

Investigating the unresolved causes of sudden cardiac deaths among Nepalese labour migrants in Malaysia: A verbal autopsy study

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Abstract:

Background: Recent studies of Nepalese male migrant workers in Gulf Cooperation Council (GCC) countries and Malaysia have highlighted substantial health risks, with many cardiovascular-related deaths reported as sudden cardiac deaths. Most such deaths are not adequately investigated. This study explored (a) the circumstances surrounding these deaths and (b) potential contributing factors.

Method and Materials: Following public and patient involvement and engagement (PPIE) activities with key stakeholders and Nepalese migrant communities in Malaysia, we conducted a verbal autopsy study of 57 friends, roommates, and relatives of 40 Nepali nationals who had died unexpectedly in Malaysia.

Results: Most of the deceased were men (92.5%, n=37), with a mean age of 34.5 years (SD 8.3) and a mean duration of employment in Malaysia of 5.9 years (SD 4.4). Only 40.0% (n=16) reportedly received a regular weekly rest day, while 80.0% (n=32) worked more than 8 hours per day. Among those who consumed alcohol (n=33), one-third (33.3%, n=11) drank daily. More than half of the deceased (55.0%, n=22) had at least one pre-existing health condition, most commonly hypertension (32.5%, n=13), followed by diabetes (7.5%, n=3).

Conclusion: The circumstances surrounding sudden deaths among Nepalese migrant workers in Malaysia suggest a potential contribution from cardiovascular risk factors, lifestyle behaviours, and adverse working conditions. Reducing this burden will require targeted health-promotion interventions, improved prevention and management of cardiovascular risk factors, stronger occupational health protections, and measures to prevent the production and consumption of counterfeit alcohol.

Keywords: Sudden deaths, Nepalese migrants, verbal autopsy, lifestyles, working conditions

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Introduction

Labour migration remains a cornerstone of Nepal's economy. Between 2008 and 2024, more than 5.7 million labour permits were issued for foreign employment, including 954,319 in fiscal year 2022/23 and 23/24 [1]. More than 80% of these permits were issued for migration to six Gulf Cooperation Council (GCC) countries and Malaysia.

While labour migration generates substantial economic benefits for Nepal [2], it also brings considerable health and social costs to migrants and their families. According to the Foreign Employment Board's (FEB) records of financial assistance, more than 600 Nepalese migrant workers have died annually since 2011/12. In 2022/23 and 2023/24, recorded deaths exceeded 1,200 per year, with the single most common classification (19.4%) listed as 'natural causes' without further specification [1]. However, this figure likely underestimates the true burden because it largely relies on compensation claims by families. In addition, sudden deaths of undocumented migrant workers remain largely absent from official statistics.

Malaysia hosts over 400,000 workers from Nepal [3]. Within this population, sudden cardiovascular-related deaths (SCDs), often reported as 'sudden nocturnal deaths', have emerged as a particular concern [4] and appear to occur more frequently among Nepalese migrants than among other migrant groups in the country.

Evidence suggests that SCD is associated with several occupational and behavioural risk factors common among migrant workers, including long working hours [5], exposure to extreme temperatures [6], strenuous physical activity [7], heavy alcohol consumption [8], and overweight or obesity (9). Consistent with these observations, factory workers and production operators accounted for 56% of CVDs among Nepalese migrant workers in Malaysia in 2015 [4].

SCDs among migrants and refugees have been documented for several decades. However, young and male migrants from Southeast Asia tend to be disproportionately affected [10, 11]. Evidence of SCDs among Southeast Asians includes reports from refugees in the United States [10,12], Lao refugees in Thailand [13], and Thai workers in Singapore [14]. Some key explanations for those deaths included ventricular fibrillation [12], psychological stress [14], thiamine deficiency [15] potassium deficiency [16], family history [13,14], and heat stress [17].

Reports of SCDs among Nepalese migrant workers in Malaysia and the Gulf have increased in recent decades, which is particularly concerning given that Nepalese migrant workers

are predominantly young, typically under 30 years, considered relatively healthy, and undergo mandatory medical examinations (although there are some speculations about the quality of those tests) before departure from Nepal and after arrival in destination countries. However, Nepal lacks comprehensive age- and sex-specific cause-of-death data, which has limited comparisons of the epidemiology of cardiovascular mortality among migrants and non-migrants for many years [18]. Since medical autopsies are often unavailable or logistically burdensome for migrants in Malaysia, verbal autopsies (VA) could be a useful and cost-effective measure to investigate these deaths. Verbal autopsies are valid, ethically appropriate, and a culturally accepted method for the investigation of Sudden Cardiac Deaths (SCD) [19, 20]. VA is also a validated approach against hospital records and is widely accepted in migrant-specific scenarios in Southeast Asia. Studies have also used VA to develop targeted interventions on risk factors, which have strengthened evidence-based migration policies [19, 21].

Given the increasing burden of SCDs among Nepalese migrants in Malaysia and the lack of epidemiological data to explain them, our team conducted a public and patient involvement and engagement (PPIE) workshop in Malaysia in 2019 to explore research priorities related to SCDs among Nepalese migrant workers. The workshop involved 20 participants, including researchers from Malaysian universities, representatives from national and international non-governmental organisations, Ministry of Health officials, and migrant workers. Findings from the workshop have been published elsewhere [18]. Participants described recurring reports of apparently healthy, asymptomatic Nepalese migrant workers dying suddenly during sleep. They perceived these deaths to occur more frequently among Nepalese workers than among other migrant groups. Participants also reported that many workers were employed in physically demanding manufacturing jobs involving extensive overtime, and that alcohol consumption, including counterfeit or low-cost alcoholic beverages, was common. Participants highlighted the limited availability of medical records from health facilities, immigration authorities, and the Embassy of Nepal, and noted that police reports often relied on secondary information. The workshop recommended the use of VA methods involving interviews with close contacts, including roommates, friends, and relatives. Against this background, we conducted a VA study among roommates, friends, and relatives of Nepalese migrant workers who died suddenly in Malaysia to characterise the circumstances surrounding these deaths and identify potential contributing factors.

Methodology

Study Design and Participants

We conducted a VA study [19] with friends, roommates, and relatives of 40 Nepalese migrants who had died unexpectedly in Malaysia within the preceding two years.

Data collection

Between May 2022 and February 2023, face-to-face interviews using the VA tool were administered with roommates, friends, or relatives who had close contact with the deceased migrants. Interviews were conducted by an experienced Nepal-speaking research assistant (RA) based in Malaysia. Before data collection, the RA received two days of in-person training in Malaysia by a research team member [NA] and one day of virtual training by team members [PRR, NA, AP] covering the VA instrument and study procedures, trauma-informed interviewing, management of participants' emotional responses, researcher and participant safety, and data security, following the WHO 2022 VA training curriculum for interviewers.

A seven-member Technical Advisor Group (TAG) was formed, comprising Nepalese migrant leaders, migrant health advocates in Malaysia, migration health researchers, and clinicians (cardiologists and forensic pathologists from Malaysia and Nepal).

Questionnaire design and validation

The preliminary instrument was developed based on the WHO 2022 VA tool and further refined during a two-day workshop involving TAG members, subject experts, and relevant stakeholders in Malaysia. The instrument was piloted among ten Nepalese migrant workers in Malaysia to assess comprehensiveness and linguistic and cultural appropriateness.

The final VA tool consisted of structured, mostly closed-ended questions that included eight main sections: (i) interviewee background and relation to the deceased migrant; (ii) socio-demographic characteristics of deceased migrants; (iii) socio-economic details (occupation, income); (iv) work characteristic (daily working hours, rest periods, physical demands, heat exposure, working hours); (v) working and living conditions in Malaysia; (vi) lifestyle factors (diet, smoking, drinking, physical activities); (vii) medical history (recent medical conditions, mental stress; activities and circumstances surrounding 24–48 hours before death (e.g., gasping or groaning); (viii) post death events (postmortem, insurance, funeral arrangements) activities during the 24 h preceding death (e.g., strenuous work, long working hours, or health complaints) [The VA tool used in this study is available from the corresponding author upon reasonable request]. The

final VA tool used for all interviews was prepared in Nepali language which was also reviewed by Nepalese subject experts and members of the migrant community in Malaysia for feasibility and acceptability.

Inclusion and exclusion criteria

Interview participants were eligible if they had close social contact with the deceased and could provide detailed information on the deceased's health status, lifestyle, work patterns, and circumstances preceding death. We excluded individuals without close contact with the deceased or those unable to participate because of time constraints, mainly due to work demands.

Sample Size Calculation

A list of Nepalese migrants reported to have died in the preceding two years was obtained from the Embassy of Nepal in Kuala Lumpur, Malaysia. We reviewed the list and then identified those who were suggested to have died from cardiovascular causes or during sleep. In next stage, we used a non-random approach to identify and invite potential interview participants using the work addresses of deceased. Given the difficulty of first identifying the deceased's workplaces and subsequently locating their social networks, we managed to find a total of 57 friends, roommates, and relatives of 40 Nepalese migrants who had died unexpectedly in Malaysia within the preceding two years. A sample size calculation was not appropriate given nature of the study and limited sampling frame.

Outcome Variable

The primary outcome was the reported circumstances preceding and surrounding sudden death, including symptoms and health complaints during the 24–48 h before death, activities immediately preceding death, and circumstances at the time of death.

Explanatory Variables

Potential explanatory variables included socio-demographic characteristics, occupational and living conditions, lifestyle behaviours, and medical history. These variables were examined descriptively to characterise potential factors that might have contributed to the circumstances preceding death.

Ethical Committee Approval

Ethical approval was obtained from Bournemouth University (July 2020) and the Ethics Consultative Service for Marginalised Population (ECS-MP), University of Malaya (approved Feb 2021). All participants received a Nepali-language information sheet explaining the study, potential risks, and their rights. Written informed consent was obtained from all before data collection. Confidentiality and anonymity were maintained, and all data were managed in accordance

with ethical standards for research involving human participants. Additional support was available to address any psychological distress experienced by the research assistant, recognising that research involving death can be emotionally challenging for participants and researchers [22].

Data Management and Statistical Analysis

Completed VA questionnaires were entered into Microsoft Excel by the research assistant. NA and PR checked for completeness and consistency before analysis. The cleaned dataset was imported into Stata version 18 for analysis. Descriptive analyses were conducted to summarise participants' characteristics and the deceased individuals' sociodemographic, occupational and living characteristics, lifestyle, and circumstances of death, using frequencies and percentages for categorical variables and mean and standard deviation for continuous variables, as appropriate.

Results

Participants in this study were predominantly male with a mean age of 33.9 years (SD 7.1). The mean duration of their relationship with the deceased was 6.3 years (SD 6.2). Work colleagues comprised the largest proportion of respondents (42.5%, $n=17$), followed by friends (27.5%, $n=11$); relatives and roommates each accounted for 15.0% ($n=6$) of participants. Table 1 summarises the key sociodemographic characteristics of the deceased ($n=40$). Most were male (92.5%, $n=37$) and married (77.5%, $n=31$), with a mean age of 34.5 years (SD 8.3). The largest proportion originated from Koshi Province (32.5%, $n=13$), and Janajati groups accounted for 42.5% ($n=17$) of deaths.

The mean duration of employment in Malaysia was 5.9 years (SD 4.4), with 47.5% ($n=19$) having worked there for more than 5 years. Factory worker was the most common occupation (50.0%, $n=20$). Most individuals worked 8–12 hours/day (70.0%, $n=28$), with a mean working duration of 10.9 hours/day (SD 2.2), and nearly one-third (32.5%, $n=13$) reported having no weekly day off. Most worked primarily

indoors (57.5%, $n=23$), reported moderate heat exposure (75.0%, $n=30$), and engaged in light physical activity (77.5%, $n=31$). Mean daily rest time was 53.7 minutes (SD 32.1). Living conditions were generally rated favourably, with 50.0% ($n=20$) described as good and 40.0% ($n=16$) as excellent (Table 2), and all had water available at work, but none had air-conditioning in their room.

Nearly half of the deceased were current smokers (45.0%, $n=18$), of whom 40.9% ($n=9$) smoked 5–10 cigarettes daily. Current alcohol use was reported in 77.5% ($n=31$), and use of non-smoked tobacco products in 50.0% ($n=20$). Among current and former drinkers ($n=33$), all consumed counterfeit or locally produced low grade alcohol, 33.3% ($n=11$) consumed alcohol daily. More than half of the deceased (55.0%, $n=22$) had at least one pre-existing health condition, most commonly high blood pressure (32.5%, $n=13$), followed by diabetes (7.5%, $n=3$). Among those with a known health condition ($n=22$), 54.5% ($n=12$) were receiving treatment; half for high blood pressure, two (16.7%) for diabetes, and four (33.3%) for other conditions (Table 3).

Table 4 summarises the circumstances surrounding death. On the day of death, 62.5% ($n=25$) of the deceased had reportedly attended work, with a mean working duration of 9.7 hours (SD 4.9). Most had eaten dinner that day (72.5%, $n=29$), and 35.0% ($n=14$) were reportedly made unusual sounds immediately before death. Death most commonly occurred in the deceased's hostel or usual accommodation (77.5%, $n=31$) and during the morning hours (06:00–12:00; 45.0%, $n=18$).

A postmortem examination was reportedly conducted in 80.0% ($n=32$) of cases. More than half of the deceased were covered by insurance (57.5%, $n=23$), and death-related expenses were most often borne by the employer (82.5%, $n=33$) (Table 5).

Table 1: Socio-economic and demographic characteristics of the deceased

Variables	Number (%)
Sex	
<i>Male</i>	37 (92.5%)
<i>Female</i>	3 (7.5%)
Age group (years)	
20 to 29	11 (27.5)
30 to 39	17 (42.5)
40 to 49	11 (27.5)
50 or above	1 (2.5)
Province (Nepal)	
<i>Koshi</i>	13 (32.5)
<i>Lumbini</i>	11 (27.5)
<i>Bagmati</i>	7 (17.5)
<i>Madhesh</i>	7 (17.5)
<i>Gandaki</i>	2 (5.0)
Ethnicity	
<i>Janajati</i>	17 (42.5)
<i>Madheshi</i>	11 (27.5)
<i>Chhetri</i>	6 (15.0)
<i>Dalit</i>	4 (10.0)
<i>Brahmin</i>	1 (2.5)
<i>Muslim</i>	1 (2.5)
Level of education	
<i>Secondary school</i>	21 (52.5)
<i>Primary school</i>	13 (32.5)
<i>No formal education but literate</i>	2 (5.0)
<i>Illiterate</i>	2 (5.0)
<i>Post-secondary school</i>	1 (2.5)
<i>Doesn't know</i>	1 (2.5)
Marital status	
<i>Married</i>	31 (77.5)
<i>Never married</i>	6 (15.0)
<i>Divorced</i>	2 (5.0)
<i>Doesn't know</i>	1 (2.5)
Usual occupation in Nepal	
<i>Farmer</i>	14 (35.0)
<i>Doesn't know</i>	10 (25.0)
<i>Business</i>	4 (10.0)
<i>Foreign employment elsewhere</i>	2 (5.0)
<i>Student</i>	2 (5.0)
<i>Other*</i>	8 (20.0)
	Mean (SD)
Age (years)	34.5 (8.3)
Number of children (n=33)	2.1 (1.1)

**mechanic, building/factory worker, barber, dancer, schoolteacher, woodcutter, and driver*

Table 2: Work and living characteristics of the deceased in Malaysia

Variables	Number (%)
Working duration	
<i>Less than one year</i>	5 (12.5)
<i>1 to 2 years</i>	4 (10.0)
<i>2 to 3 years</i>	3 (7.5)
<i>3 to 4 years</i>	3 (7.5)
<i>4 to 5 years</i>	6 (15.0)
<i>More than five years</i>	19 (47.5)
Occupation	
<i>Factory worker</i>	20 (50.0)
<i>Security guard</i>	9 (22.5)
<i>Agriculture worker</i>	3 (7.5)
<i>Hotel worker</i>	3 (7.5)
<i>Cleaner</i>	2 (5.0)
<i>Construction worker</i>	1 (2.5)
<i>Driver</i>	1 (2.5)
<i>Marketing</i>	1 (2.5)
Working hours per day	
<i>Up to 8 hours</i>	8 (20.0)
<i>8 to 12 hours</i>	28 (70.0)
<i>More than 12 hours</i>	4 (10.0)
Rest duration per day (inc. lunch time)	
<i>Less than 30 minutes</i>	13 (32.5)
<i>30 to 60 minutes</i>	20 (50.0)
<i>More than 60 minutes</i>	7 (17.5)
Weekly days off allowed	
<i>None</i>	11 (27.5)
<i>One day</i>	26 (65.0)
<i>Two days</i>	3 (7.5)
Weekly off days taken	
<i>Never</i>	13 (32.5)
<i>Sometimes</i>	11 (27.5)
<i>Always</i>	16 (40.0)
Usual work setting	
<i>Outdoor</i>	4 (10.0)
<i>Indoor</i>	23 (57.5)
<i>Outdoor and indoor mix</i>	13 (32.5)
Heat exposure	
<i>Low</i>	8 (20.0)
<i>Moderate</i>	30 (75.0)
<i>Doesn't know</i>	2 (5.0)

Level of physical activity at work	
<i>Light</i>	31 (77.5)
<i>Moderate</i>	9 (22.5)
<i>Heavy</i>	0 (0)
	Mean (SD)
Working duration (years)	5.9 (4.4)
Working hours per day	10.9 (2.2)
Monthly income (RM)	2251 (543)
Rest time per day (minutes)	53.7 (32.1)
Number of people in a room	
<i>Up to 4</i>	28 (70.0)
<i>5 to 8</i>	4 (10.0)
<i>More than 8</i>	8 (20.0)
Proper ventilation in a room	
<i>Yes</i>	38 (95.0)
<i>No</i>	2 (5.0)
Overall rating of living condition	
<i>Moderate</i>	4 (10.0)
<i>Good</i>	20 (50.0)
<i>Excellent</i>	16 (40.0)
	Mean (SD)
Number of people in a room	5.1 (4.8)

Table 3: Lifestyle-related characteristics and medical history deceased in Malaysia

Variables	Number (%)
Use of smoked tobacco	
<i>Current smoker</i>	18 (45.0)
<i>Past smoker</i>	4 (10.0)
<i>Non-smoker</i>	14 (35.0)
<i>Doesn't know</i>	4 (10.0)
Cigarettes per day (n=22)	
<i>1 to 5</i>	8 (36.7)
<i>5 to 10</i>	9 (40.9)
<i>More than 10</i>	4 (18.2)
<i>Doesn't know</i>	1 (4.5)
Use of non-smoked tobacco	
<i>Current user</i>	20 (50.0)
<i>Past user</i>	3 (7.5)
<i>Non-user</i>	17 (42.5)
Frequency of non-smoking tobacco use (n=23)	
<i>1 to 3 times a day</i>	9 (39.1)
<i>More than 3 times a day</i>	9 (39.1)
<i>1 to 5 times a week</i>	5 (21.7)

Alcohol use	
<i>Current drinker</i>	31 (77.5)
<i>Past drinker</i>	2 (5.0)
<i>Non-drinker</i>	6 (15.0)
<i>Doesn't know</i>	1 (2.5)
Frequency of alcohol use (n=33)	
<i>Daily drinker</i>	11 (33.3)
<i>1 to 3 times a week</i>	19 (57.6)
<i>3 to 5 times a week</i>	2 (6.1)
<i>Few times a month</i>	1 (3.0)
Combined use of tobacco (smoked & non-smoked) and alcohol	
<i>Ever user of smoked and non-smoke tobacco</i>	13 (32.5)
<i>Ever user of smoked tobacco and alcohol</i>	22 (55.0)
<i>Ever user of non-smoked tobacco and alcohol</i>	22 (55.0)
<i>Ever user of all smoked and non-smoked tobacco and alcohol</i>	13 (32.5)
Drug use	
<i>Yes</i>	0 (0)
<i>No</i>	38 (95.0)
<i>Doesn't know</i>	2 (5.0)
Non-work-related physical exercise	
<i>Never</i>	30 (75.0)
<i>Sometimes</i>	8 (20.0)
<i>Doesn't know</i>	2 (5.0)
Existing health condition*	
<i>Yes</i>	22 (55.0)
Type of health condition	
<i>High Blood Pressure</i>	13 (32.5)
<i>Diabetes</i>	3 (7.5)
<i>Abdominal problems</i>	3 (7.5)
<i>Vision problem</i>	1 (2.5)
<i>Tuberculosis</i>	1 (2.5)
<i>Hands and feet crippled</i>	1 (2.5)
<i>Frequent chest pain</i>	1 (2.5)
<i>Frequent headache</i>	1 (2.5)
<i>Undisclosed health issue</i>	1 (2.5)
Currently on treatment/medication (n=22)	
<i>Yes</i>	12 (54.5)
<i>No</i>	9 (40.9)
<i>Does not know</i>	1 (4.5)
Health condition for treatment/medication (n=12)	
<i>High blood pressure</i>	6 (50.0)
<i>Diabetes</i>	2 (16.7)
<i>Abdominal pain</i>	1 (8.3)
<i>Used Nepali medicine, disease unknown</i>	1 (8.3)
<i>Does not know</i>	2 (16.7)
<i>*Three deceased had two health conditions</i>	

Table 4: Circumstances around death

Variables	Number (%)
New health/work/or personal problems in the last 30 days	
<i>Yes*</i>	8 (20.0)
<i>No</i>	31 (77.5)
<i>Does not know</i>	1 (2.5)
Stressed more than usual in the last 30 days	
<i>Yes</i>	7 (17.5)
<i>No</i>	32 (80.0)
<i>Doesn't know</i>	1 (2.5)
Went to work on the day the deceased died	
<i>Yes</i>	25 (62.5)
<i>No</i>	14 (35.0)
<i>Jobless</i>	1 (2.5)
Working hours on the day the deceased died (n=25)	
<i>Up to 8 hours</i>	8 (32.0)
<i>8 to 12 hours</i>	14 (56.0)
<i>More than 12 hours</i>	3 (12.0)
Took dinner on the day of dying	
<i>Yes</i>	29 (72.5)
<i>No</i>	10 (25.0)
<i>Does not know</i>	1 (2.5)
Talked as usual on the day of dying	
<i>Yes</i>	32 (82.5)
<i>No</i>	6 (15.4)
<i>Does not know</i>	1 (2.6)
Notable incident/behaviour on the day of dying	
<i>Yes**</i>	9 (22.5)
<i>No</i>	31 (77.5)
Unusual sound just before death	
<i>Yes***</i>	14 (35.0)
<i>No</i>	23 (57.5)
<i>Does not know</i>	3 (7.5)
Death hours	
<i>Morning (6 AM to 12 PM)</i>	18 (45.0)
<i>Afternoon (12 PM to 6 PM)</i>	7 (17.5)
<i>Evening (6 PM to 12 PM)</i>	6 (15.0)
<i>Night (12 PM to 6 AM)</i>	9 (22.5)
Place of death	
<i>Company hostel/usual accommodation</i>	31 (77.5)
<i>Workplace</i>	6 (15.0)
<i>Health facility</i>	2 (5.0)
<i>Public place</i>	1 (2.5)

*Complains of body not working properly, stomach pain, slurry speech, poor vision, personal situations such as family and financial issues

**Heavy alcohol intake, complain of chest pain and headache, vomit, restlessness and trouble breathing, personal and family stress

***gasping, groaning, producing a loud sound

Table 5: Post-death circumstances

Variables	Number (%)
Postmortem undertaken	
<i>Yes</i>	32 (80.0)
<i>No</i>	4 (10.0)
<i>Does not know</i>	4 (10.0)
Postmortem report provided to family	
<i>Yes</i>	22 (55.0)
<i>No</i>	8 (20.0)
<i>Does not know</i>	10 (25.0)
Deceased covered by insurance	
<i>Yes</i>	23 (57.5)
<i>No</i>	10 (25.0)
<i>Does not know</i>	7 (17.5)
Place of funeral	
<i>Nepal</i>	32 (80.0)
<i>Malaysia</i>	7 (17.5)
<i>Does not know</i>	1 (2.5)
Who bore death-related costs? (e.g. sending body back to Nepal, funeral)	
<i>Employer</i>	33 (82.5)
<i>Friends in Malaysia</i>	5 (12.5)
<i>Family from Nepal</i>	2 (5.0)
	Mean (SD)
Time to send the body back to Nepal (in days) (n=30)	17.6 (14.1)

Discussion

To our knowledge, this is the first study to investigate the circumstances surrounding sudden deaths among Nepalese labour migrants in Malaysia, using VA interviews with friends, roommates, and relatives of deceased workers. The SCDs occurred predominantly among young and middle-aged men working in factories and security sectors. The findings suggest that these SCDs are likely influenced by a combination of behavioural, occupational, and underlying health-related factors rather than a single determinant.

Lifestyle and cardiometabolic risk factors

The high prevalence of alcohol and tobacco use alongside hypertension among the deceased points to the potential contribution of modifiable cardiovascular risk factors. More

than 80% of the deceased were reported to be current or former alcohol users, with 33% drinking daily. Likewise, over half were current or former users of smoked and smokeless tobacco products. These levels appear substantially higher than in the general Nepalese population [23]. Alcohol consumption and smoking are well-established risk factors for hypertension and cardiovascular disease [24, 25, 26]. Although our study cannot establish a causal relationship, the combination of high alcohol consumption, hypertension, and possible exposure to unregulated alcohol products warrants further investigation. The widespread consumption of cheap, counterfeit, and possibly toxic alcohol [27], smoking alongside underlying hypertension likely exacerbated the risk of cardiovascular diseases [28] risks were compounded by the fact that only half

of the migrants with known health conditions were receiving treatment at the time of death, suggesting important gaps in diagnosis, treatment, or continuity of care.

Similarly, the burden of cardiovascular risk factors identified in this study is likely to be underestimated. Migrant workers may experience undiagnosed hypertension and other chronic conditions because of barriers to healthcare access, including financial constraints, long working hours, concerns about employment security, and limited health literacy. This interpretation is consistent with wider evidence suggesting substantial health-related fitness problems as a recent report estimated that annually 2,900–5,260 Nepalese migrants are declared medically unfit for employment in Malaysia [29].

Working conditions and potential occupational risks

Occupational factors may also contribute to adverse health outcomes. For example, most deceased workers had been employed in Malaysia for several years, and the majority reportedly worked more than 8 hours per day, with about one-third reportedly having no regular weekly day off. Long working hours without weekly rest days, alongside, hypertension, sleep disturbance, and psychological stress have been associated with increased risks of cardiovascular disease, hypertension, and psychological stress [5]. A recent study of returnee Nepalese migrants from the GCC and Malaysia reported a high prevalence of hypertension and diabetes [30]. Although our study cannot determine causality, the long working hours observed among the deceased suggest that occupational stressors may have contributed to underlying cardiovascular vulnerability.

Most workers in our study were employed indoors, reported moderate rather than severe heat exposure, had access to drinking water, were engaged primarily in light physical activity, and the majority also died indoors. Living conditions were generally rated favourably, with most accommodation described as well-ventilated, and overall conditions reported as good, although without air-conditioning. These findings differ from previous hypotheses linking heat stress to sudden deaths among Nepalese migrant workers in Qatar [17]. Although Malaysia and the GCC are significantly different for Nepalese labour migrants in terms of weather and working conditions, the possibility of cumulative or unrecognised heat-related effects cannot be excluded.

Circumstances and patterns of death

The predominance of deaths occurring in usual accommodation, particularly during periods of rest, is consistent with reports of SCDs among Southeast Asian populations [12, 13, 14]. Although postmortem examinations were reportedly conducted in most cases, discussions with stakeholders suggested that comprehensive autopsies are often not undertaken unless criminal activity is suspected [18].

Our finding that the majority of deaths occurred between 6 AM and 12 PM is also consistent with the existing literature on Thai migrants in Singapore and Taiwan, as well as among Laotian refugees [13, 14, 31]. The deaths reported in our study occurred during rest and sleep hours rather than working hours, supporting claims of autonomic shifts and ventricular vulnerability during sleep [32]. This supports the notion that abnormal physiological responses following occupational fatigue, followed by relief during rest, may trigger fatal arrhythmias in vulnerable people.

Most deceased appeared to have been well on the day of death, having attended work and eaten, and communicated normally. This observation is consistent with the sudden and unexpected nature of the deaths and suggests that overt symptoms were either absent or not recognised by those around them. More than one-third of the deceased reportedly made unusual sounds immediately before death, potentially indicating acute cardiorespiratory events, although this observation requires further clinical investigation. The fact that many individuals had worked long hours on the day of death also raises questions about the potential interaction between occupational fatigue, underlying cardiovascular disease, and SCD.

Geographical and ethnic distribution of deaths

The distribution of deaths by province and ethnicity broadly reflects established patterns of labour migration from Nepal. The higher representation of migrants from Koshi and Lumbini provinces and among Janajati and Madheshi populations [1] may reflect their greater participation in foreign employment rather than an increased mortality risk. However, the absence of denominator data prevents assessment of differential mortality risks across population groups.

This study provides evidence on the circumstances surrounding SCDs among Nepalese migrant workers in Malaysia. The findings highlight the need for improved cardiovascular risk assessment and management among migrant workers, including routine screening for hypertension and other chronic conditions during employment. Public health interventions should address alcohol consumption, tobacco use, smokeless tobacco use, and other behavioural risk factors through culturally appropriate and evidence-based approaches. There is an urgent need to conduct comprehensive autopsies of deceased migrant workers in Malaysia and classify the causes of death according to internationally accepted standards, such as the International Classification of Diseases (ICD)-11. The use of broader terms for cardiovascular deaths hinders the initiative to address their root causes.

Strengthened surveillance and regulatory measures are also needed to prevent the sale and distribution of counterfeit alcohol. In addition, workplace policies that promote adequate rest and recovery, together with accessible and migrant-friendly

health services, may help reduce preventable mortality among this population. Further epidemiological and clinical research, including studies incorporating detailed autopsy findings and comparison groups, is required to clarify the causes and mechanisms of sudden death in migrant workers.

Conclusion

Sudden deaths in Malaysia among migrant workers from Nepal may be associated with a combination of lifestyle-related and cardiovascular risk factors, potentially compounded by occupational stressors and limited engagement with healthcare services. This demands a systemic and targeted interventions in Nepal and Malaysia that will include cardiovascular risk screening, improved hypertension detection and management, reduction of harmful alcohol use, tobacco cessation, and enforcement of appropriate working hours and rest periods.

Limitation of the study

This study has several limitations. First, the small sample size and restriction to deaths occurring in Malaysia limit generalisability. Secondly, information came from friends, roommates, and relatives, introducing the possibility of recall bias and incomplete reporting. Thirdly, the absence of a comparison group prevents identification of factors that independently increase mortality risk. Fourthly, VA relies on proxy reporting and cannot establish definitive medical causes of death, particularly in the absence of comprehensive autopsy findings. Finally, the descriptive design does not permit causal inference regarding the relationships between occupational exposures, lifestyle factors, underlying health conditions, and mortality.

What is already known on this topic

Reports of sudden cardiac deaths (SCDs) among Nepalese migrant workers in Malaysia and the Gulf countries have increased in recent decades. This is particularly concerning because they are predominantly young, often aged under 30 years, and generally healthy. Migrant workers undergo mandatory medical examinations before departure from Nepal and, in many destination countries, after arrival, although concerns have been raised about the quality and adequacy of these assessments. However, Nepal lacks comprehensive, age- and sex-specific cause-of-death data, limiting understanding of the epidemiology and determinants of cardiovascular mortality among migrant and non-migrant populations. Evidence on the circumstances and potential contributing factors underlying SCDs among Nepalese migrant workers remains particularly limited.

What this study adds

This is the first verbal autopsy (VA) study to characterise the circumstances surrounding sudden deaths among Nepalese migrant workers in Malaysia, drawing on accounts from

roommates, friends, and relatives of deceased workers. Although the study has several limitations and did not aim to investigate a causal relationship, it does provide additional insights into potential cardiovascular, behavioural, and occupational factors that might contribute to these deaths, including the need for improved identification and management of cardiovascular risk factors among migrant workers. These findings highlight the importance of strengthening health assessments before and during migration, including routine screening and management of hypertension and other chronic health conditions, alongside improved occupational health protections, and targeted health-promotion interventions.

Future scope of the study

Future research should incorporate clinical records, post-mortem findings, and toxicological investigations to better understand the relative contribution of alcohol use, hypertension, cardiovascular disease, and occupational factors to sudden deaths among migrant workers. Similarly, studies with larger samples and comparative designs are needed to better understand the pathways leading to mortality and to inform evidence-based interventions aimed at improving the health and well-being of migrant workers.

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Authors' contribution

NA, PR, and EvT designed the study. AP, EMF, and BKK supported the PPIE workshop and field work. BKK collected the data. NA analysed the data. PR and SB drafted the manuscript and all the authors contributed to reviews the manuscript, and editing. All authors have approved the final version of the manuscript.

Competing interests

The authors declare that there is no conflict of interest.

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