9% of Chinese ($p < 0.010$). South Asians were also the most likely to have HLD among those above the age of 40 (11.0%, $p < 0.010$) (figure 1B).

A multivariate logistic regression analysis showed consistent differences in the odds of CVRFs between regions of origin after correcting for age. South Asians and Southeast Asians had higher odds for most CVRFs compared with Chinese (online supplemental annex table 1).

**Table 2** Prevalence of comorbid conditions (pre-existing and newly diagnosed), CVRFs and other non-communicable disease at the time of discharge

	All (N=883)	Chinese (n=118)	South Asian (n=688)	Southeast Asian (n=77)	P value
Comorbid conditions*, n (%)	333 (37.7)	34 (28.8)	258 (37.5)	41 (53.3)	0.003
Pre-existing, n (%)	150 (17.0)	14 (11.9)	115 (16.7)	21 (27.3)	0.018
Newly diagnosed, n (%)	229 (25.9)	21 (17.8)	181 (26.3)	27 (35.1)	0.024
CVRFs and other non-communicable disease at the time of discharge, n (%)	306 (34.7)	30 (25.5)	238 (34.6)	38 (49.4)	0.003
CVRF, n (%)	189 (21.4)	18 (15.3)	142 (20.6)	29 (37.7)	0.001
DM, n (%)	63 (7.1)	1 (0.9)	57 (8.3)	5 (6.5)	0.015
HTN, n (%)	140 (15.9)	17 (14.4)	97 (14.1)	26 (33.8)	<0.001
HLD, n (%)	52 (5.9)	2 (1.7)	44 (6.4)	6 (7.8)	0.102
Other, n (%)	134 (15.2)	13 (11.0)	109 (15.8)	12 (15.6)	0.400

All differences in proportions were tested for significance using the χ^2 test. The p value tests the statistical significance of the differences in overall prevalence of comorbid conditions, CVRFs and non-communicable diseases,

*Comorbid conditions included pre-existing and newly diagnosed conditions during the admission. The prevalence of pre-existing and newly diagnosed conditions did not add up to the total prevalence as some who had newly diagnosed conditions also had pre-existing ones.

CVRF, cardiovascular risk factor; DM, diabetes mellitus; HLD, hyperlipidaemia; HTN, hypertension.

Need for follow-up medical care

Of the patients, 39.1% required follow-up after discharge from the hospital and 20.8% were given appointments in the specialist outpatient clinics within the hospital, the majority for documentation of resolution of pneumonia on interval chest radiographs. Of the patients, 18.2% had follow-up visits arranged in primary care settings for continuation of care for chronic medical problems, and a small number of patients (0.3%) elected to return to their home country for continuation of care.

DISCUSSION

The prevalence of CVRFs and other non-communicable disease at the time of discharge in our migrant worker cohort was 34.7%, of which the majority (63.1%) received diagnoses during their admission for COVID-19. This represented a health burden that was previously undetected and unaddressed. The focus on CVRFs was intentional due to the greater impact on healthcare resourcing related to the necessity of long-term management. Cardiovascular disease is the leading cause of death globally. The reduction of premature mortality from cardiovascular diseases and in the prevalence of DM and HTN is the objective of the WHO's Global Action Plan for non-communicable diseases.¹⁴

There were significant differences in the prevalence of CVRFs between migrant workers from different countries of origin; South Asians and Southeast Asians were more likely to have them compared with Chinese. The possible reasons for disparities included differences in genetics, diet and lifestyle, health literacy and healthcare systems in their home countries. As Singapore is a country with

high migration traffic and currently hosts 2.52 million migrants of many different nationalities, management of health services to serve such a heterogeneous group with different healthcare needs is complex.¹⁵ Further large-scale epidemiological studies are necessary to validate our findings.

Study data in comparison with existing literature

Our study results showed a similar prevalence of DM when compared with a recent study on COVID-19-positive migrant workers in another local hospital (7.1% vs 7.9%)¹¹ and comparable with the prevalence in Singaporean residents (8.6%).¹⁶ We compared our data with existing South Asian-specific studies given that South Asians formed the largest proportion (77.9%) of our study population. The overall prevalence of DM in South Asian patients in our study was comparable with that reported in India and Bangladesh.^{17 18}

Within Singapore, the prevalence of HTN and HLD within our study population appeared markedly lower than the respective prevalence in Singapore's population (15.9% vs 21.5% for HTN; 5.9% vs 33.6% for HLD).¹⁶ Similarly, our reported HTN and HLD prevalence in South Asians was lower compared with studies in Bangladesh and India despite a well-distributed age range in our study.^{18–20}

The incongruence in the prevalence of HTN and HLD may have been related to detection bias due to differences in our study methodology compared with nationwide screening programmes. A lower prevalence of HTN could have resulted from physician apprehension to diagnose HTN based on inpatient elevated BP, cognisant that white coat HTN and anxiety due to admission for

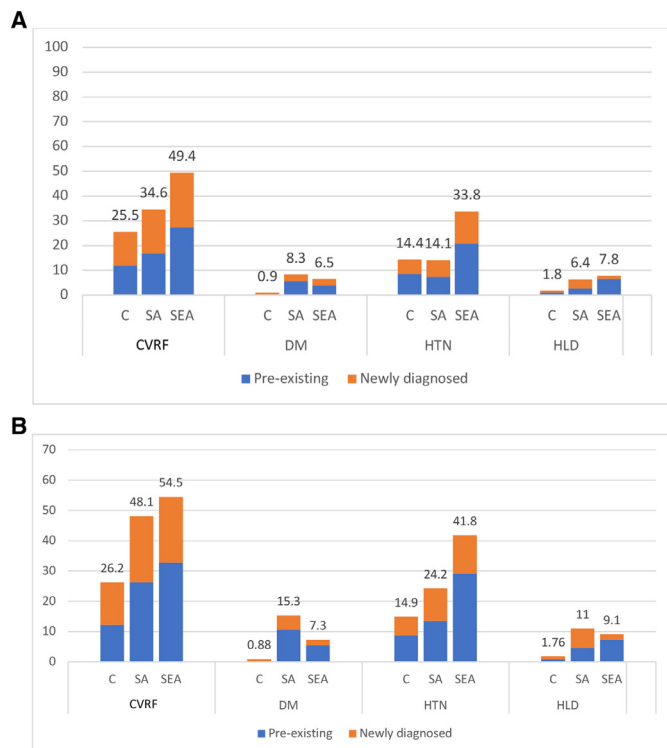


Figure 1 (A) Bar chart showing the prevalence of chronic non-communicable diseases by country of origin (Chinese, South Asian and Southeast Asian). $P < 0.050$ for differences in overall prevalence for all conditions except HLD ($p = 0.102$) ($N = 883$). (B) Bar chart showing the prevalence of non-communicable diseases by country of origin (Chinese, South Asian and Southeast Asian) for those aged above 40. $P \leq 0.010$ for differences in overall prevalence for all conditions ($n = 516$). C, Chinese; CVRF, cardiovascular risk factor; DM, diabetes mellitus; HLD, hyperlipidaemia; HTN, hypertension; SA, South Asian; SEA, Southeast Asian.

a COVID-19 infection could have confounded the BP readings. The lipid panel blood test was only performed for patients suspected with metabolic syndrome or when another CVRF was diagnosed. Hence HLD is likely underestimated in our cohort. In addition, we postulate that since the majority of our study population work in manual labour industries, the regular physical activity required in these occupations may confer protection against cardiovascular disease and risk factors.

Health-seeking behaviours and barriers to care

Of Singapore's migrant worker population, 22.0% reported ever having financial barriers to accessing healthcare, where costs are high relative to their low income.²¹ This study also showed the majority had poor knowledge of their healthcare insurance entitlements, including coverage for outpatient expenses, and 55.0% of doctors were unfamiliar with the financial resources available for migrant workers' healthcare. Another barrier to chronic disease diagnosis and care is the fear of repatriation.^{22 23} Certain employers may have chosen to send their migrant worker employees back to their home country to receive non-emergency treatment.²⁴

Many migrant workers resorted to self-treatment, remote treatment (eg, friends transporting medications from home countries), traditional medicine, non-profit organisations, paying out-of-pocket for care at private primary care providers,²⁵ awaiting return to home countries for care or unfortunately forgoing care altogether.^{22 26} In some cases, pursuit of these alternatives compromised the quality or timeliness of essential care, with adverse health consequences such as the development of complications arising from poorly controlled DM and HTN.^{24 27} Furthermore, COVID-19 travel restrictions have disrupted the means of obtaining healthcare and medication from overseas.

Developments and recommendations

The outbreak of COVID-19 infections in the migrant worker population in Singapore has highlighted health disparities, which has given Singapore the impetus to start discussions on migrant workers' health concerns.²⁸

Since August 2020, regional healthcare centres have been set up within dormitories to improve migrant workers' access to medical care, encouraging early treatment. For migrant workers not residing within dormitories, telemedicine has been made available for them. To alleviate concerns on healthcare costs, consultation fees for acute respiratory illness, acute and chronic conditions are waived.²⁹

Mental health has taken a spotlight during this pandemic, with movement restrictions exacerbating feelings of isolation, anxiety and despair among migrant workers.³⁰ Our hospital harnessed technology to provide information and support materials and to facilitate communication between migrant workers and the healthcare team using iPads. In addition, group video conference sessions were organised with a psychologist and translator to cushion the psychosocial impact of the pandemic.³¹

Labour policy makers can consider working with migrant worker advocacy groups to re-examine their policies overseeing migrant worker health, including healthcare subsidy, insurance coverage, mitigating employer gate-keeping of healthcare and reviewing the comprehensiveness of health screening.²⁴ However, caution needs to be taken to avoid the use of screening as a tool to disqualify migrant workers from their current work if it does not significantly impair their ability to continue working.⁷

There is a need for future research into scientifically vigorous, large-scale studies to examine non-communicable diseases within the general migrant worker population in Singapore, including economic burden analysis. Data will be able to direct interventions to improve CVRF and other disease detection and control, including provisions for long-term medical follow-up. While this may increase burden on healthcare resources, it is cost-effective as early treatment and disease control reduces the direct costs associated with complications and the indirect costs associated with productivity loss.³²



Limitations

First, during the study period, there was no standardised protocol to evaluate for CVRFs in the hospitalised migrant workers with COVID-19 infection. This might have resulted in the underdiagnosis of CVRFs. As there were multiple medical teams caring for patients in the isolation wards, there might have been inconsistent practices in screening for and diagnosing CVRFs. All patients had their BP monitored during admission and had standardised blood tests that included random serum glucose levels. Further diagnostic tests to confirm DM were ordered in the presence of an elevated serum glucose level, although it is possible that some cases might have been missed. Screening for HLD was less consistent and was usually performed after diagnosing other CVRFs.

Second, despite translators, language barriers may have had contributed to under-reporting of medical history and pre-existing chronic diseases. The majority of our study subjects spoke Bengali or Tamil as their first language, with limited English. Furthermore, hospitalised migrant workers may have chosen to conceal medical history for fears of its repercussions on their employability and insurance.

In addition, our cohort of 883 male subjects only represented a small fraction of the total number of dormitory-dwelling migrant workers in Singapore and an even smaller fraction of those infected with COVID-19 at the time of the study. Singapore citizens and permanent residents, foreign domestic helpers, foreign workers holding PMET roles and migrant workers with severe infection were not represented in this study.

Due to the retrospective nature of this study, there was no longitudinal follow-up to track compliance to subsequent outpatient appointments. This information would have given further insight into their health-seeking behaviour, barriers to continuation of care and how to address them.

CONCLUSION

Medical assessment of inpatient COVID-19-positive migrant workers has unmasked a significant prevalence of undiagnosed CVRFs and other non-communicable diseases, attributed to a lack of robust screening processes, compounded by barriers to accessing healthcare. This study highlighted the health service requirements and opportunities for Singapore as a host country to serve our sizeable migrant worker population better. More can be done through harnessing of public solidarity and social cohesion to drive policy and system-level changes to effect sustainable improvements that last beyond this period of scrutiny cast on migrant worker health by the pandemic. The long-term aim would be to reduce the healthcare disparity between the local community and migrant workers to promote the overall health of this unique population.

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input and comments on manuscript drafts leading to the final submission. SAMM is responsible for the overall content as the guarantor.

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Patient consent for publication Not required.

Ethics approval This study involves human participants. The study protocol was reviewed by SingHealth Institutional Review Board (institutional ethical committee). Due to the nature of the study using secondary data sources without identifiable information, the study was granted exemption from formal review (CIRB ref: 2020/2629).

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