Original Article

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Prevalence and Factors Associated with Hyperglycemia among Myanmar Migrant Workers in Mueang District, Chiang Rai Province, Thailand: a Cross-Sectional Study

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Abstract:

Objectives: This study aimed to estimate the prevalence of hyperglycemia and identify factors associated with hyperglycemia among Myanmar migrant workers, aged over 18 years, in Mueang district, Chiang Rai province, Thailand.

Material and Methods: A cross-sectional study was performed on 402 Myanmar migrant workers aged over 18 years in Mueang District, Chiang Rai Province, Thailand. A questionnaire was used to collect research data, and blood pressure, body mass index, waist circumference, and fasting blood glucose levels were measured. Multiple logistic regression analyses were used to analyze the association between variables at a significance level of a=0.05.

Results: Among all the participants, 42.0% were male and 58.0% were female, with a mean age of 38.9 years (standard deviation=10.4). The prevalence of hyperglycemia was 13.4%. Six factors were found to be significantly associated with hyperglycemia in multivariate analysis; including: ethnicity (adjusted odd ratio (AOR)=4.76, 95% confidence interval (CI) =1.25–18.14), high blood pressure (AOR=3.83, 95% CI=1.82–8.03), overweight (AOR=5.19, 95% CI=2.28–11.81), obese (AOR=3.87, 95% CI=1.17–12.79), parent's history of diabetes mellitus (DM) (AOR=6.86, 95% CI=1.45–32.46), smoking (AOR=6.24, 95% CI=2.08–18.69), and depression (AOR=4.21, 95% CI=2.00–8.89).

Conclusion: The prevalence of hyperglycemia among Myanmar migrant workers was 13.4%. Ethnicity, high blood pressure, body mass index, parental history of DM, smoking and depression were significantly associated with hyperglycemia. The findings of this study are useful for the development of policies and measures for preventing and controling hyperglycemia and DM among Myanmar migrant workers.

Keywords: associated factors, Chiang Rai, hyperglycemia, Myanmar migrant workers, prevalence

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Introduction

Hyperglycemia is characterized by a high glucose level in the bloodstream that is often caused by endocrine and metabolic disorders; especially diabetes mellitus (DM).[1] DM is also one of the major lifestyle-related diseases in non-communicable diseases (NCDs), which are globally significant health-related threats to people.[2] The American Diabetes Association classifies DM into four types: type 1 DM, type 2 DM, other specific types of DM, and gestational DM. Among them, type 2 DM is the most common type and mainly occurs in the elderly. The risk factors for DM are associated with various factors; including, genetics, ethnicity, aging, obesity, high blood pressure, and dietary patterns. All of these are linked to socioeconomic development in their daily activities; such as, heavy alcohol consumption or particularly for fun, tobacco use, carbohydrate diet, high blood triglyceride levels, and an inactive lifestyle.[3] Uncontrolled diabetes can cause damage to many parts of the body, leading to chronic hyperglycemia and serious complications; such as, severe physical health problems or death, mental consequences, societal, and national economic consequences.[4]

According to the 2018 Thailand's registered migrant status, Thailand hosted approximately 3.9 million international registered migrants, of which 2.3 million were Myanmar migrant workers.[5] Chiang Rai province is close to the Tachileik Township, the Shan State of Myanmar, and hosts 25,000 registered Myanmar migrant workers.[6] The push factors for their migration from the country of origin are economic hardship, political insecurity, and restrained policies. The annual increase in the number of migrant workers worldwide poses a public health challenge to the national health system and increases economic costs. Epidemiological risk factors and changes in migrant lifestyles have become essential factors in the role of public health. Although urban lifestyle among migrants creates better access to healthcare services, education, and social services, adverse changes; such as, a sedentary lifestyle and nutrition transition can cause health problems.[7]

The Ministry of Public Health in Thailand and Myanmar has formulated a 5-year national NCDs prevention and control strategic plan (2017-2021), which also includes diabetes. Although, Myanmar tertiary hospitals have diabetes clinics, they have not established health insurance systems and are not set up entirely to international standards; hence, both regional patients with DM and migrant workers with DM must spend their own money at some cost.[8] Another point is that migrants with DM can experience economic problems in the host country and administrative problems in the national healthcare systems.[7]

Previous researchers have also reported the factors associated with prediabetes among Myanmar migrants.[9] However, the prevalence of hyperglycemia and the associated factors among Myanmar migrant workers has not yet been studied. Therefore, this study aimed to estimate the prevalence of hyperglycemia and identify the factors associated with hyperglycemia among Myanmar migrant workers aged over 18 years in Mueang district, Chiang Rai province, Thailand. The findings of this study will be useful in the development of policies and measures to both prevent and control hyperglycemia and DM.

Material and Methods

A cross-sectional study was conducted to determine the factors associated with hyperglycemia among Myanmar migrant adult workers aged over 18 years in Mueang District, Chiang Rai province, Thailand.

The seven Myanmar migrant's workplace areas (Rop Wiang, Wiang, Ban Du, Nang Lae, Tha Sut, Doi hang, and San Sai in Mueang district, Chiang Rai province) were the study settings.

The study population consisted of Myanmar migrant workers aged over 18 years, who have been living in Mueang Chiang Rai for at least one year from 2020.

The participants were Myanmar migrant workers who have been living in Chiang Rai for at least one year in Mueang Chiang Rai. Patients aged ≥18 years were eligible for participation in the study. People who were under fasting for at least 8 hours before the test, were willing, and met the inclusion criteria were invited to participate in the study. The sample size was calculated using the standard method for a cross-sectional design[10], with p=0.11, q=0.89, and e =0.03. Therefore, 402 participants were required for the analysis.

A validated questionnaire was used to collect data from the participants. The questionnaire was divided into six sections. Part 1 (five questions) was used to collect physical examination data; including, blood pressure, weight, height, waist circumference, and fasting blood sugar (glucose). Part 2 (eight questions) was used to collect data on general characteristics. Part 3 (three questions) was used to collect data on health status: parent's history of DM, and hypertension. Part 4 (11 questions) was used to collect data on health behavior practices for DM prevention. Part 5 (10 questions) was used to collect data on knowledge of DM prevention. Part 6 (10 questions) was used to collect data on attitudes toward DM prevention.

The validity and reliability of the questionnaire was tested and improved before its use. Three experts, in relevant fields, were asked to determine the validity of the questionnaire for review and improvement it was then translated from English to Burmese through the item-objective congruence technique. A pilot test was administered to 30 participants with characteristics similar to those of the study population in the same study area; the feasibility and sequence of the questions were then evaluated. Moreover, the reliability was tested for the 10 questions on knowledge of DM prevention and 10 questions on attitude toward DM prevention, with overall Cronbach's alpha values of 0.79 and 0.87.

Depression was screened using the standard questionnaire, Patient Health Questionnaire-2 (PHQ-2) and classified as yes (answering yes for either of 2 questions) and no (answering no for both questions). The total score of knowledge was 10 (100%); it was classified as the score ranging from; high knowledge (70-100%), medium knowledge (40-69.99%), and low knowledge (<40%).[11] In addition, the total score for attitudes was 30 (100%); the levels of attitude were classified as: negative (<40%), neutral (40–70%), and positive (>70%).[12]

Several measurements were taken in this study. First, blood pressure was classified into two categories: <140/90 mmHg was normal; and ≥140/90 mmHg was high blood pressure. Second, body mass index (BMI) was classified into four categories; <18.50 kg/m^2 was underweight, 18.50-24.99 kg/m^2 was normal, 25.00-30.00 kg/m^2 was overweight, and >30.00 kg/m^2 was obesity. Third, the waist circumference for males was classified into two categories: ≤90 cm was normal, and >90 cm was over the standard cutoff. For females, it was classified into two categories: ≤88 cm was normal, >88 cm was over the standard cutoff. Fourth, fasting blood sugar was classified into two categories: <126 mg/dl was not hyperglycemia, and ≥126 mg/dl was hyperglycemia.

Myanmar migrant workers were randomly selected from a list of migrant workers. Burmese labor was conducted to provide information regarding the research objective, the benefit of the study, and its protocols. On the date of data collection, participants were asked to fill out an informed consent form before the physical examination, measurement of fasting blood sugar, and completion of the questionnaire. Fasting blood sugar was measured from finger-stick blood of the participants who fasted for at least 8 hours, by using a glucose meter (Apex Biotechnology Corp., Taiwan). The data were collected between June 2 and November 30, 2021.

Statistical analysis was performed using SPSS, version 20, 2014 (SPSS, Armonk, NY, USA). Descriptive statistics were used to describe the participants' general characteristics and prevalence of hyperglycemia in terms

of percentages, means, and standard deviations (S.D.). Participant characteristics were analyzed and compared using the chi-square test or Fisher's exact test. Logistic regression analysis was used to identify the factors associated with hyperglycemia. Crude and adjusted odds ratios (OR and AOR) were calculated. Variables that showed a p-value of <0.5 were included in the multiple logistic regression model.

All the study protocols and materials have been reviewed and approved by The Mae Fah Luang University Research Ethics Committee (EC 21047-18). All participants were provided with essential information regarding the study protocols before written informed consent was obtained.

Results

A total of 402 Myanmar migrants were recruited; 42.0% and 58.0% participants were male and female, respectively, with a mean age of 38.9 years. One-third of the respondents were Burmese (35.3%), half of the respondents were Buddhists (57.7%), 81.3% of the respondents were labor, 65.4% of participants completed secondary and high school education, and 80.1% of participants were married. Moreover, most participants (54.0%) had an annual income for the whole family of more than 90,000 Baht (Table 1).

The prevalence of hyperglycemia among Myanmar migrant workers aged over 18 years in Mueang, Chiang Rai province, Thailand, was 13.4%. Some participants (20.9%) had been informed of their diagnosis of hypertension. One-third of both genders were overweight (29.9%), and 31.3% of the respondents had a greater risk of DM than the normal waistline. Most participants migrated to Chiang Rai due to economic hardship and political insecurity (90.8%), and 56.5% had to pay for self-medication. Among all the participants, 3.2% had a history of DM through their parents; 7.5% of participants consumed highly oily food, and 75.9% did not control their body weight. Smoking and alcohol consumption habits were noted in 6.0% and 11.2% of participants, respectively. Furthermore, 15.9% of the participants had sleeping problems and 24.1% had depression. The minority of participants (8.7%) reported performing exercises for at least 30 min per day, whilst 41.8% of the participants did not exercise; but were working in jobs involving a high physical activity level. Half of the participants had a moderate level of knowledge, 70.9% of participants had a neutral attitude, and 26.1% had a highly positive attitude (Table 2).

Table 1 Sociodemographic characteristics of the participants

Characteristics	n	%
Gender		
Male	169	42.0
Female	233	58.0
Age (years)		
18-29	82	20.4
30-39	136	33.8
40-49	121	30.1
50-59	49	12.2
≥60	14	3.5
mean=38.9, min=19, max=77, S.D.=10.4		
Ethnic/Race		
Karen	92	22.9
Shan	105	26.1
Burmese	142	35.3
Akha	63	15.7
Religions		
Buddhism	232	57.7
Christianity	158	39.3
Muslim	12	3.0
Education Level		
Illiterate	52	13.0
Primary	87	21.6
Secondary and high school	263	65.4
Occupation		
Labor	327	81.3
Agriculture-related	63	15.7
Unemployed	12	3.0
Annual family income (Baht)		
39,000-60,000	67	16.7
60,001-90,000	118	29.3
>90,000	217	54.0
Marital status		
Single	80	19.9
Married and ever married	322	80.1

Comparisons of characteristics between the hyperglycemia and non-hyperglycemia groups revealed that the following variables were significantly different: ethnicity (p-value=0.006), occupation (p-value=0.035), marital status (p-value=0.035), hypertension (p-value=0.001), body mass index (BMI) (p-value=0.001), waist circumference (p-value =0.001), parent's history of DM (p-value=0.002), history of hypertension (p-value=0.001), smoking (p-value=0.001), drinking alcohol (p-value=0.001), and depression (p-value =0.001) (Table 3).

Fourteen variables were associated with hyperglycemia in binary univariate analysis; including: age, ethnicity/race, unemployment, marital status, high blood pressure, BMI, waist circumference, parent's history of DM, history of hypertension, consumption of oily food, smoking, alcohol drinking, depression, and knowledge regarding diabetes prevention (Table 4).

Table 2 Health status, behaviors, knowledge, and attitude toward diabetes prevention

Characteristics	n	%
High blood pressure		
No (<140/90 mmHg)	318	79.1
Yes (≥140/90 mmHg)	84	20.9
BMI		
Normal (18.50-24.99 kg/m^2)	217	54.0
Underweight (<18.50 kg/m^2)	29	7.2
Overweight (25.00-30.00 kg/m^2)	120	29.8
Obesity (>30.00 kg/m^2)	36	9.0
Waist circumference		
Normal	276	68.7
Risk to diabetes	126	31.3
(Male >90 cm, Female >88 cm)		
Hyperglycemia		
No (<126 mg/dL)	348	86.6
Yes (≥126 mg/dL)	54	13.4
Type of health service		
Access full or partial health service	175	43.5
Self-medication	227	56.5
Reasons of migration		
Economic hardship/Political insecurity	365	90.8
Environmental factors	15	3.7
Conflict with family/community	22	5.5
Parent's history of diabetes		
No	363	90.3
Yes	13	3.2
Unknown	26	6.5
History of hypertension		
Yes	35	8.7
No	367	91.3
Consuming oily food		
Low	71	17.7
Moderate	301	74.9
High	30	7.4
Weight control		
Yes	97	24.1
No	305	75.9
Smoking		
No	365	90.8
Yes	24	6.0
Ever in the past	13	3.2
Drinking alcohol		
No	309	76.9
Yes	45	11.2
Ever in the past	48	11.9
Sleeping problem		
Yes (<6 hours)	64	15.9
No (≥6 hours)	338	84.1
Using opium		
Yes	0	0.0
No	399	99.3
Ever in the past	3	0.7
Using heroin		
Yes	0	0.0
No	401	99.8
Ever in the past	1	0.2
Using methamphetamine		
Yes	0	0.0
No	400	99.5
Ever in the past	2	0.5
Exercise		
Yes	35	8.7
No	199	49.5
Highly active physical work	168	41.8
Depression (PHQ-2)		
Yes	97	24.1
No	305	75.9
Knowledge regarding diabetes mellitus prevention		
Low	63	15.7
Moderate	201	50.0
High	138	34.3
Attitude towards diabetes prevention		
Negative	12	3.0
Neutral	285	70.9
Positive	105	26.1

BMI=body mass index, PHQ-2=Patient Health Questionnaire-2

Table 3 Comparisons of characteristics between hyperglycemia and non-hyperglycemia

Characteristics	Hyperglycemia				χ^2	p-value
	Yes		No			
	n	%	n	%		
Gender						
Male	19	11.2	150	88.8	1.20	0.273
Female	35	15.0	198	85.0		
Age (years)						
18–29	5	6.1	77	93.9	5.84	0.211
30–39	19	14.0	117	86.0		
40–49	18	14.9	103	85.1		
50–59	9	18.4	40	81.6		
≥60	3	21.4	11	78.6		
Ethnic/race						
Karen	6	6.5	86	93.5	12.52	0.006*
Shan	15	14.3	90	85.7		
Burmese	29	20.4	113	79.6		
Akha	4	6.3	59	93.7		
Religion						
Buddhism	34	14.7	198	85.3	2.65	0.266
Christianity	17	10.8	141	89.2		
Muslim	3	25.0	9	75.0		
Education level						
Illiterate	8	15.4	44	84.6	0.46	0.792
Primary school	10	11.5	77	88.5		
Secondary and high school	36	13.7	227	86.3		
Occupation						
Labor	38	11.6	289	88.4	6.71	0.035*
Agriculture-related	4	19.0	51	81.0		
Unemployed	4	33.3	8	66.7		
Annual family income (Baht)						
39,000–60,000	8	11.9	59	88.1	1.77	0.411
60,001–90,000	20	16.9	98	83.1		
>90,000	26	12.0	191	88.0		
Marital status						
Single	5	6.2	75	93.8	4.43	0.035*
Married/ever married	49	15.2	273	84.8		
Types of health service						
Partial or full health service	24	13.7	151	86.3	0.02	0.884
Self-medication	30	13.2	197	86.8		
Reasons of migration						
Economic hardship/political insecurity	45	12.3	320	87.7	4.27	0.118
Environmental factors	4	26.7	11	73.3		
Conflict with family/community	5	22.7	17	77.3		
High blood pressure						
No (<140/90 mmHg)	25	7.9	293	92.1	40.62	<0.001*
Yes (≥140/90 mmHg)	29	34.5	55	65.5		
BMI						
Normal (18.50–24.99)	11	5.1	206	94.9	42.20	<0.001*
Underweight (<18.50)	1	3.4	28	96.6		
Overweight (25.00–30.00)	35	29.2	85	70.8		
Obesity (>30.00)	7	19.4	29	80.6		

Table 3 (continued)

Characteristics	Hyperglycemia				χ^2	p-value
	Yes		No			
	n	%	n	%		
Waist circumference						
Normal	21	7.6	255	92.4	25.68	<0.001*
Risk to diabetes (Male >90 cm, Female >88 cm)	33	26.2	93	73.8		
Parent's history of DM						
No	46	12.7	317	87.3	12.88	0.002*
Yes	6	46.2	7	53.8		
Unknown	2	7.7	24	92.3		
History of hypertension						
Yes	14	40.0	21	60.0	23.27	<0.001*
No	40	10.9	327	89.1		
Consuming oily food						
Low	7	9.9	64	90.1	5.35	0.069
Moderate	39	13.0	262	87.0		
High	8	26.7	22	73.3		
Weight control						
Yes	8	8.2	89	91.8	2.95	0.086
No	46	15.1	259	84.9		
Smoking						
No	41	11.2	324	88.8	19.01	<0.001*
Yes	10	41.7	14	58.3		
Ever in the past	3	23.1	10	76.9		
Drinking alcohol						
No	32	10.4	277	89.6	13.46	0.001*
Yes	8	17.8	37	82.2		
Ever in the past	14	29.2	34	70.8		
Sleeping problem						
Yes (<6 hours)	9	14.1	55	85.9	0.026	0.872
No (≥6 hours)	45	13.3	293	86.7		
Exercise						
Yes	1	2.9	34	97.1	4.39	0.111
No	26	13.1	173	86.9		
Highly physical activity	27	16.1	141	83.9		
Depression (PHQ-2)						
Yes	29	29.9	68	70.1	29.8	<0.001*
No	25	8.2	280	91.8		
Knowledge regarding diabetes prevention						
Low	11	17.5	52	82.5	5.48	0.064
Moderate	32	15.9	169	84.1		
High	11	8.0	127	92.0		
Attitude towards diabetes prevention						
Negative	2	16.7	10	83.3	1.12	0.571
Neutral	35	12.3	250	87.7		
Positive	17	16.2	88	83.8		

*Significant level at α=0.05

BMI=body mass index, DM=diabetes mellitus, PHQ-2=Patient Health Questionnaire-2

Table 4 Univariate analyses in identifying factors associated with hyperglycemia

Characteristics	Yes		No		OR	95% CI	p-value
	n	%	n	%			
Gender							
Male	19	11.2	150	88.8	1.00		
Female	35	15.0	198	85.0	1.39	0.76–2.53	0.274
Age (years)							
18–29	5	6.1	77	93.9	1.00		
30–39	19	14.0	117	86.0	2.50	0.89–6.97	0.080
40–49	18	14.9	103	85.1	2.60	0.95–7.56	0.061
50–59	9	18.4	40	81.6	3.46	1.08–11.03	0.035*
≥60	3	21.4	11	78.6	4.2	0.87–20.07	0.072
Ethnic/race							
Karen	6	6.5	86	93.5	1.02	0.27–3.80	0.966
Shan	15	14.3	90	85.7	2.45	0.77–7.77	0.126
Burmese	29	20.4	113	79.6	3.78	1.27–11.27	0.017*
Ahka	4	6.3	59	93.7	1.00		
Religion							
Buddhism	34	14.7	198	85.3	0.51	0.13–2.00	0.338
Christianity	17	10.8	141	89.2	0.36	0.08–1.46	0.155
Muslim	3	25.0	9	75.0	1.00		
Education level							
Illiterate	8	15.4	44	84.6	1.00		
Primary school	10	11.5	77	88.5	0.71	0.26–1.94	0.510
Secondary and high school	36	13.7	227	86.3	0.87	0.38–2.00	0.747
Occupation							
Labor	38	11.6	289	88.4	1.00		
Agriculture-Related	12	19.0	51	81.0	1.78	0.87–3.65	0.110
Unemployed	4	33.3	8	66.7	3.80	1.09–13.23	0.036*
Annual family income (Baht)							
39,000–60,000	8	11.9	59	88.1	0.99	0.42–2.31	0.993
60,001–90,000	20	16.9	98	83.1	1.49	0.79–2.82	0.209
Over 90,000	26	12.0	191	88.0	1.00		
Marital status							
Single	5	6.2	75	93.8	1.00		
Married/ever married	49	15.2	273	84.8	2.69	1.03–6.99	0.042*
Type of health service							
Partial/complete health service	24	13.7	151	86.3	1.04	0.58–1.86	0.884
Self-medication	30	13.2	197	86.8	1.00		
Reasons of migration							
Economic hardship/Political insecurity	45	12.3	320	87.7	0.48	0.16–1.36	0.170
Environmental factors	4	26.7	11	73.3	1.23	0.27–5.64	0.784
Conflict with family/community	5	22.7	17	77.3	1.00		
High blood pressure							
No (<140/90 mmHg)	25	7.9	299	92.1	1.00		
Yes (≥140/90 mmHg)	29	35.5	55	65.5	6.18	3.36–11.34	<0.001*
BMI							
Normal (18.5–25 kg/m^2)	11	5.1	206	94.9	1.00		
Underweight (<18.5 kg/m^2)	1	3.4	28	96.6	0.67	0.08–5.38	0.705
Overweight (25–30 kg/m^2)	35	29.2	85	70.8	7.71	3.74–15.89	<0.001*
Obesity (>30 kg/m^2)	7	19.4	29	80.6	4.52	1.62–12.50	0.004*

Table 4 (continued)

Characteristics	Yes		No		OR	95% CI	p-value
	n	%	n	%			
Waist circumference							
Normal	21	7.6	255	92.4	1.00		
Risk to diabetes (Male >90 cm, Female >88 cm)	33	26.2	93	73.8	4.30	2.37–7.82	<0.001*
Parent's history of DM							
No	46	12.7	317	87.3	1.00		
Yes	6	46.2	7	53.8	5.90	1.90–18.34	0.002*
Unknown	2	7.7	24	92.3	0.57	0.13–2.51	0.461
History of hypertension							
Yes	14	40.0	21	60.0	5.45	2.57–11.55	<0.001*
No	40	10.9	327	89.1	1.00		
Consuming oily food							
Low	7	9.9	64	90.1	1.00		
Moderate	39	13.0	262	87.0	1.36	0.58–3.18	0.477
High	8	26.7	22	73.3	3.32	1.08–10.23	0.036*
Weight control							
Yes	8	8.2	89	91.8	1.00		
No	46	15.1	259	84.9	1.97	0.89–4.34	0.090
Smoking							
No	41	11.2	324	88.8	1.00		
Yes	10	41.7	14	58.3	5.64	2.35–13.52	<0.001*
Ever in the past	3	23.1	10	76.9	2.37	0.62–8.96	0.204
Drinking alcohol							
No	32	10.4	277	89.6	1.00		
Yes	8	17.8	37	82.2	1.87	0.80–4.36	0.147
Ever in the past	14	29.2	34	70.8	3.56	1.73–7.33	0.001*
Sleeping problem							
Yes (<6 hours)	9	14.1	55	85.9	1.06	0.49–2.30	0.872
No (≥6 hours)	45	13.3	293	86.7	1.00		
Exercise							
Yes	1	2.9	34	97.1	1.00		
No	26	13.1	173	86.9	5.1	0.67–38.9	0.115
Highly physical activity	27	16.1	141	83.9	6.5	0.85–49.6	0.071
Depression (PHQ-2)							
Yes	29	29.9	68	70.1	4.77	2.62–8.67	<0.001*
No	25	8.2	280	91.8	1.00		
Knowledge regarding diabetes prevention							
Low	11	17.5	52	82.5	2.44	0.99–5.98	0.051
Moderate	32	15.9	169	84.1	2.18	1.06–4.50	0.034*
High	11	8.0	127	92.0	1.00		
Attitude towards diabetes prevention							
Negative	2	16.7	10	83.3	1.03	0.20–5.15	0.966
Neutral	35	12.3	250	87.7	0.73	0.39–1.36	0.315
Positive	17	16.2	88	83.8	1.00		

*Significant level at α=0.05

BMI=body mass index, DM=diabetes mellitus, PHQ-2=Patient Health Questionnaire-2

Six factors were associated with hyperglycemia, after adjusting for other factors, using the multiple logistic regression model: ethnicity, high blood pressure, BMI, parent's history of diabetes, smoking and depression. Participants who were Burmese had a 4.76 times (95% CI =1.25–18.14) chance of having hyperglycemia than those who were Akha. For those who had high blood pressure they had a 3.82 times (95% CI=0.03–0.19) likely higher risk of having hyperglycemia than those who did not have high blood pressure. Participants who were overweight (BMI=25–30 kg/m^2) had a 5.40 times (95% CI=2.48–11.76) greater chance, while those who were obese had a 4.49 times (95% CI=1.42–14.12) greater chance of having hyperglycemia than those who had normal weight (BMI= 18.5–25 kg/m^2). Participants whose parents had a history of DM were 6.726 times more likely (95% CI=1.55–29.1) to have hyperglycemia than those whose parents did not have DM. Those who had a habit of smoking two or more cigarettes a day had a 6.24 times (95% CI=2.08–18.69) more chance of hyperglycemia than those who did not have a smoking habit. Participants who had depression had a 3.86 times (95% CI=1.93–7.72) more chance of having hyperglycemia than those who did not have depression (Table 5).

Table 5 Multivariate analyses in identifying factors associated with hyperglycemia

Characteristics	Yes		No		AOR	95% CI	p-value
	n	%	n	%			
Ethnic/race							
Karen	6	6.5	86	93.5	1.24	0.26–5.72	0.782
Shan	15	14.3	90	85.7	2.92	0.72–11.75	0.131
Burmese	29	20.4	113	79.6	4.76	1.25–18.14	0.022*
Ahka	4	6.3	59	93.7			
High blood pressure							
No (<140/90 mmHg)	25	7.9	299	92.1	1.00		<0.001*
Yes (>140/90 mmHg)	29	35.5	55	65.5	3.83	1.82–8.03	
BMI							
Normal (18.5–25 kg/m^2)	11	5.1	206	94.9	1.00		
Underweight (<18.5 kg/m^2)	1	3.4	28	96.6	0.92	0.09–6.52	0.946
Overweight (25–30 kg/m^2)	35	29.2	85	70.8	5.19	2.48–11.76	<0.001*
Obesity (>30 kg/m^2)	7	19.4	29	80.6	3.87	1.42–14.12	0.026*
Waist circumference							
Normal	21	7.6	255	92.4			
Risk to diabetes (Male >90 cm, Female >88 cm)	33	26.2	93	73.8			
Parent's history of DM							
No	46	12.7	317	87.3	1.00		
Yes	6	46.2	7	53.8	6.86	1.45–32.46	0.015*
Unknown	2	7.7	24	92.3	0.77	0.13–4.36	0.773
Smoking							
No	41	11.2	324	88.8	1.00		
Yes	10	41.7	14	58.3	6.24	2.08–18.69	0.001*
Ever in the past	3	23.1	10	76.9	0.90	0.16–4.89	0.904
Depression (PHQ-2)							
Yes	29	29.9	68	70.1	4.21	2.00–8.89	<0.001*
No	25	8.2	280	91.8	1.00		

*Significant level at α=0.05

BMI=body mass index, DM=diabetes mellitus, PHQ-2=Patient Health Questionnaire-2

Discussion

The prevalence of hyperglycemia among Myanmar migrant workers in this study was 13.4%, which is slightly higher than the prevalence of DM among people in Myanmar (10.8%).[13] In northern Thailand, the prevalence of type 2 DM in the elderly hill tribe population was 16.8%[14], and that among the middle-aged and elderly Lisu hill tribe was 18.1%.[2] Although, the prevalence of hyperglycemia among Myanmar migrant workers in Mueang and Chiang Rai was lower than that in hill tribes in northern Thailand, Malaysia, China, and Nepal[14-17], the prevalence of hyperglycemia in this study was higher than that of people in Myanmar, Lao, Korea, India, and Bangladesh.[13,18-20] The difference could be that the respondents had different lifestyle characteristics.

A previous study reported that the association between migrant status and DM might be affected by genes, pre-migration background, access to health and social health services, post-migration lifestyle, and legal and socio-economic status.[7] This information supports this studys' findings, in that the different prevalence of hyperglycemia could be due to migrant status; especially, the impact of health status and health behaviors toward DM prevention. According to the results of this study, comprehensive DM prevention among migrant workers needs to be improved, and if there is no intervention among migrant workers without hyperglycemia they could be at high risk of developing DM in the future.

In this study, ethnicity was significantly associated with hyperglycemia. A previous study in northern Thailand, elderly hill tribe populations; such as, Lahu, Yao, Karen, and Lisu demonstrated that they had a greater chance of developing type 2 DM than the Akha tribe.[21] The study in Myanmar demonstrated that Burmese people had unhealthy diets, physical inactivity; and particularly unhealthy habits in daily cooking; such as, using oily cooking and consuming salty foods and addtionally faced thethe challenge of integrating health services.[13,22] Other studies suggested that the risk of type 2 DM in different ethnic group depends on genetics, socio-demographics, and economic change.[14,21] The parent's history of DM was also significantly associated with hyperglycemia. Similarly, studies in Nepal, Malaysia, and Thailand have observed that a family history of DM is significantly associated with DM development.[14,15,17] However, a study in northern Thailand observed that it is insignificant within the Lisu hill tribe.[2] This could be related to the genetic susceptibility to hyperglycemia, a range of metabolic abnormalities (mitochondrial inheritance), and the subject's behaviors being influenced by their parents from childhood to adulthood.[23,24]

Hypertension was also significantly associated with hyperglycemia, which is similar to the findings of several studies.[25,26] Other studies observed that increasing BMI had a significant relationship with hypertension, which could cause the impulsion of an obesity-induced insulin resistance effect on hypertension in individuals with DM through effects on the blood vessels.[21,27] Another study confirmed that long-term hyperglycemia causes macrovascular complications; such as hypertension.[28]

BMI has been shown to be a risk factor for hyperglycemia. Generally, screening should be considered in all age groups with BMI ≥25 kg/m^2 as a risk factor for DM.[29] Previous studies have reported that obesity is associated with type 2 DM.[21,30,31] Several studies have also reported that most subjects with hyperglycemia are overweight, obese or have a high waist circumference.[2,32] However, some studies have found that BMI was not significantly associated with type 2 DM or hyperglycemia.[25] Smoking was found to be significantly associated with hyperglycemia. The studies in India, northern Thailand, and Southwest Ethiopia, showed a statistically significant association between diabetes and smoking.[33,2] A study had mentioned that smoking was a well-recognized risk factor for developing type 2 diabetes.[34] This might be due to smoking-induced oxidative stress effects directly on blood

glucose homeostasis, develops insulin resistance or raising the rate of hepatic gluconeogenesis and glycogenolysis as well as which high concentrations of distributing epinephrine and norepinephrine contribute to hyperglycemia.[34,35]

Depression is a significant factor associated with hyperglycemia, which is similar to the findings of previous studies. One study showed that depression promotes the risk for progressive insulin resistance and incident type 2 diabetes mellitus, because long term increased cortisol levels in depression disturb insulin function.[36] Another study indicated that different environmental and behavioral factors; such as, low socioeconomic status, poor sleep, lack of physical exercises, and diet promoted the association between depression and diabetes.[37] In this study, the participants faced relocation, cultural discrepancy, poor housing, unemployment, poverty, difficulty communicating with the staff for health care services, limited health insurance, and the current COVID-19 pandemic, which might lead to depression.

There are some limitations to this study. Due to its cross-sectional study design; the temporal link between the dependent variable (hyperglycemia) and independent variables could not be determined, because both were examined at the same time. Therefore, it only provides information at a specific point in time, and may not contain valuable information that occurs outside of that time point. Measurement of fasting blood glucose levels in capillary blood using a glucose meter is also a limitation for diagnosis of diabetes mellitus. In addition, this finding may not be generalizable to other populations of migrant workers.

Conclusion

The prevalence of hyperglycemia among Myanmar migrant workers was 13.4%. Ethnicity, high blood pressure, BMI, parental history of DM, smoking and depression were significantly associated with hyperglycemia development. The findings of this study are useful for the development of policies and measures to prevent and control hyperglycemia and DM among Myanmar migrant workers. This might lead to improved rights and equity in healthcare for migrant workers.

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Conflict of interest

We declare no conflicts of interest.

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