

Prevalence and Predictors of Overweight and Obesity among Military Personnel with Low Socio-Economic Status in Kuala Lumpur

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Abstract

Background: It is a major public health concern when 52% of adults worldwide were overweight and obese. Military institutions worldwide were included, which led to negative impacts on the overall combat readiness due to the obesity-associated-diseases. This study determined the prevalence and predictors of overweight and obesity among the low socioeconomic status (SES) army personnel in Kuala Lumpur.

Methods: A cross-sectional study involving 772 low SES army personnel in Kuala Lumpur was conducted. Online questionnaires were distributed while anthropometric measurements' data were obtained from Military Lifetime Health Record (MLHR) system with BMI of $\geq 25\text{kg/m}^2$ as the outcome. Data analysed using SPSS version 23.0 (descriptive and inferential statistics).

Results: The median age of the respondents was 30 (IQR=7) years. The prevalence of overweight and obese army personnel was 41.1% (95%CI:37.6-44.6). The predictors found were being married (AOR:2.026,95%CI:1.318-3.113), secondary education (AOR:2.545,95%CI:1.245-5.203), Lance Corporal (AOR:1.994,95%CI:1.061-3.748), Corporal (AOR:2.814,95%CI:1.578-5.020), Sergeant (AOR:4.174,95%CI:2.076-8.390), past injury (AOR:1.879,95%CI: 1.191-2.965), history of obese sibling (AOR:1.737,95%CI:1.013-2.973), history of obese parent (AOR:3.344,95%CI:1.965-5.688), history of obese grandparent (AOR:11.321,95%CI:2.207-58.072), poor knowledge on dietary intake (AOR:1.524,95%CI:1.077-2.157), less than 2 litres daily plain water intake (AOR:1.606,95%CI:1.166-2.210).

Conclusions: Knowledge on dietary intake and plain water intake are the two modifiable predictors for overweight and obesity found in this study, while the other nine predictors are non-modifiable. Understanding on issues surrounding the low SES group will help the strategic level in planning for future comprehensive interventions on overweight and obesity, specifically targeting on those predictors.

Background

In 2016, World Health Organisation revealed that 52.2% adults (18 years and above) worldwide fell into the overweight and obesity group. Overweight and obesity are defined as abnormal or excessive fat accumulation that has negative impact on one's health [1]. In Malaysia, the national survey reported that the prevalence of overweight and obesity among adults (18 years and above) has increased significantly from 21.0% in 2005 to 50.1% in 2019 [2].

The military organization in Malaysia puts great emphasis on physical profile and fitness of the soldiers to maintain the overall force readiness. Despite that, the organization is still not spared from this problem. Little information can be deduced from published literature on the prevalence of overweight and obesity in the military organization in Malaysia [3]. A cross-sectional study in Malaysia, involving 913 military personnel from an army division in 2015, found high percentage of overweight and obesity, at 57.2% [4]. The same study, also found that overweight and obesity was much higher in the low socioeconomic status (SES) group as compared to high SES group (52.6% and 4.6% respectively) [4].

In military institutions worldwide, sociodemographic factors ^[5, 6], family history of obesity ^[7], lifestyle factors such as diet intake ^[8], physical activity ^[9], sleep quality ^[10], stress factor ^[11] and readiness to change factor ^[12] are often associated with overweight and obesity. However, in the military organization in Malaysia, previous studies only reported the relationship between socio-demographic to overweight and obesity ^[4], rendering the relationship with other factors left unknown. The military organization in Malaysia has different social and physical environment, distinctly different from the general populations. Hence, specific understanding of all of the factors causing overweight and obesity is crucial.

Overweight and obesity is also associated with non-communicable diseases. No publication on the prevalence of non-communicable diseases (NCDs) among army personnel was found. In a systematic review of 74 longitudinal or cross-sectional studies among 90,758 Chinese military personnel between Year 2000 to 2016, there were high prevalence rates of hypertension, hyperlipidaemia, diabetes mellitus, heart diseases, cerebrovascular diseases and chronic obstructive pulmonary diseases ^[13]. Mild obesity was associated with the loss of one in ten, and in severe obesity, the loss of one in four potential disease-free years from major non-communicable diseases during middle and later adulthood ^[14]. The loss of disease-free years will further affect the career progression of the low socioeconomic status personnel, and may lead to dismissal from the military service.

In view of the increasing cost of living and widening of socio-economic status gap in Malaysia, the low SES group has received more attention from the government and top military commanders ^[15]. Overweight and obesity problems among them will lead to a vicious cycle of non-career progression and low-income category in long run, hence a greater health and financial burden to the country especially upon their retirement. The findings from this study will assist the top commanders to understand the predictors of overweight and obesity among the soldiers, especially in the low SES group. This in turn, will become the basis for new policy development, new health intervention programs and a comprehensive social support plan for this group in order to optimise healthy lifestyle, reduce the prevalence of overweight and obesity and reduce the overall financial burden related to its complications in the military organization. Findings from this study may also be a good reference for any health education programme involving army personnel. These efforts are also in line with the Sustainable Developmental Goal No 3.4 ^[16].

Methods

This cross-sectional study was conducted from September 2019 to July 2020 among 772 active-duty army personnel from Other Ranks with household income less than RM 3860, working under the formations/units in the army camps located in Kuala Lumpur, Malaysia. Their income group are categorised under the low SES group according to the Malaysian National Registration Department, 2019 ^[17].

Proportionate random sampling of all army personnel from camps in Kuala Lumpur was used to select the respondents. The sample size was calculated using the two proportions formula ^[18] from a population-based research by National Health and Morbidity Survey (2015) in Malaysia ^[19]. The P_1 used was 0.174 (from proportion of young age group with obesity and overweight), P_2 was 0.292 (from proportion of old age group with obesity and overweight) and P value was 0.233 with 95% Confidence Interval and 80% power which made up to 722 for total sample size ^[19]. Those who were at mission area or attending courses, physically handicapped, had history of using steroids either as medication or supplements, who were in the transition training or leaving the service in the next 3 years (in weaning-off-training phase) and who were under the Body Building Team were exempted. Besides that, army personnel working in training centres, university and army hospitals were all excluded from this study as they might have different training routines. Ethical approval were obtained from the Malaysian Armed Forces Health Services Ethic Committee before conducting the study. Informed consents of the respondents were asked prior to the study.

Self-administered online questionnaires were distributed to the selected eligible army personnel. The questionnaire consists of all independent variables such as: sociodemographic factors, 9 items; current health status, past medical history and family history of obesity, 3 items; knowledge on physical activity, 15 items ^[20]; knowledge on dietary intake, 15 items ^[21]; physical activity, 6 items ^[22]; dietary intake, 18 items ^[23]; sleep quality, 9 items ^[24]; smoking status, 9 items ^[25]; stress, 25 items ^[26]; and readiness to change, 32 items ^[27]. The questionnaire was adapted in Malay language from previous validated questionnaires in several past studies which were related to this study using factor analysis. Face and content validity were done where by all comments were taken and appropriate correction were made for further improvement of the questionnaire. The reliability of the questionnaire was measured by intraclass correlation coefficient (ICC) with the value between 0.7 to 0.8.

Officer in charge in each Army units were tasked to make sure that all selected army personnel able to provide response via the online link within the time duration given. All study variables were extracted from the Google document "Cloud" database contained each respondent' answers of the self-administered online questionnaire. Army Identification Numbers were asked to be filled by the respondents as an identifier. However, to ensure confidentiality of the online data, measures were taken to make the Google document "Cloud" password protected, which can be opened only by the researcher. Following this, their Army Identification Numbers were used as the identifier to match the data from the online questionnaire to each record from the Military Lifetime Health Record (MLHR) system. The anthropometric measurements data (weight and height) taken from each respondents' latest PULHEEMS (Physical, Upper Limb, Lower Limb, Hearing, Right Eye, Left Eye, Mental state and Stability) medical examination record from December 2019 to February 2020 were analysed. Those data had been obtained and inserted into the MLHR system by military health practitioner in respective Army units in Kuala Lumpur. All the data collected was verified by relevant Medical Officers from each of the unit involved.

BMI was calculated for each respondent before analysis. BMI of $\geq 25\text{kg/m}^2$ used to classify overweight and obesity as per WHO BMI classification. Data were analysed using statistical package for the social sciences version 23.0 involving descriptive and inferential statistics. All of the continuous data were categorized to categorical data such as age, BMI, knowledge score, time of taking the meals and sleep duration. For bivariate analysis, chi-square and simple logistic regression were used. For multivariable analysis, multiple logistic regression tests were used. This study used a level of significance of 0.05 with confidence interval of 95%.

Results

Demographic characteristics

The response rate was 96.5%. A total of 772 army personnel from the low SES category participated in this study. The age of respondents ranging from 20 to 37 years old, with median age of 30 (IQR:7). Descriptive characteristics of the study participants are presented in Table I. Majority of the respondents were 30 to 34 years of age (36.3%), male (81.9%), Islam (90.8%), Malay (88.1%), married (67.7%), have poor socioeconomic status (93.7%), in Corporal (KPL) rank (52.2%), with at least having secondary education (83.7%), in Combat Service Support element (42.6%) and with 5 to 15 year experience in service (61.7%).

Table I. Sociodemographic characteristics of the respondents (N = 772)

Characteristic		Median (IQR*)	Frequency	Percentage
Age group (years)	20–24	30 (7)	99	12.8
	25–29		260	33.7
	30–34		280	36.3
	35–39		133	17.2
Gender	Male		632	81.9
	Female		140	18.1
Religion	Islam		701	90.8
	Hindu		18	2.3
	Christian		53	6.9
Ethnicity	Malay		680	88.1
	Chinese		2	0.3
	Indian		18	2.3
	Others		72	9.3
Marital Status	Single		229	29.7
	Married		523	67.7
	Divorcee		19	2.5
	Widow/Widower		1	0.1
SES	≤ RM 950		49	6.3
	RM 951 to RM 3860		723	93.7
Rank	Private (PBT)		146	18.9
	Lance Corporal (LKPL)		131	17.0
	Corporal (KPL)		403	52.2
	Sergeant (SGT)		92	11.9
Level of Education	Secondary Education		646	83.7
	Post-secondary Education		67	8.7
	Tertiary Education		59	7.6
Type of Elements/Trade	Combat		240	31.1

Characteristic	Median (IQR*)	Frequency	Percentage
	Combat Support	203	26.3
	Combat Service Support	329	42.6
Years of Service	Less than 5 years	157	20.3
	5 to 15 years	476	61.7
	More than 15 years	139	18.0
*IQR: Inter quartile range			

Prevalence of overweight and obesity

The overall median BMI among the army personnel with low socioeconomic status in Kuala Lumpur was $24.32 \pm 4.29 \text{ kg/m}^2$. The prevalence of overweight and obesity among the respondents were 41.1% (n = 317).

Associated factors of overweight and obesity

Out of 39 factors studied, only 11 factors (seventeen sub variables) have significant relationships with overweight and obesity among the army personnel with low socioeconomic status in Kuala Lumpur which are age ($\chi^2 = 44.529$, df = 3, $p < 0.001$), marital status ($\chi^2 = 48.601$, df = 2, $p < 0.001$), rank ($\chi^2 = 53.829$, df = 3, $p < 0.001$), level of education ($\chi^2 = 12.814$, df = 2, $p = 0.002$), year of service ($\chi^2 = 46.921$, df = 2, $p < 0.001$), current health status ($\chi^2 = 8.061$, df = 3, $p = 0.045$), past medical illness ($\chi^2 = 7.095$, df = 1, $p = 0.008$), past injury ($\chi^2 = 9.383$, df = 1, $p = 0.002$), family history of obesity ($\chi^2 = 33.144$, df = 1, $p < 0.001$), knowledge on dietary intake ($\chi^2 = 8.707$, df = 1, $p = 0.003$) and plain water intake ($\chi^2 = 6.145$, df = 1, $p = 0.013$) (details in Table II).

(Table II in additional file 1)

Predictors of overweight and obesity

All methods; Backward LR and Forward LR methods were used to analyse the seventeen variables and subsequently, eleven predictors were finally obtained using the Forward Likelihood Ratio method. Criteria of $p < 0.25$ was used in selecting the variables to the Multivariable analysis. The eleven predictors for overweight and obesity among the army personnel with low SES in Kuala Lumpur camps were: married (AOR: 2.026, 95% CI: 1.318–3.113), secondary education (AOR: 2.545, 95% CI: 1.245–5.203), rank of Lance Corporal (AOR: 1.994, 95% CI: 1.061–3.748), Corporal (AOR 2.814, 95% CI: 1.578–5.020), Sergeant (AOR: 4.174, 95% CI: 2.076–8.390), past injury (AOR: 1.879, 95% CI: 1.191–2.965), obese siblings (AOR: 1.737, 95% CI: 1.013–2.973), obese parents (AOR: 3.344, 95% CI: 1.965–5.688), obese grandparents (AOR: 11.321, 95% CI: 2.207–58.072), knowledge on diet intake (AOR: 1.524, 95% CI: 1.077–2.157) and plain water intake (AOR: 1.606, 95% CI: 1.166–2.210), as per shown in Table III. R squared residual for the final predictive model was 21.5%. The final model fit has a good fit as evidenced by Hosmer and

Lemeshow goodness of fit test ($\chi^2=5.505$, $df = 8$, $p = 0.702$) with 79.0 % specificity and 56.5% sensitivity. Demonstrated ROC curve for the final model is 0.751 (95% CI:0.701–0.788).

Table III. Predictors for overweight and obesity among the army personnel with low socioeconomic status in Kuala Lumpur

Factors	Overweight and Obesity, n(%)		AOR	95%CI	p-value
	Yes	No			
Marital Status					
Married	256(48.9)	267(51.1)	2.026	1.318, 3.113	0.001
Single	51(22.3)	178(77.7)	1.000		
Level of Education					
Secondary Education	281(43.5)	365(56.5)	2.545	1.245, 5.203	0.010
Tertiary Education	12(20.3)	47(79.6)	1.000		
Rank					
Lance Corporal (LKPL)	48(36.6)	83(63.4)	1.994	1.061, 3.748	0.032
Corporal (KPL)	194(48.1)	209(51.9)	2.814	1.578, 5.020	< 0.001
Sergeant (SGT)	51(55.4)	41(44.6)	4.174	2.076, 8.390	< 0.001
Private (PBT)	24(16.4)	122(83.6)	1.000		
Past Injury					
Yes	57(54.8)	47(45.2)	1.879	1.191, 2.965	0.007
No	260(38.9)	408(61.1)	1.000		
Family History of Obesity					
Sibling	36(52.2)	33(47.8)	1.736	1.013, 2.973	0.045
Parent	49(63.6)	28(36.4)	3.344	1.965, 5.688	< 0.001
Grandparent	9(81.8)	2(18.2)	11.321	2.207, 58.072	0.004

Factors	Overweight and Obesity, n(%)		AOR	95%CI	p-value
No Family History	223(36.3)	392(63.7)	1.000		
Knowledge on Dietary Intake					
Poor	234(44.7)	290(55.3)	1.524	1.077, 2.157	0.017
Good	83(33.5)	165(66.5)	1.000		
Plain Water Intake					
Less than 2 litres a day	161(45.9)	190(54.1)	1.606	1.166, 2.210	0.004
More than 2 litres per day	156(37.1)	265(62.9)	1.000		

Discussion

A descriptive analysis comparison of the findings from this study indicates a high prevalence of overweight and obesity among the army personnel with low SES in Kuala Lumpur camps (41.1%). This is consistent with both studies by Reyes et al. (2015) in the United States Army [28] and Hattachote et al. (2019) [9] in the Royal Thai Army, however, when compared with the Malaysian National Health Morbidity Survey 2019 [2], the prevalence obtained in this study was lower by 9 %. Similarly, the obese prevalence obtained in this study was also smaller by 13.8% as compared to another study done among the low SES group by Razni et al. (2015) [4], while the overweight prevalence was almost similar at 38.0%. This study showed that about more than one third of the army personnel in each camp in Kuala Lumpur were either overweight or obese.

Married personnel, are more likely to be overweight and obese as compared to those who are single [29]. Living without a partner, either being single or divorced/widow/widower was associated with lower body weight ($p < 0.05$) [30]. The reason might be due to the variety of food choices provided by their spouses, as compared to the pre-planned food menu approved by local administration for the army personnel who were single. Thus, the food portion's they took and the nutrition might be different. Support system such as spouses is needed as to motivate individuals towards healthy lifestyle. Poor support system can lead to increase in BMI in married couple especially among those who has obese spouse [31].

The second predictors of overweight and obesity in this study was secondary education. Ghee (2016) in a systematic review, mentioned that the obesity rate was lower in those with higher education background, and lowest among those with tertiary education background [32]. Higher level of education increases the obesity awareness and trend of healthy lifestyle, hence reducing the occurrence of overweight and obesity [33]. However, the finding by Hruby & Hill (2015) [6] among US Army soldiers contradicted this, in which they found that higher education such as having advanced degree seemed to be in a relationship with higher odd of overweight/obesity (AOR = 1.29, 95% CI: 1.21–1.38). This might be because, higher

snacks and fast prepared food were not an issue^[33]. A balance in having the knowledge on healthy lifestyle and actually practicing it is really needed to overcome this issue.

This study also found that the higher the rank is, the more likely a soldier will be either overweight or obese, consistent with other studies such as the finding by Smith et al. (2012)^[34] and Fear et al. (2011)^[35]. The rank level in the Army is closely related to the number of years in service. The promotion of an army personnel to the next higher rank is mostly time-based and assessment based^[36]. However, rank does not always run in-line with the year of service in army personnel with high Body Mass Index (BMI). This is due to the fact that the army personnel who are overweight/obese, will not be considered for a promotion. Being demoralised, they have little motivation to lose weight. Higher rank comes with higher salary^[37], thus increase one's SES. Higher socioeconomic status, were more likely to be the cause for overweight and obese because it will lead to consuming high-calorie food and avoiding physically tough tasks^[38].

The army personnel with past injury were more likely to be overweight and obese as compared to those without, consistent with Gregory et al. (2014), who reported that having a history of knee injury showed significant yearly increment in BMI as compared to those without ($p = 0.03$), as well as significant positive difference in body fat percentage between both group ($p = 0.009$)^[39]. The consistency of physical training among the army personnel might be affected by the past injury, in which there will either be no or little time and effort being invested in doing physical activities^[40]. Findings among injured soldiers in the Hruby et al. (2015), Sanderson at al. (2011), and Teyhen et al. (2016) studies have validated the findings, in which injured soldiers are more likely to become overweight and obese due to limitations in their ability to follow the normal high intensity physical regime in the military, and hence are living life in a more sedentary manner^[6, 40, 41].

Family history of obesity was another predictor of overweight and obesity in this study. study Shi et al. (2014), found the same finding, in which the odds of being overweight and obesity were higher in the respondents with history of having obese sibling and obese mother ($p < 0.001$) as compared to those with no family history^[7]. Family history is a complex factor with underlying genetic predisposition, which reflects the effect of shared genetics and environment among close relatives^[42]. The latter is made known as family acts as a support system in shared physical and social environment towards either healthy or unhealthy lifestyle. The controversial issue with regards to this is, should the military organization in Malaysia limit the intake of those with positive family history of obesity, in order to reduce the prevalence of obesity among its personnel in the long run?

Out of the eleven predictors found in this study, only two of them are modifiable risk factors which are knowledge on dietary intake and plain water intake. Knowledge on dietary intake finding in this study is similar with the findings by Pengpid & Peltzer (2014), in which they mentioned that the odd of overweight and obesity was higher in respondents with lower dietary risk knowledge (95% CI:0.41,0.99)^[43].

Knowledge is important to help army personnel to differentiate between unhealthy and healthy diet and sedentary with active lifestyles.

Plain water intake was also found to be a significant predictor in this study, consistent with a study on 50 overweight female participants in Mumbai found that body weight, BMI, sum of skinfold thickness and appetite score were lower after 8 weeks in those with good plain water intake ($p < 0.01$) [44]. This could be possibly due to the combination of thermogenesis, distention of gastrointestinal organs, changes in osmolarity besides and appetite suppressing effect of drinking enough plain water [44]. Advocating for proper hydration in the busy army routine will improve and hydration profile and help to promote weight loss.

The military organization in Malaysia has conducted various intervention programmes to combat overweight and obesity including health promotion programmes and lifestyle behavioural changes programmes. Some of the programmes did showed positive impacts in instilling awareness among the army personnel, changes their lifestyle and reducing their BMI, However, the findings in this study are showing that, despite many intervention programmes were implemented over the last 2 decades, the cumulative results of all the interventions showing only minimal impact. A closer look at the military intervention programs revealed that, all the intervention programs were merely a one off ad hoc-event every now and then, and were not a standardized whole army intervention programme. However, the limitation of this cross-sectional study was that it could not determine the temporal relationship between overweight and obesity with the factors. This study design also makes it difficult to draw any conclusions on causal relationships based on the findings.

Conclusions

In conclusion, the prevalence of overweight and obesity among the army personnel with low SES in Kuala Lumpur camps are high at 41.1%. A better study design in the form of cohort (prospective), or mixed method, should be conducted to really assess all the relevant risk factors for a conclusive data.

Intervention must be planned and executed from the top-down manner along the chain of command of the military organization. The intervention should be standardized and comprehensive, inclusive, well-structured and evidence-based with more focus on modifiable risk factors to ensure optimal impact.

List Of Abbreviations

AOR adjusted odd ratio

BMI body mass index

MLHR Military Lifetime Health Record System

PHE periodic health examination

PULHEEMS Physical, Upper Limb, Lower Limb, Hearing, Eye (R), Eye (L), Mental and Stability

SES socioeconomic status

Declarations

Ethics approval and consent to participate

Ethical approval has been obtained from Malaysian Armed Forces Health Services Ethics Committee. Informed consent was taken from each participant prior to the study.

Consent for publication

Not applicable

Availability of data and materials

The datasets analysed during the current study are not publicly available due to the military personnel's data confidentiality but are available from the corresponding author on reasonable request.

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Author's contributions

NQNAR designed the study, performed data management, data collection, data analysis and drafted the paper. NAMZ supervised the study and edited the paper. MAM supervised the data collection process. All authors read and approved the final manuscript.

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