Anaemia Among Men in Malaysia: Who Are the Most Affected?

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Abstract

This study aims to determine the prevalence of anaemia and factors associated with anaemia among men in Malaysia. Data from the National Health and Morbidity Survey 2019 was utilized. Haemoglobin level for men aged 15 years and above who gave their consent was measured using HemoCue® Hb 201+ System©. Majority of them (87.2%) were men aged 15-59 years referring to the younger age group. The prevalence of anaemia among men was 12.6% (95% confidence interval [CI]: 10.9, 14.5). Prevalence was higher in the older men (30.7%; 95% CI: 26.6, 35.1) than the younger men (10.0%; 95% CI: 8.2, 12.2). The multivariable logistic regression observed that anaemia among men was associated with older age (adjusted odds ratios [aOR] = 3.1; 95% CI: 2.1, 4.4) and those with diabetes (aOR = 1.5; 95% CI: 1.2, 2.1). Older men are more affected by anaemia than younger men. Anaemia among older men in Malaysia is considered at the level of moderate to severe public health significance and the likelihood of developing anaemia increases among older men with diabetes. These often-overlooked issues among men need to be detected and treated early to prevent complications and to improve their quality of life.

Introduction

Anaemia shows a decreasing trend in the global prevalence from 27.0% in 2013 to 22.8% in 2019, however it still affects near one quarter of the world population[1,2]. Anaemia is described according to population subgroups such as men (15-59 years), women of reproductive aged (15-49 years), elderly (60 years and above), preschool-aged children (less than five years) and school-aged children (5-14 years)[3]. Even though the most affected population was women and preschool-aged children, anaemia still prevalent among men. A local population-based study observed that the prevalence of anaemia among men aged 15 years and above was 14.3%[4] in 2015. A study conducted in India observed a prevalence of 23.2%, while a study conducted in Russia observed a lower prevalence of 5.9%[5,6].

According to the WHO, anaemia among men is defined as haemoglobin (Hb) level less than 13.0 g/dL. It can further be divided into anaemia level of severity of mild, moderate and severe[7]. Mild anaemia is usually asymptomatic and only recognised during routine medical check-up whereas those with the symptoms of anaemia may experience lethargy, weakness and a reduction in normal human function. Anaemia decreases the quality of life and may worsen the outcome of those with chronic diseases[8]. The aetiology of anaemia can be multifactor including nutritional deficiencies, tropical disease, hemoglobinopathies, gastrointestinal losses and anaemia of chronic disease which varies according to geographical distribution, country's income status, age group and gender[2,8].

Anaemia among men was not given appropriate attention due to the lower number of affected populations compare to women and preschool-aged children. While older men who had anaemia were grouped together as anaemia among older persons because of the relationship of older age and the presence of chronic diseases nearly equal in both genders. Anaemia among men usually discovered accidentally due to other health problems[9,10]. Prevalence of anaemia among men increased tremendously among older persons where the prevalence was four times higher among those aged 75 years and above compared to the younger men[11]. Anaemia is generally associated with socio-demographic profiles, lifestyle factors and chronic diseases such as chronic kidney disease, diabetes mellitus and cardiovascular disease[12–16]. Anaemia among men might also be related to work or exposure with lead and sometimes is unexplained[17–19]. Anaemia among men in Malaysia was not given adequate attention in terms of looking into the factor that contributes to the problem. The objective of this study is to determine the prevalence of anaemia according to socio-demographic profiles, lifestyle factor and the presence of chronic illness. The second objective is to determine the associated factors of anaemia among overall, younger and older men in Malaysia.

Methodology

National Health and Morbidity Survey (NHMS) is a scheduled survey to measure the disease burden among Malaysian population. The survey applied a multistage stratified random cluster sampling strategy to ensure a nationally representative sample. Malaysia was stratified into 13 states and three federal territories. Each state was divided into enumeration blocks. The first stage of sampling was the selection of enumeration block and the second stage was the selection of living quarters. Respondents aged 15 years and above were eligible for this study. Socio-demographic data was collected using face-to-face interview by trained data collectors.

Anthropometric measurements such as height and weight were measured. Blood pressure was measured and capillary blood sampling for point-of-care testing was done. These procedures were conducted by qualified and trained nurses who joined the data collection team. Tanita Personal Scale HD 319, SECA Stadiometer 213 were used to measure height and weight. Blood pressure was measured via Omron Japan Model HEM-907. The point-of-care testing included the test for fasting blood glucose and cholesterol level via CardioChek® PA Analyzer[20]. The HemoCue haemoglobinometer (HemoCue® Hb 201+ System, Angelhom, Sweden) was used to check the haemoglobin level. The point-of-care was suitable for population-based screening as it contributed a reliable data and comparable to the laboratory gold standard method[21–23]. The respondents were seated properly and given reassurance prior to the blood pressure examination and the finger prick procedure. The nurses followed the guideline of the safety procedure and clinical waste disposal. The methodology of NHMS 2019 was reported clearly in technical

report and shared publicly[24]. The sample size for this study was estimated using two proportion method based on the risk factors of diabetes mellitus and yielded the minimum sample size of 2880 respondents[15].

Ethics approval and consent to participate

This study was registered with the National Medical Research Register (NMRR) and bearing registration number NMRR-18-3085-44207. The ethical approval for this study was obtained from the Medical Research and Ethics Committee, Ministry of Health, Malaysia. This study was conducted in accordance with the Declaration of Helsinki. Written consent was taken from the respondents prior to the survey. An added written consent from parents or legal guardian was documented for respondents aged less than 18 years.

Variables definitions

The socio-demographic variables included age group, marital status, ethnicity, level of education, place of residence, occupational status and household income. The lifestyle variables were current smoking status, physical activity status and body mass index. Chronic diseases included diabetes mellitus, hypertension and hypercholesterolaemia. Anaemia in men was defined as haemoglobin levels of less than 13.0 g/dL. It can be further classified into the level severity of mild (11.0-12.9 g/dL), moderate (8.0-10.9 g/dL) and severe anaemia (< 8.0 g/dL). Haemoglobin level was adjusted for the respondents who smoked cigarettes by subtracting 0.3g/dL from the measured level[7]. Body mass index (BMI) is measured according to the Malaysian Clinical Practice Guidelines of Obesity of four categories; underweight (<18.5 kg/m^2), normal (18.5-22.9 kg/m^2), overweight (23.0-27.4 kg/m^2) and obese (<27.5 kg/m^2)[24]. A respondent known to have diabetes and those newly detected via fasting capillary blood glucose of 7.0 mmol/L or higher was defined as having diabetes mellitus. Those with blood cholesterol of more than 5.2 mmol/L were defined as hypercholesterolaemia. Respondents who have had a blood pressure of ≥140/90 mmHg or known hypertension were considered as having hypertension[25]. The validated short version of the International Physical Activity Questionnaire was used to measure respondents' physical activity status[26].

Data Analysis

This study used IBM SPSS Statistics for Windows version 21.0 and also R version 4.0.2 software. The complex samples analysis was utilized to generate weighted descriptive analysis, bivariate analysis and multivariable logistic regression analysis. The dependent variable was anaemia status and the independent variables were socio-demographic profiles, lifestyle factors and chronic diseases. The independent variables were tested using simple logistic regression analysis, subsequently tested in the multivariable logistic regression. The results were reported according to the final adjusted model and the odds ratio not equal to one was considered as a significant factor. In addition, effect size based on the adjusted odds ratios (aORs) was taking into consideration during data interpretation; small effect (>1.5) and large effect (≥3)[27]. Multicollinearity problems and two-way interaction terms were checked for the final model. The complex sample multivariable logistic regression model fitness was assessed using the classification table percentage and Akaike Information Criterion (AIC).

Results

The response rate for this study was 94.4% with the total respondent of 5079 men. The study sample represented the population of men aged 15 years and above in Malaysia which accounted for 11.8 million. Of the total respondents, 87.2% (95% CI: 85.8, 88.5) were men aged 15-59 years referring to the younger aged group and 12.8% (95% CI: 11.5, 14.2) were older men (aged 60 years and above). There were 77.5% of the respondents resided in urban areas while 75.7% had jobs. Respondents who were not working came from those who had retired (15.1%) and students (9.2%).

The prevalence of anaemia was tabulated according to three groups of overall men, younger men and older men versus their sociodemographic profiles, lifestyle factors and the presence of chronic diseases. The overall prevalence of anaemia among men was 12.6% (95% CI:10.9, 14.5). Further age group categorisation observed that prevalence of anaemia among younger men was 10.0% (95% CI: 8.2, 12.2) and older men was 30.7% (95% CI:26.6, 35.1) as shown in Table 1. The trend of anaemia according to five-years age group interval showed that the rate was sharply increased from the age group 60-64 years to age group 75 years and above as pictured in Figure 1. Apart from the age group comparison where the prevalence of anaemia was three times higher in older men than younger men, older men who had diabetes were nearly two times higher than the older men who did not have diabetes (38.7%; 95% CI: 31.9, 45.9 versus 24.5%; 95% CI: 20.0, 29.7) as shown in Table 1. The prevalence of chronic diseases and lifestyle factors among younger men and older men was tabulated in Table 2 to give clearer picture on the impact of chronic diseases burden according to age groups. The prevalence of diabetes mellitus, hypertension and hypercholesterolaemia were consistently higher among older men in contrast to the prevalence of current smoker which was higher among younger men. More than half of older men were having an income of below 40% of the total Malaysian population income.

Simple logistic regression analysis observed that anaemia was associated with older age, place of residence, education level, occupational status, diabetes, hypertension and hypercholesterolaemia as shown in Table 3. However, the multivariable logistic regression observed that

anaemia among men was associated with older age (aOR = 3.07; 95% CI: 2.14, 4.41) and those who were having diabetes (aOR = 1.53; 95% CI: 1.15, 2.05). The factors were adjusted with other sociodemographic, lifestyle and other related chronic diseases factors by controlling the confounding variables in the final model. A significant interaction terms was found involving older age and diabetes (aOR 1.92; 95% CI: 1.10, 3.37; p-value 0.023). Subsequently, the model was split into two models; model among older men and model among younger men. Model among older men observed that anaemia was associated with older men who have diabetes (aOR = 2.45; 95% CI: 1.55, 3.88) however, the similar association was not observed in the model of younger men.

Discussion

Anaemia among men was not given adequate attention due to a lower prevalence rate and a lesser number of affected populations compared to women and children[4,6]. This study observed that 12.6% of men in Malaysia had anaemia and the prevalence was three times higher among older men. A similar pattern of gradual increasing trends of anaemia with older age in previous studies with the starting point at the age of 50 years and above[11,28]. According to the WHO, the burden of anaemia was considered as moderate public health significance if the prevalence is between 20-39%. A previous local study noted that the trends of moderate public health significance among men started at the age of 50 years and this study found that it started a bit late at 60 years[7,11]. The improvement seen after four years is might due to improvement in chronic illness management in this country[29]. Prevalence of more than 40% is considered as a severe situation and need urgent action referring to anaemia in age group 75 years and above in this study[7].

The prevalence of anaemia among men varies according to age as discussed above. It also varies according to geographical distribution, ethnicity, household income and diet practice[19,30,31]. The prevalence of anaemia in developed country such as the United States is much lower at 3.5% while for developing country such as India observed a prevalence of 23.2%[6,32]. A local study done recently reported that the prevalence of anaemia among men 35 to 70 years old was only 4.9% because this study used venous blood sampling and laboratory method for haemoglobin testing[33].

The overall prevalence of anaemia among men via population-based survey was 14.3% (96%CI 13.3, 15.4) in 2015 and 12.6% (95%CI: 10.9,14.5) in 2020 which was more representative of the Malaysian men population[24]. However, this overall prevalence does not picture the burden of anaemia in specific group like the very old age group (75 years and above) of which obviously at the highest prevalence. By selecting the appropriate targeted group for anaemia estimates, it attracts the attention of policy maker to look into the problem seriously. Another example of targeted group for anaemia, person with diabetes. A local study observed prevalence of anaemia among men who had type 2 diabetes and chronic kidney disease was at 28.4% which required public health attention[29]. Older men who were underweight and having diabetes were noted to have a higher prevalence of anaemia. However, the pattern of prevalence of anaemia among younger men was nearly similar across all the socio-demographic factors, lifestyle factors and chronic diseases.

This study also investigated the factor associated with anaemia among men as the prevalence rate shows a huge difference between younger and older men. The possible reasons for these finding will be discussed according to the magnitude of association in the multivariable logistic regression model. The adjusted model indicated that age and the presence of diabetes were associated with anaemia among men after controlling for confounding variables. Although age had a significant interaction with diabetes mellitus, further analysis observed that older men with diabetes were associated with anaemia and the similar association was not found among younger men. The possible reason for this findings is due to the older men with diabetes may have diabetic nephropathy or renal anaemia and this condition might not present among younger men with diabetes[29,34,35].

Besides diabetes mellitus, older person may presented with other chronic diseases such as hypertension, ischaemic heart disease, cerebrovascular disease and malignancy diseases[36]. Anaemia among older person also associated with dementia, disability and emotional disturbances which further impaired their activities of daily living and food intake[37,38]. However, this study only measured prevalence of diabetes mellitus, hypertension and hypercholesterolaemia which consistently higher among older men than younger men. The association of anaemia and hypertension was not found in this this study and the previous study[39]. Hypertension was included in the final model as the disease was prevalent among men in Malaysia and may related with cardiovascular disease. The presence of anaemia among those with cardiovascular problem worsened their health outcomes[40,41].

Nonetheless, anaemia screening should be conducted regularly among older men as age is independently contributing to anaemia. Older age alone contributes to anaemia with the evidence of low erythropoietin level in the blood even though the older persons did not have chronic illnesses[42,43]. Haemoglobin level among healthy older person is physiologically decreasing with increasing age, however the cut-off point among older men remained at 13g/dL[44]. Older person tends to develop undernutrition due to lack of food, feeding problems, inappropriate diet or malabsorption[30]. A Higher prevalence of anaemia is expected in the place or country where poverty still a significant problem or the presence of political instability[6].

The presence of anaemia among older person was associated with reduced survival rate and quality of life, however the impact was not observed among those aged below 60 years in Netherlands[45]. Among younger men, the association of diabetes and anaemia was not detected due to the small number of younger men who have diabetes or had developed diabetic nephropathy. This finding also explains that the cause of anaemia among younger men might be contributed by other causes such as acute blood loss, genetic disorder or nutritional deficiency. Young men usually have reversible cause of anaemia and lower prevalence of chronic illness.

Strengths and Limitations

This study used survey design methods, which has an advantage on Malaysian population representativeness. It utilised the online platform via an application using a tablet where the data was sent to the central team, immediately. It also used a validated point-of-care testing and well-trained data collectors were employed to collect data including medical staff for the clinical part. Screening for anaemia using a capillary blood sample may cause a little higher haemoglobin level which may result in underestimation. However, this point of care testing has been used widely for population-based screening and has been proven to provide a reliable estimation and comparable to the laboratory method[6,21,22]. In terms of data analysis, the multivariable analysis eliminates the confounding factor while highlighting the interaction issue enables the researcher to interpret findings according to specific a group.

The limitation of this study includes using the population-based data of the main objective is measuring the burden of non-communicable disease and its risk factors, hence much relevant information regarding anaemia was not collected. Information on the prevalence of chronic kidney disease, medication and supplement history intake, peptic ulcer disease, other tropical diseases, lead exposure in the work setting and dietary intake are important in anaemia prediction. Even though this is a population survey data, comparison of anaemia according to major ethnicities could not be made due to the small sample size of other ethnicities. The relationship of anaemia and underweight were not observed in this study due to the inadequate sample size among respondent who were underweight and a higher proportion of respondents who were overweight and obese. The survey was a cross-sectional design and had a limitation in a causal relationship.

Conclusion

The prevalence of anaemia was higher among older men than younger men and the figures reflected a moderate to severe public health significance for the older men. Anaemia among men in Malaysia was associated with older age and those with diabetes mellitus. Anaemia among men is not given an adequate attention hence, the problem is only discovered later. Taking adequate nutritional supplementation of iron and healthy food according to food pyramids besides regular medical examination can be initiated at individual level. Healthcare workers should be aware of anaemia problem among older age and regular anaemia screening of the targeted group may improve quality of life and prevent early disease complications.

Abbreviations

aOR: adjusted odds ratios;

BMI: body mass index;

NHMS: National Health and Morbidity Survey;

NMRR: National Medical Research Register;

WHO: World Health Organization.

Declarations

Ethics approval and consent to participate

This study was registered with the National Medical Research Register (NMRR) and bearing registration number of NMRR-18-3085-44207. The ethic approval for this study was obtained from the Medical Research and Ethic Committee, Ministry of Health, Malaysia. Written consent was obtained from the respondent prior the survey was conducted.

Consent for publication

Not applicable.

Availability of data and materials

The dataset for this study is available; anyone requesting this dataset should consult the Ministry of Health, Malaysia.

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Competing interests

All authors disclose that they have no competing interests and no potential conflicts of interest regarding the publication of this article.

Authors' contributions

SMA, NAS, SSG, NA contributed in the designing the study, data cleaning, data analysis, interpretation of the findings and drafted the manuscript. Finally, the paper has been reviewed thoroughly by NCAR, NAMZ, NHN, TAS, NAA. All the authors approved the final version.

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Tables

Table 1: Prevalence of Anaemia Among Men in Malaysia According to Socio-demographic Profiles, Chronic Diseases and Lifestyle Factors

Variables	All men (≥15 years) n=4973				Younger men (15-59 years) n= 3738				Older men (≥ 60 years) n =1055			
	n	(%)	95% CI		n	(%)	95% CI		n	(%)	95% CI	
			lower	upper			lower	upper			lower	upper
Overall anaemia	732	12.6	10.9	14.5	412	10.0	8.2	12.2	320	30.7	26.6	35.1
Mild anaemia	584	10.5	8.9	12.4	325	8.4	6.7	10.6	259	25.0	21.3	29.1
Moderate to Severe anaemia	148	2.1	1.6	2.6	87	1.5	1.1	2.1	61	5.7	4.0	8.0
Marital status												
Married	546	13.8	12.1	15.7	277	10.2	8.4	12.3	269	29.8	25.4	34.7
Not married	186	10.9	8.4	14.1	135	9.8	7.2	13.2	51	35.9	24.9	48.5
Strata												
Urban	395	11.8	9.8	14.2	231	9.3	7.1	12.0	164	30.0	24.9	35.6
Rural	337	15.3	13.0	17.9	181	12.4	9.8	15.6	156	32.7	27.4	38.6
Ethnicity												
Malay	479	12.7	11.3	14.3	280	10.3	8.9	12.0	199	29.5	25.0	34.5
Non-Malay	253	12.5	9.6	16.1	132	9.6	6.5	14.0	121	31.8	25.2	39.3
Level of education												
Primary	292	16.2	13.2	19.8	88	9.9	6.9	14.2	204	32.2	27.0	37.9
Secondary	323	11.9	9.7	14.5	239	10.7	8.4	13.6	84	25.8	20.0	32.7
Tertiary	115	10.4	7.9	13.5	84	8.6	6.3	11.8	31	37.5	24.4	52.8
Occupation												
Currently not working	311	18.6	16.0	21.5	84	10.6	8.1	13.7	277	34.3	29.1	40.0
Currently working	420	10.7	8.7	13.1	327	9.9	7.8	12.4	137	24.7	19.1	31.3
Household income group												
Below 40%	340	13.8	11.8	16.2	167	9.6	7.8	11.9	173	33.8	27.9	40.3
Middle 40%	231	11.1	8.9	13.6	156	10.0	7.7	12.8	75	23.8	17.3	31.7
Top 20%	111	12.1	7.8	18.3	80	10.4	6.0	17.3	31	36.3	24.3	50.3
Diabetes												
Yes	277	20.0	17.0	23.5	109	11.6	9.0	15.0	168	38.7	31.9	45.9
No	425	10.9	8.9	13.1	273	9.4	7.4	11.9	152	24.5	20.0	29.7
Hypertension												
Yes	361	17.0	14.7	19.4	129	11.1	8.9	13.7	232	30.1	25.6	35.1
No	341	10.6	8.5	13.2	253	9.3	7.1	12.1	88	32.0	23.7	41.6
Hypercholesterolaemia												
Yes	344	15.2	13.1	17.5	157	10.5	8.4	13.0	187	32.1	26.9	37.7
No	358	11.3	9.0	14.0	225	9.4	7.1	12.4	133	29.0	22.8	36.2
Physical activity status												
Inactive	214	14.5	12.1	17.4	88	9.3	6.9	12.4	126	33.6	26.1	42.1
Active	489	12.0	10.0	14.5	304	10.1	7.9	12.9	185	28.3	23.4	33.6
Current smoker												

Yes	238	11.0	8.6	14.1	177	10.0	7.4	13.3	259	33.1	28.3	38.4
No	492	13.8	12.0	15.8	233	10.0	8.2	12.3	61	23.5	17.2	31.2
BMI (Asian cut-off)												
Underweight	51	16.1	10.4	24.0	30	12.1	7.1	19.8	21	44.3	22.1	69.0
Overweight & Obese	419	11.6	10.2	13.3	245	9.5	8.0	11.3	174	25.5	20.9	30.6
Normal	180	12.7	8.7	18.3	96	9.7	5.5	16.7	84	34.9	26.7	44.0

Table 2: Prevalence of Chronic Diseases and Lifestyle Factors Among All Men, Younger Men and Older Men in Malaysia

Variables	All men (≥15 years)			Younger men (15-59 years)			Older men (≥ 60 years)		
	prevalence	95% CI		prevalence	95% CI		prevalence	95% CI	
		lower	upper		lower	upper		lower	upper
Diabetes	18.2	16.6	19.9	14.4	12.8	16.21	41.9	37.8	46.1
Hypertension	30.3	28.2	32.5	24.2	22.1	26.37	68.6	64.4	72.6
Hypercholesterolaemia	32.0	29.7	34.4	28.9	26.5	31.44	51.4	46.9	55.9
Physically inactive	22.1	20.4	24.0	20.0	18.2	21.82	36.6	32.3	41.1
Current smoker	40.5	37.9	43.1	42.9	40.0	45.75	24.0	20.6	27.8
BMI									
Underweight	7.3	6.0	8.7	7.2	6.0	8.7	7.5	5.0	11.3
Overweight	35.0	32.9	37.2	34.0	31.7	36.4	41.8	37.1	46.7
Obese	28.9	26.8	31.2	29.7	27.3	32.1	24.0	20.4	28.1
HH income group									
Below 40%	39.0	36.0	42.1	36.5	33.2	39.9	59.0	54.2	63.6
Middle 40%	38.9	36.2	41.7	40.4	37.5	43.4	27.6	23.3	32.3
Top 20%	22.0	19.3	25.0	23.1	20.1	26.4	13.5	10.4	17.3

Table 3: Factors Associated with Anemia Among All Men, Younger Men and Older Men in Malaysia

Variables	Crude			*Model among men (≥15 years)				Model among younger men (15-59 years)				Model among older men (≥ 60 years)			
	OR	95% CI		aOR#	95% CI		p-value	aOR#	95% CI		p-value	aOR#	95% CI		
		LL	UL		LL	UL			LL	UL			LL	UL	
Age group (years)															
15-59	-	1	-	1	-	-		-	-	-		-	-	-	
≥ 60	3.99	2.92	5.45	3.07	2.14	4.41	<0.001	-	-	-		-	-	-	
Marital status															
Married	-	1	-	1	-	-		1	-	-		1	-	-	
Not married	0.766	0.58	1.02	0.935	0.66	1.33	0.707	0.89	0.61	1.29	0.526	1.40	0.65	3.01	0.384
Place of residence															
Urban	-	1	-	1	-	-		1	-	-		1	-	-	
Rural	1.35	1.02	1.8	1.261	0.95	1.67	0.105	1.33	0.94	1.89	0.106	1.19	0.70	2.00	0.524
Ethnicity															
Malay	-	1	-	1	-	-		1	-	-		1	-	-	
Non-Malay	0.979	0.71	1.35	1.079	0.74	1.58	0.697	1.09	0.65	1.83	0.749	1.05	0.66	1.69	0.824
Level of education															
Primary	1.673	1.14	2.45	1.009	0.67	1.52	0.964	0.93	0.52	1.67	0.803	0.86	0.40	1.88	0.711
Secondary	1.168	0.88	1.56	1.249	0.91	1.72	0.174	1.34	0.94	1.92	0.105	0.84	0.39	1.80	0.646
Tertiary	-	1	-	1	-	-		1	-	-		1	-	-	
Occupation															
Currently not working	2.62	1.92	3.56	1.14	0.82	1.57	0.433	0.96	0.59	1.55	0.852	1.32	0.77	2.27	0.309
Currently working	-	1	-	1	-	-		1	-	-		1	-	-	
Household income group															
Below 40%	1.163	0.69	1.97	0.81	0.45	1.47	0.495	0.75	0.37	1.52	0.430	1.02	0.47	2.22	0.961
Middle 40%	0.901	0.57	1.43	0.79	0.49	1.28	0.339	0.84	0.48	1.46	0.534	0.59	0.28	1.25	0.168
Top 20%	-	1	-	1	-	-		1	-	-		1	-	-	
Diabetes mellitus															
Yes	2.059	1.56	2.72	1.53	1.15	2.05	0.004	1.19	0.83	1.70	0.342	2.45	1.55	3.88	0.002
No	-	1	-	1	-	-		1	-	-		1	-	-	
Hypertension															
Yes	1.721	1.30	2.28	1.08	0.80	1.45	0.629	1.17	0.83	1.64	0.365	0.86	0.54	1.38	0.544
No	-	1	-	1	-	-		1	-	-		1	-	-	
Hypercholesterolaemia															
Yes	1.41	1.06	1.88	1.12	0.82	1.52	0.467	1.09	0.75	1.58	0.648	1.16	0.73	1.84	0.519
No	-	1	-	1	-	-		1	-	-		1	-	-	
Current smoker															
Yes	0.775	0.59	1.02	0.97	0.71	1.33	0.861	1.02	0.72	1.47	0.894	0.67	0.39	1.15	0.144
No	-	1	-	1	-	-		1	-	-		1	-	-	

Physical activity status															
Inactive	1.241	0.91	1.69	1.06	0.74	1.50	0.755	0.98	0.61	1.59	0.945	1.27	0.76	2.11	0.364
Active	-	1	-					1	-	-		1	-	-	
BMI (Asian cut-off)															
Underweight	1.318	0.7	2.56	1.39	0.69	2.80	0.353	1.31	0.55	3.14	0.542	1.53	0.55	4.30	0.417
Overweight & Obese	0.904	0.6	1.39	0.81	0.51	1.30	0.379	0.87	0.46	1.63	0.664	0.63	0.37	1.08	0.092
Normal	-	1	-	1	-	-		1	-	-		1	-	-	
*Interaction terms of factor aged ≥ 60 years and diabetes (aOR 1.92; 95% CI: 1.10, 3.37; p-value 0.023) caused the main model to be split into model among younger men (15-59 years) and model among older men as above.															

#adjusted with all variables. Complex Sample Classification Table Percentage: 87.7%.

Pseudo R Squares (Nagelkerke: 0.110, Cox and Snell: 0.058, McFadden: 0.079)

AIC (Full model: 2937.78, Baseline Model: 3606.4)

Figures

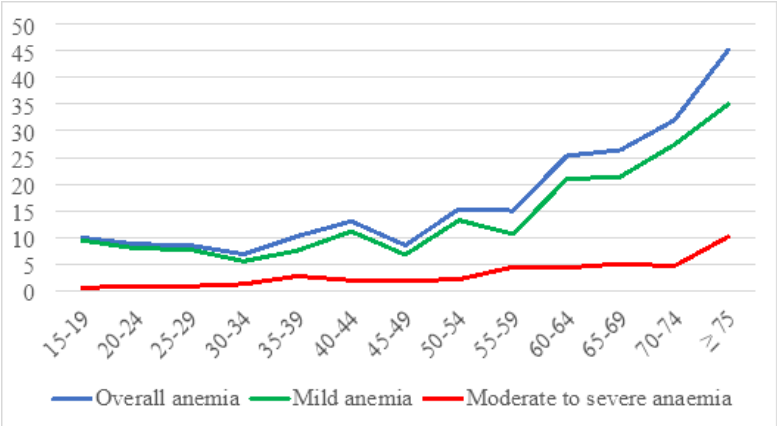

Figure 1

The Trends of Anemia's Prevalence According to the Level of Severity using a 5-Year Age Interval among Men in Malaysia