A Study on the Relationship between Body Mass Index, Body Fat Percentage, Waist Circumference, Waist-Hip Ratio with Non-Communicable Diseases among University Staffs

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Abstract

Background: Obesity becomes a main driver of global rise in non-communicable disease. Many people are unaware that Body Mass Index (BMI), Body Fat Percentage (BFT), Waist Circumference (WC) and Waist-Hip Ratio (WHR) could be potential risk of getting Non-communicable Diseases (NCDs) as only weight, height and waist circumference are more commonly taken as a baseline to diagnose NCDs. This study aims to determine the relationship between BMI, BFP, WC and WHR that will increase the risk of getting NCDs among the staffs in AIMST University. With these variable, risk of obesity related to NCDs can be estimated and appropriate treatment plans can be established, also to increase the awareness of participants on their health condition.

Methods: In this study, body weight, height and BFP, waist and hip circumference were measured for 250 staffs from each faculty or department in AIMST University. Target participants are required to answer questionnaire to collect data of the diagnosis and duration for their NCDS. These measurements were converted into BMI, BFP, WC and WHR in order to determine any relationship with NCDs.

Results: The results indicate that BMI has significant relationship with NCDs. Most of the people with high BMI were diagnosed with hypertension, followed by type 2 DM and hyperlipidemia. Nevertheless, there is no significant relationship found between variable of BFP, WC, WHR and NCDs.

Conclusion: It was indicated that BMI gives rise to obesity concern as it was shown as one of the significant risk factors that contribute to NCDs such as hypertension, type 2 DM and hyperlipidemia.

Keywords: Body mass index, obesity, waist circumference, body fat, waist-hip ratio, non-communicable diseases.

Introduction

World Health Organization (2021) defined obesity as abnormal or excessive fat that accumulates and presents a health risk. A person with a BMI of 30 or more is generally considered obese, BMI equal to or more than 25 is considered overweight (Janssen, 2002). Obesity is a major contributor to non-communicable diseases (NCDs) such as type 2 diabetes mellitus (type 2 DM), hypertension, hyperlipidemia, osteoarthritis (OA), cancer (CA), obstructive sleep apnea (OSA), and asthma. (Nuttal, 2015; Gill et al., 2017; Recalde et al., 2021). Obesity is

commonly used in classifying abnormal weight for example underweight, overweight, and obesity in adult populations and individuals. Risk factors such as body mass index (BMI), body fat percentage (BFP), waist circumference (WC), and waist-hip ratio (WHR), are believed to play an important factor in increasing the risk of getting NCDs. The purpose of this study is to determine the range of BMI, BFP, WC, and WHR and to identify the relationship between BMI, BFP, WC, WHR with NCDs.

Methods

Our research design is based on the correlational study to identify the relationship between four variables namely BMI, WC, BFP, and WHR. In this research, we had chosen the quantitative method to collect the primary data that is needed for the study while secondary data have been obtained it from relevant research journal articles and previously published data to strengthen our database to ensure our research problem is precisely addressed. Correlation research was adopted in this study as it can be used to determine prevalence and relationships among variables, and to forecast events from current data and knowledge. In addition, findings generated from correlational research can be used to inform decision-making, and to improve or initiate health-related activities or change (Curtis et al., 2016). All the data in this research was conducted specifically with the use of physical survey on the target participants by interviewing them for diagnosis of their NCDs, taking medical history and conducting physical measurements on their BMI, WC, BFP, and WHR. A systematic record and documentation of the findings were conducted as scheduled. A research protocol was written to reflect the flow of data collection procedure. This study has obtained approval from AIMST University Human Ethics Committees (AUHEC) with reference no. AUHEC/FAHP/2022/02 dated 21st September 2021 prior to the conduct of the study. The researchers conducted the entire data collection by meeting the target participants in their office and describing the purpose for the research, procedures to be done during the data collection and the expectations to the participants. Informed consent was obtained from every participant. Each target participant took about 20 minutes to complete the whole procedure. A self-administered questionnaire was distributed to the target participants to answer questions regarding the non-communicable disease that they have been diagnosed with. Almost half of items in the questionnaire are regarding the measurement of the targeted participants on their waist circumference, hip circumference, height, weight, and body fat percentage were obtained accordingly by using a measuring tape, stature meter, and body composition analysis scale. The measurements obtained were filled by researchers in the questionnaire.

The random sampling was carried out targeting at whole populations in AIMST University which consists of academic, administrative and support staff from different categories in every faculty, division, department and unit at AIMST University. Based on Krejcie and Morgan (1970) sample size determination table, from

a population of 500, a total of 217 participants should be sampled. However, by adding in the possible attrition rate of 20%, a total of 260 was the targeted samples. The participants were then selected randomly without bias. They were also answering the questionnaire voluntarily.

Data Collection & analysis

Data collection is the main basic step for investigation, regardless of the field of research. In this study, a questionnaire is used as a foremost tool to collect data among the staff in AIMST University. A questionnaire is an inquisition gauge consisting of a set of questions for the aim of reckoning from respondents through surveys. The questionnaire contains 13 items. The participants were randomly selected and informed consent obtained. After the completion of data collection, data entry and analysis were performed with statistical software SPSS version 25 based on our analysis plan. However, prior to data analysis, the dataset was checked for missing values, invalid data entry or other possible errors or outliers (Kwak & Kim, 2017).

Results and Discussions

Based on the data that was obtained, 250 respondents participated in this research, and 10 withdrew from the study. From the total sample, 60.4% are female and 39.6% male. The average age of the participants was mostly around 35-45 years old, (mean ± SD = 42.95 ± 10.369). In terms of ethnicity, Indians made up a large proportion of the sample during data collection (66.4%) (Table 1). Based on the result of current medical history, out of 250 participants, there were a greater number of them with no current or past medical history (58.4%). However, out of 9 diseases surveyed in the questionnaire, Hypertension has the highest number among the NCD (12.5%), followed by type 2 DM (12.8%) and hyperlipidemia (5.6%). Most of the diseases were newly diagnosed which is just within 1-5 years (21.6%) (Table 2).

Based on the results of analysis, BMI and NCD showed most significant relationship, ($x^2(3)=13.068$, $p<0.05$), while BFP, WC and WHR showed no significant relationship with NCDs. (Table 3 & Table 4). From the results obtained, there was indication that BMI was associated with an increased risk of hypertension. This study concurs with the review conducted by Kearney et al, (2005) that hypertension has been perceived as an outstanding health problem because of its rising prevalence and relation with other diseases. According to previous research by Dyer et al. (1990) who has a strong stand on the interrelationship between hypertension and obesity as the two was viewed as a common and major health risks to people. Likewise, the results in this study coincided with the study done by Janssen (2002), stating that BMI was the strongest correlate with increased risk of getting NCD. Thus, the combination of BMI and WC has a greater variance than either BMI or WC alone as risk factor. The variance accrued was greater when WC was added to BMI. Furthermore, this goes in line with the fact that the importance of using both BMI and WC in clinical practice to determine risk factors of getting NCDs (Janssen, 2002; Snowdon et al., 2014). Furthermore, the results showed that there is no significant relationship between BFP

($x^2(3)=4.186, p>0.05$), WC, ($x^2(3)=4.235, p>0.05$), WHR, ($x^2(3)=5.338, p>0.05$) and NCDs. The results in this study were different from previous studies as the study done by Dalton et al. (2003) has a strong standpoint on WHR having the strongest correlation with cardiovascular disease such as hypertension and it is the most useful measure of obesity to identify the individual with hypertension. Furthermore, recent findings done by Darsini et al. (2020) indicated that high WC increased the risks of developing Hypertension and type 2 DM. Nevertheless, according to the studies, most of the studies found that there were association between BFP and type 2 DM (Ghazi, et al., 2018; Lin et al., 2021). Thus, studies by Wang et al. (2005) and Feller et al., (2010) found WC was a strong predictor of type 2 DM. As a result, the findings of the review found that individuals of low or normal weight, but with large WC, should be recognized as a risk factor of NCDs (Kramer et al., 2010; Ross et al., 2020).

The downside of this study was a small sample size which might affect the generalization of the study, Further the research was conducted in one university, so the result might be affected as it is only focusing on one small population in university and the respondents might be healthy adults which might lead to failure in getting the real findings on the relationship between the four factors and NCDs. The study should be compared among all universities in Kedah state in order to get desirable results with a wider range of populations and adults with different health status. However, additional clinical studies should be needed in order to elucidate the mechanisms behind these associations between BFP, WHR and NCDs. The stronger evidence of all these four factors together will lead a person to increase the risk of getting NCDs throughout the Asian countries are still limited, especially research studies based in Malaysia. Losing weight in overweight and obese people are believed to reduce the risk of getting NCDs, but it is also well known that losing weight is not easy for obese people. Even at the best, only a limited weight reduction may be achieved. Therefore, it is important to identify other ways to reduce the risk of obesity. Due to this, public awareness of NCDs and the risk factors is necessary to be increased. Current findings will help to provide an important insight into appropriate interventions for prevention, management and treatment of NCDs in Malaysia.

Table 1: Demographic characteristics of study samples

	Frequency	**Percentage (%)**
Gender		
Male	99	39.6
Female	151	60.4
Age		
20-35	63	25.2
35-45	92	36.8
45-55	64	25.6

	Frequency	Percentage (%)
55-75	31	12.4
Race		
Malay	60	24
Chinese	22	8.8
Indian	166	66.4
Others	2	0.8
Position		
Administrative Staff	86	34.4
Academic Staff	71	28.4
Support Staff	93	37.2

Table 2: Clinical Characteristics of study samples

	Frequency	Percentage (%)
Current medical history		
No medical history	146	58.4
Hypertension	38	15.2
CAD	0	0
Hyperlipidemia	14	5.6
OA	5	2
Type 2 DM	32	12.8
OSA	3	1.2
Asthma	5	2
Dyspnea	2	0.8
Others	5	2
Past medical history		
Yes	105	42
No	145	58
Years of Diagnosis		
Non	145	58
1-5 years	54	21.6
5-10 years	26	10.4
10-15 years	10	4
15-20 years	12	4.8
>20 years	3	1.2
BMI		
Underweight	8	3.2
Normal	107	42.8
Overweight	90	36

Obesity	45	18
BFP		
Low	42	16.8
Normal	121	48.4
High	87	34.8
WC		
Low	152	60.8
Normal	82	32.8
High	16	6.4
WHR		
Excellent	51	20.4
Good	59	23.6
Average	132	52.8
At risk	8	3.2

Note: CAD: Coronary artery diseases; OA: Osteoarthritis; DM: Diabetes mellitus; OSA: Obstructive sleep apnea; BMI: Body mass index; BFP: Percentage of body fat; WC: Waist circumference; WHR: Waist-hip ratio

Table 3: Descriptive Statistics of BMI, %BF, WC, WHR and NCD.

Variables	Mean	Median	Range	SD	IQR	95% CI	
						Lower	Upper
BMI	26.319	25.492	51.6	0.80076	5.5	25.672	26.965
%BF	33.184	33.000	84.5	8.5502	10.1	32.119	34.249
WC	89.612	91.000	62.0	10.7224	14.0	88.276	90.947
WHR	0.9006	0.9189	0.60	0.7811	0.10	0.8909	0.9104

Note: BMI: Body mass index; %BF: Percentage of body fat; WC: Waist circumference; WHR: Waist-hip ratio; NCD: Non-communicable diseases; SD: Standard deviation; IQR: Inter-quartile range; CI: Confidence interval.

Table 4: Correlation coefficients between BMI, %BF, WC, WHR and NCD.

Risk factors		Frequency / %	df	x^2	Cramer's V value	P
BMI	Underweigh t	7 / 2.6 107 / 39.6	3	13.068	0.229	0.004

	Normal Overweight Obesity	90 / 33.3 45 / 16.7				
%BF	Low Normal High	50 / 14.8 108 / 40 88 / 32.6	2	4.186	0.129	0.123
WC	Low ormal High	152 / 56.3 82 / 30.4 15 / 5.9	2	4.235	0.130	0.120
WHR	Excellent Good Average At risk	51 / 18.9 59 / 21.9 132 / 48.9 8 / 3.0	3	5.338	0.146	0.149

Note: BMI: Body mass index; %BF: Percentage of body fat; WC: Waist circumference; WHR: Waist-hip ratio; NCD: Non-communicable diseases; df: Degree of freedom

Conclusion

In the nutshell, the result from this study indicates that BMI has a significant relationship with NCDs. Nevertheless, there is no significant relationship found between BFP, WC, WHR and NCDs. From this result, BMI gives rise to the obesity concern which was shown as one of the significant risk factors that can contribute to NCDs such as hypertension and Type 2 DM.

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