

Validitas Berat Badan, Tinggi Badan, dan Indeks Massa Tubuh Diri Sendiri diantara Remaja Akhir Malaysia

Validity Of Self-Reported Weight, Height And Body Mass Index Among Malaysian Late Adolescents

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Abstrak

Latar belakang: Malaysia menderita masalah obesitas dengan hampir seperempat dari anak-anak dan remaja mengalami kelebihan berat badan atau obesitas. Metode yang divalidasi diperlukan untuk menilai tren kelebihan berat badan dan obesitas dengan mudah.

Tujuan: Penelitian ini menyelidiki keakuratan tinggi dan berat badan remaja akhir Malaysia yang dilaporkan sendiri dibandingkan dengan metode pengukuran langsung.

Metode: Studi potong lintang ini dilakukan pada tahun 2019 pada 114 partisipan berusia 19-20 tahun. Berat dan tinggi badan yang dilaporkan sendiri dan diukur langsung dikumpulkan melalui panggilan telepon dan instrumen studi. Nilai berat dan tinggi yang diperoleh digunakan untuk menghitung BMI dan menentukan klasifikasi.

Hasil: Nilai ICC sangat baik antara berat badan yang dilaporkan dan diukur (ICC= 0.94; 95% CI=0.91-0.96), tinggi badan (ICC= 0.95; 95% CI=0.83-0.98) dan BMI (ICC = 0.89; 95% CI =0,78-0,94) ditemukan. Selain itu, kesepakatan yang baik yang diamati dari plot B & A menunjukkan bahwa perbedaan antara kedua variabel pengukuran independen kecil dan sebagian besar perbedaan berada dalam area batas kesepakatan pada tingkat populasi untuk nilai berat badan, tinggi badan dan BMI. Selanjutnya, Kappa Cohen menunjukkan kesepakatan substansial antara status BMI yang diukur dan dikategorikan dari berat dan tinggi badan dari kedua metode, semua ($\kappa = 0,61$; 95% CI = 0,48-0,74), anak laki-laki ($\kappa = 0,67$; 95% CI = 0,43-0,91) dan anak perempuan ($\kappa = 0,58$; 95% CI=0,43-0,73).

Kesimpulan: Studi validasi ini menyimpulkan bahwa berat dan tinggi badan yang dilaporkan sendiri sesuai dengan metode pengukuran langsung. Teknik ini dapat digunakan untuk menilai status antropometrik remaja akhir Malaysia untuk studi populasi.

Kata kunci: Validitas, Laporan Diri, Ukur Langsung, Berat Badan, Tinggi Badan, IMT, Remaja Akhir

ABSTRACT

Introduction: Malaysia suffers from obesity problems with nearly a quarter of the children and adolescents being overweight or obese. Validated methods are needed to measure the trend of overweight and obesity easily.

Objective: The study investigates the precision of Malaysian late adolescents' self-reported height and weight compared to direct-measured methods.

Methods: About 114 young adults aged 19-20 years old participated in this cross-sectional study in 2019. Self-reported and direct-measured anthropometrics including height and weight were gathered through phone calls and study instruments. The obtained height and weight values calculates BMI and determines classifications.

Results: The ICC value were excellent between reported and measured weight (ICC= 0.94; 95% CI=0.91-0.96), height (ICC= 0.95; 95% CI=0.83-0.98) and BMI (ICC = 0.89; 95% CI=0.78-0.94) were found. Additionally, good agreement observed from B & A plots indicated that the differences between both independent measurement variables were minor and most of the differences were within the area of the limit of agreement at the population level for their anthropometric measurements. The Cohen's Kappa showed substantial agreement of BMI calculated from reported weight and height ($\kappa = 0.61$; 95% CI= 0.48-0.74), boys ($\kappa = 0.67$; 95% CI=0.43-0.91) and girls ($\kappa = 0.58$; 95% CI=0.43-0.73).

Conclusion: This validation study concluded that self-reported height and weight were in agreement with direct-measured methods. This technique can be utilized to assess the anthropometric status of Malaysian late adolescents for population studies.

Keywords: Validity, Self-Reported, Direct-Measured, Weight, Height, BMI, Late Adolescents

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Received: 17-07-2021, Accepted: 24-11-2021, Published online: 25-11-2021.

doi: 10.20473/amnt.v5i3.2021. 377-386. Joinly Published by IAGIKMI & Universitas Airlangga

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INTRODUCTION

A rapidly growing global epidemic of overweight and obesity is occupying many parts of the world. According to the current facts from World Health Organization (WHO), obesity has almost tripled globally since 1975. Malaysia has been leading within Asian countries with overweight/obesity problems with nearly half of the population (aged ≥ 18) are overweight or obese ¹. Based on the "Tackling obesity in ASEAN" report produced by Economist Intelligence Unit (EIU) revealed that Malaysia achieved the highest obesity (13.3%) and overweight (38.5%) across all six countries studied ². The most recent National Health and Morbidity Survey (NHMS) in 2019 reported overweight and obese prevalence of 30.4% and 19.7% respectively among Malaysian adults³. Childhood and adolescent obesity are another big issue because it contributes to the escalating prevalence of non-communicable diseases among youngsters and in turn become another burden to the country ^{1,4}. In Malaysia, the obesity prevalence among children (aged < 18) is escalating ^{1,4,5}.

Overweight children and adolescents are at many folds at risk of becoming overweight adults as negative impacts of childhood obesity continue through adulthood⁶⁻⁸. Consequently, adolescents become at risk of developing numerous medical conditions later in life⁹. Health conditions may lead to chronic diseases that result in death and a loss of working population that impacts the nation's economy. In addition, obesity also affects children's cognitive & mental health by developing stress, sadness and low self-esteem. Obese children often face stigmatization and social discrimination that cause them to lack participation in social activities. Their habit of keeping away from the community and less social interaction results in fewer friends and more time spent in sedentary activities⁹. These alarming adolescent obesity issues require a need for a quick and valid method to evaluate the trend of overweight and obesity among them.

Generally, directly measured height and weight are the first preference in calculating BMI ¹, however self-reported height and weight are most commonly applied in surveillance systems and wide-ranging studies ¹⁰ but due to the restriction of time, manpower ¹¹ and cost, an alternative way is worth to be considered. Nevertheless, inaccuracy of this self-reported weight and height especially among overweight or obese adolescents ¹² potentially may impact on misclassification of BMI ¹³, leads to difficulty in implementing and evaluating health programs ¹⁴.

Self-reported methods are utilized when there are limitations in terms of budget or manpower constraints to obtain measured anthropometric values. Thus, the credibility of such self-reported measures is critical to ensure the quality of data that circumvent biases due to misclassification. Apart from that, high

correlations have been observed between the self-reported and direct-measured height and weight in many validities research but most were in western countries ^{10,15-17}. Limited information exists regarding the rationality of these measures in the Asian context and especially even rare among the adolescent population. Only one self-reported weight and height validation study was conducted among 663 adolescents aged 13-17 years old in Kelantan, Malaysia ¹⁸ but no study has been done on late adolescents (aged 19-20) who completed secondary schools. Therefore, validation studies of self-reported height, weight and BMI status are to be used as an alternative method in assessing the weight of the adolescents in the community.

METHODS

A cross-sectional study in which the data of self-reported and direct-measured height, weight and BMI and social demographic characteristics were collected from 114 adolescents aged 19-20 years old in 2019. School-going students who participated in the Malaysian Health and Adolescents Longitudinal Research (MyHeARTs) study from 2012-2016 were contacted. The MyHeARTs study included schools from three states in Peninsular Malaysia including Kuala Lumpur and Selangor and Northern Perak¹⁹. A telephone interview was conducted to obtain sociodemographic characteristics, self-reported weight and height. Subsequently, appointments were made to measure their height and weight. Data collection was conducted between January and March 2019 and participants who completed both phases of self-reported and direct measures were included in the study. Individuals' self-reported values of weight and height were recorded to the nearest kilogram (kg) and nearest centimeter ¹⁰ respectively. Subsequently, the self-reported BMI was calculated and recorded in kilogram per meter square (kg/m²). Other than that, several socio-demographic characteristics such as marital status, socioeconomic status, place of residence as well as past medical history were assessed. During the second phase, trained enumerators took anthropometric measures according to the standard protocols.

Student height was measured with a SECA 217 portable calibrated stadiometer (Seca Portable 217, Seca, UK) and student weight was assessed using calibrated SECA 813 high-capacity digital flat scale (Seca 813, Seca, UK). Individuals' BMI cut-off points of 25 kg/m² defines overweight and 30 kg/m² defines obesity²⁰. These cut-off points are meaningful for comparisons between or within populations.

The data management and analysis were conducted with IBM SPSS statistical software package version 25.0 (SPSS Inc., Chicago, IL, USA) for Windows. Statistical significance for all the data analyses performed in the study was set at $p < 0.05$. A paired t-test was applied



for normally distributed data to determine the mean differences between the self-reported and direct measured height for all late adolescents and then stratified by sex. In contrast, the Wilcoxon Signed-Rank test (non-parametric) was used considering the non-normally distributed data of some variables (weight and BMI values). Independent T-test was applied to compare the differences of variables (height) bias according to gender as height was distributed normally. In opposition, the Mann-Whitney U test was used for weight and BMI as they were not normally distributed. Bland Altman plot (limits of agreement)²¹ was used to display and measure the agreement between self-reported and direct measured weight, height and BMI and to analyze the differences between the measurements by the two methods on each subject²². The agreement is represented by the mean/median difference between self-reported and direct-measured data. The intraclass correlation coefficient (ICC) acts as a reliability index that measures the correlation and agreement between measurements. In this study, ICCs were calculated to measure the association between self-reported and direct measured methods. Reliability ranges between 0.5-0.75, 0.75-0.9 and greater than 0.9 indicating moderate,

good and excellent reliability, respectively. Cohen's Kappa statistics was applied to assess the correct categorization of body mass index (BMI) status calculated from reported and measured values. The range for kappa values is from -1.00 to 1.00 indicating perfect disagreement to agreement.

Ethical approval was obtained by the MyHeART study team from Medical Ethics Committee, University Malaya Medical Centre (MEC Ref. No: 896.34) and from Medical Research & Ethics Committee; Ministry of Health (MOH) Malaysia (Reference number: NMRR-14-376-20486). Informed consent was collected from the study participants before data collection.

RESULTS AND DISCUSSION

The selected socio-demographic characteristics of 114 healthy late adolescents without chronic diseases were displayed in Table 1. More than half of the participants were female (68.4%) and males were 31%. The study subjects comprised of the three main ethnic groups in Malaysia which were Malay (61.4%), Chinese (33.3%) and Indian (5.3%). Most of the study participants (76.3%) were full-time students who furthered their studies in colleges, polytechnic schools and universities.

Table 1: Sociodemographic characteristics of study participants

Socio-demographic characteristics		n (%)
Age	19	102 (89.5)
	20	12 (10.5)
Sex	Male	36 (31.6)
	Female	78 (68.4)
Ethnicity	Malays	70 (61.4)
	Chinese	38 (33.3)
	Indian	6 (5.3)
Marital Status	Single	114 (100)
Socioeconomic Status	Full time study	87 (76.3)
	Full-time work	19 (16.7)
	Part-time work	5 (4.4)
	Work and Study	2 (1.8)
	At home	1 (0.9)
Place of Residence	Urban	111 (97.4)
	Rural	3 (2.6)

Figure 1 shows the Bland-Altman plot of the differences of self-reported and direct-measured weight, height and BMI versus mean weight, height and BMI, respectively from both methods. Bland-Altman plot was constructed to study agreement between self-reported and measured anthropometrics. Y-axis displays the difference between the self-reported and direct-measured data and the X-axis was the mean of total self-reported and direct-measured values divided by two. In this study the median weight difference (bias) was -0.5 kg, this indicates that the self-reported method measures 0.5 kg lesser than the direct-measured and this value formed the middle line of the 95% limits of the agreement below

zero. Out of 114, 110 (96.5 %) of the differences were within the area of limits of agreement, while there were only four data (3.5%) that were equally distributed below the lower and above the upper limit. Overall, there was good agreement between self-reported and direct measured weight with a minimal 0.5 kg differences below zero only.



Bland-Altman Plot

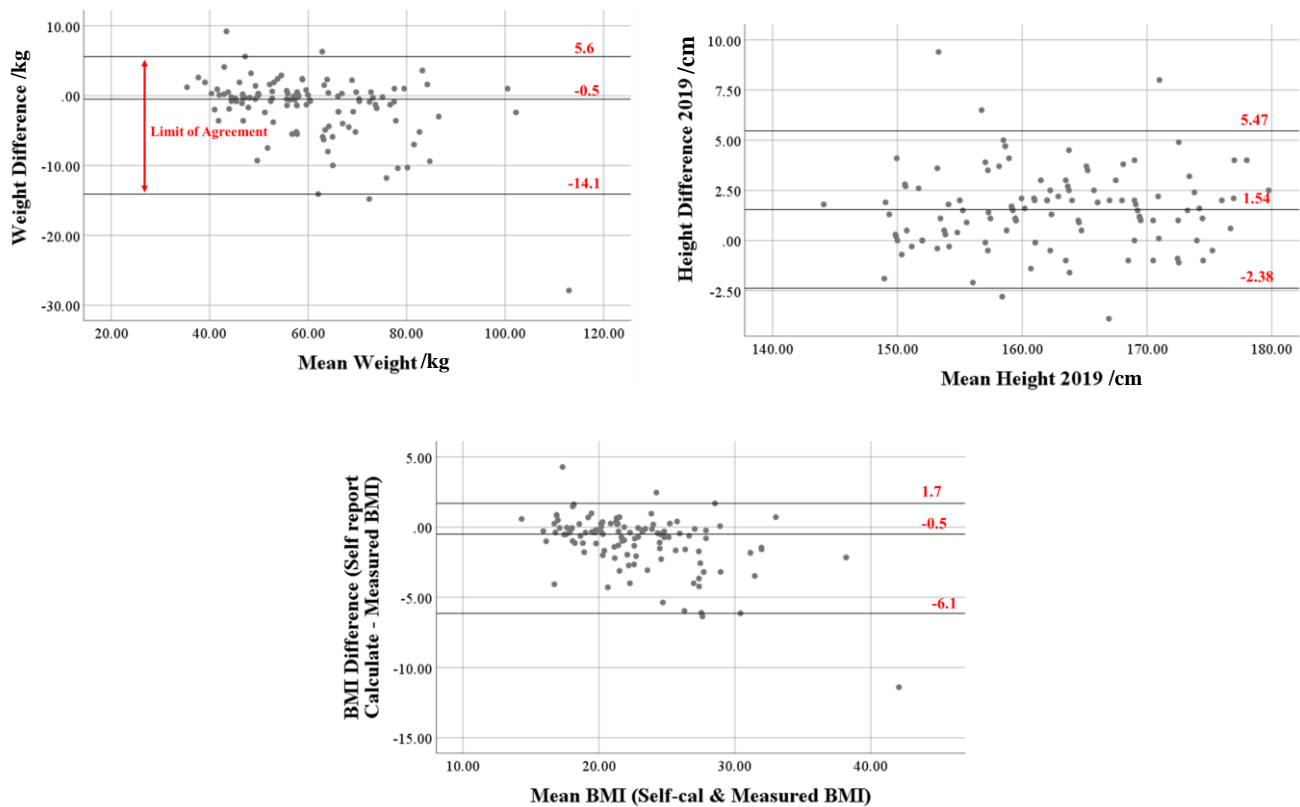


Figure 1 Bland-Altman plot of overall weight, height and BMI differences versus mean weight, height and BMI of self-reported and direct-measured method

*Difference= Reported – Measured
*Mean = (reported + measured)/2

The mean height difference was 1.54 cm that indicates on average the self-reported method measures 1.54 cm more than the direct-measured and this value formed the middle line of the 95% LOA above zero. Out of 114, 109 of the differences were within the area of limits of agreement, while there were only five participants (4.4%) were found to be out of the LOA. Approximately 96% of the height differences were within the area of LOA between 5.47 and -2.38 cm with a mean bias of 1.54 cm.

The median difference of BMI was -0.5 kg/m², this indicates that the self-reported method measures 0.5 kg/m² less than the direct-measured and this value formed the middle line of the 95% limits of the agreement below zero which were -6.1 and 1.7 kg/m². Out of 114, 110 of the differences were within the area of limits of agreement, while there were only four readings (3.5%) were equally found located out of the LOA area. Around 96.5% of the adolescents' BMI difference values fell between 1.7 kg/m² and -6.1 kg/m². In summary, the width of LOA for BMI (7.8 kg/m²) among all participants was greater than one IQR of the measured weight values (IQR=6.0 kg/m²). However, the width of LOA was less than two IQR, therefore showing good agreement between

self-reported and direct-measured BMI values with a minimal difference of 0.5 kg/m².

Table 2 shows the descriptive of self-reported and direct-measured weight (median, inter-quartile range), height (mean, standard deviation) and BMI (median, inter-quartile range) by sex. The magnitude of differences between both methods was also compared. Late adolescents significantly under-reported their weights with a minimal median difference of 0.5 kg (IQR =3.7, range=-27.9 to 9.2, d=0.23, p<0.05) and significantly over-reported their heights by 1.5 cm (SD = 2.0, 95% CI =1.2-1.9, d=0.19, p<0.05) but both the effect size for the difference was small. The self-reported BMI values were quantified from self-reported weight and height whereas the direct measured BMI values were calculated from direct measured weight and height. Overall, the median of the self-reported BMI (21.6 kg/m², IQR=5.3, range=14.6-37.1) was significantly lower than direct-measured BMI (22.9 kg/m², IQR=6.0, range=14.0-47.8) with a median difference of -0.5 kg/m² (IQR=1.8, range=-11.4- 4.3, p<0.05), but the effect size of difference was small (d=0.38).



For males, the median differences between self-reported and direct-measured values were 0.7 kg (IQR = 5.2, range=-10.4-3.6, $d=0.19$, $p<0.05$) for weight with small magnitude of difference, and 1.8 cm (SD=2.2, 95% CI= 1.1-2.5, $d=0.36$, $p<0.05$) for height. For females, the corresponding values were -0.4 kg (IQR = 3.0, range=-27.9-9.2, $d=0.21$, $p<0.05$) for weight with small magnitude of difference and 1.4 cm (SD = 1.9, 95% CI=1.0-1.9, $d=0.23$, $p<0.05$) for height. In male, the median self-reported BMI was 22.0 kg/m² (SD=3.4, 95% CI=20.8-23.1) while the direct-measured BMI was 23.2 kg/m² (SD=3.6, 95% CI=22.0-24.4), this means there was a significant underestimate of BMI values with a median difference of -0.5 kg/m² (IQR=2.0, range=-6.1 to 1.7, $p<0.05$). Then in

females, self-reported BMI was 21.6 kg/m² (IQR=5.7, range=14.6-37.1) which was significantly lower than the direct-measured BMI, 22.3 kg/m² (IQR=7.3, range=14.0-47.8). Wilcoxon's Sign ranked test shows all the differences for both sexes between two methods were significant and self-reported was lower than direct measured BMI, but the magnitude of differences was small ranged between 0.34 to 0.38 and the difference values were also small (-0.5 kg/m²) which were near to zero. Besides that, by gender, Mann Whitney U test analysis presented no significant differences discovered between boys and girls proven that there were no gender differences in the underestimation of BMI values.

Table 2: Descriptives of weight, height and BMI based on self-reported and direct measurement

	All/n=114	Male/n=36	Female/n=78
Weight (kg)	Median (IQR)	Median (IQR)	Median (IQR)
Self-reported	57.5(17.7)	64.9 (11.1)	55.0(18.3)
Range	36-101	45-85	36-101
Direct measured	58.4(21.1)	67.0 (11.2)	56.2 (20.5)
Range	34.8-126.9	49.5-89.4	34.8-126.9
**Difference	-0.5 (3.7)*	-0.7 (5.2)*	-0.4(3.0)*
Range	-27.9-9.2	-10.4-3.6	-27.9-9.2
Cohen's d	0.23	0.19	0.21
	Mann Whitney U test [#]		
Difference		-0.3	
p		0.6	
Height	Mean	Mean	Mean
Self-reported	163.0 (8.3)	171.7 (4.9)	158.9 (6.2)
95% CI [§]	161.4-164.5	170.1-173.4	157.5-160.3
Direct measured	161.4 (8.2)	169.9 (5.1)	157.5 (6.2)
95% CI [§]	159.9-163.0	168.2-171.6	156.1-158.9
	Paired T test		
Mean difference*	1.5 (2.0)*	1.8 (2.2)*	1.4 (1.9)*
95% CI [§]	1.2-1.9	1.1-2.5	1.0-1.9
Cohen's d	0.19	0.36	0.23
	Independent T Test [#]		
Mean difference		0.4	
p		0.3	
BMI values	Median (IQR)	Median (IQR)	Median (IQR)
Self-reported	21.6 (5.3)	22.0 (3.4)	21.6(5.7)
Range	14.6-37.1	20.8-23.1	14.6-37.1
Direct measured	22.9(6.0)	23.2 (3.6)	22.3(7.3)
Range	14-47.8	16.1-30.6	14-47.8
**Difference	-0.5(1.8)*	-0.5 (2.0)*	-0.5(1.7)*
Range	-11.4-4.3	-6.1-1.7	-11.4-4.3
Cohen's d	0.38	0.34	0.35



Mann Whitney U Test [#]	
Difference [#]	0
p	0.6

*Significant at $p < 0.05$

§ 95% CI= 95% Confidence Interval

**Difference=Self-reported data – directly measured data (Wilcoxon signed-rank test and Paired Sample t-test compare the differences)

#Mann Whitney U test and Independent T-test compare between sexes

Intraclass Correlation Coefficient

Table 3 shows results of intraclass correlation coefficient (ICC) between self-reported and direct measured weight, height and BMI of all participants, by males and females. The overall ICC analysis shows excellent reliability (0.94, CI=0.91-0.96) between self-reported and direct measured weight. Both males and females also show excellent reliability, which was 0.92 (CI=0.82-0.98) and 0.94 (CI=0.85-0.98) respectively. The ICC values demonstrate excellent reliability (0.95, CI=0.83-0.98) between self-reported and direct measured

height. Males (0.85, CI=0.47-0.94) had a lower ICC value which falls under the good reliability category as compared to females (0.93, CI=0.79-0.98) were categorized under excellent reliability. The ICC values for BMI proved good reliability (0.89, CI=0.78-0.94) between the two measurements methods. Males had an ICC value of 0.83 (CI=0.54-0.93) for BMI which falls under the good reliability category as well as females 0.90 (CI=0.81-0.94) were also categorized under good reliability.

Table 3: Results of ICC between Self-Reported and Direct Measured Weight, Height and BMI

	Weight (kg)	Height	BMI (kg/m ²)
	ICC (95% CI)		
All (n=114)	0.94 (0.91-0.96)	0.95 (0.83-0.98)	0.89 (0.78-0.94)
Male (n=36)	0.92 (0.82-0.98)	0.85 (0.47-0.94)	0.83 (0.54-0.93)
Female(n=78)	0.94 (0.85-0.98)	0.93 (0.76-0.98)	0.9 (0.81-0.94)

Percentage of Agreement (Kappa)

Table 4 shows the number of late adolescents categorized by BMI status based on self-reported and direct measurements of all participants and between boys and girls. Based on the direct-measured BMI status calculated from direct-measured weight and height, approximately half of the adolescents were under normal weight (n=60), almost one-third of the total participants were overweight and obese (n=36) while the remaining participants were underweight (n=18) category. Among all 114 respondents, most adolescents were of normal weight, 53 out of 60 (88%) and classified correctly, then the second-highest was underweight adolescents, approximately 78% of them classified correctly. Furthermore, 56% of overweight and 54.5% of obese adolescents were classified correctly. From direct-measured BMI status, higher proportions of female adolescents were under the overweight and obese category as compared to males.

Cohen's Kappa statistics shows a significant and substantial agreement between the BMI categorization quantified from self-reported and directly measured

values ($\kappa = 0.61$; 95% CI=0.48-0.74; $p < 0.05$). A higher agreement among boys were found compared to girls. A significant substantial agreement found between male BMI status categorized based on self-reported and the direct measurements ($\kappa = 0.67$, 95% CI=0.43-0.91; $p < 0.05$) and only moderate agreement for female BMI status categorized based on self-reported and the direct measurements ($\kappa = 0.58$, 95% CI=0.43-0.73; $p < 0.05$). However, observed from the 95% confidence interval between males and females, there will be a chance that the Cohen's kappa statistic value will be the same, therefore this gives evidence that there was no difference when comparing the agreement for BMI status between males and female. In summary, overall as well as for both males and females, a substantial agreement between self-reported and measured BMI status was discovered.



Table 4: Number of late adolescents categorized by BMI status based on self-reported and direct measured weight and height

		Direct Measured (n)					Total	Cohen's Kappa (95% CI)
		Underweight	Normal	Overweight	Obesity			
Self-reported (n)	All	Underweight	14	5	0	0	19	0.61* (0.48, 0.74)
		Normal	4	53	11	2	70	
		Overweight	0	2	14	3	19	
		Obesity	0	0	0	6	6	
		Total	18	60	25	11	114	
	Males	Underweight	3	2	0	0	5	0.67* (0.43, 0.91)
		Normal	0	21	3	1	25	
		Overweight	0	0	6	0	6	
		Obesity	0	0	0	0	0	
		Total	3	23	9	1	36	
	Females	Underweight	11	3	0	0	14	0.58* (0.43, 0.73)
		Normal	4	32	8	1	45	
		Overweight	0	2	8	3	13	
Obesity		0	0	0	6	6		
Total		15	37	16	10	78		

*Significant at $p < 0.05$

This study investigated the validity of self-reported weights and heights to analyze the accuracy of self-reported BMI to identify overweight and obesity in a sample of Malaysian late adolescents. The mean difference between self-reported and direct measured weight values was significantly under-reported and between self-reported and direct-measured height values was significantly over-reported as expected. Findings stated that although most adolescents and adults will under-report weight^{17,23,24}, the differences between self-reported and direct measured values are greater among females^{10,12,25-34}. This general finding was in contrast with the current study results as the presented study discovered boys had a larger weight difference (-0.7 kg) while the weight difference for girls was -0.4 kg. The main reason for the disparities might be due to the differences in norms, culture and ethnicity which may affect the perception and satisfaction of an adolescent. The study results echo the findings from Asian studies^{18,35}. In terms of height, there were mixed findings that involved over-reporting of height^{31,36-38} and under-reporting of height^{18,26,39,40} thus producing partial consistency with the present findings.

The ICC values^{16,26,27,38} and Bland-Altman plots^{12,26,38,41} showed good correlation and fair agreement for weight and height measurements between self-reported and direct-measured methods and this concurred with findings from many other countries. Similar results were also found in a separate analysis by

sex for ICC and Bland Altman plot where both boys and girls had a good correlation and fair agreement between both weight and height measurement methods. As such, many studies concluded that self-reported weight and height are appropriate to be used in large-scale surveys and epidemiology studies at the population level^{18,36,38} to calculate BMI and determine weight status.

The median difference of self-reported BMI values was significantly under-reported^{10,18,26,29,31,36,38,40}. In particular, a study in Thailand found parallel findings with lower self-reported BMI³⁵. This was perhaps due to similarities in culture, education standards and knowledge in health. However, in this study, the BMI values between males and females showed no gender differences. In addition, the ICC and B&A plots showed good correlation and fair agreement in all adolescents as well as separately by gender. When self-reported and direct-measured methods of BMI values calculated were classified into BMI status (underweight, normal weight, overweight and obese), substantial agreement was found between both measurement methods. Therefore, self-reported weight, height and corresponding BMI values are valid proxy measurements^{10,40}. Nevertheless, self-reported BMI should be utilized cautiously and better to be used in the form of a continuous variable rather than to be categorized into BMI status due to the possibility of BMI misclassification.

In summary, self-reported weight and height can be used as an alternative method in large-scale surveys and epidemiological to quantify self-reported



BMI. A beneficial situation to consider is especially during the current pandemic of Covid-19 where it is much easier to obtain self-reported measurements via a telephone interview rather than meeting face to face.

Strengths and Limitations

This study is one of the first to validate self-reported weight, height and resultant BMI amongst late adolescents entering early adulthood in Peninsular Malaysia. Apart from that, self-reporting as an alternative method can be used in the future in large epidemiological surveys and surveillance studies to calculate the resultant BMI values and monitor the trend of nutritional status or to assess the effectiveness of a health-related program. This method will save time, manpower and cost. This is considered a cost-effective method with minimum resources to yield maximum benefits. In addition, these results were beneficial in planning and developing new programs, activities, studies or surveys focused on health and anthropometric data that will increase compliance and participation of the population in the program or large-scale surveys.

The study had several limitations. Some parents were not willing to participate and did not allow researchers to reach/contact their kids. The far distance (a few hundred kilometers) of some schools made it challenging to approach the participants. Apart from that, not all participants were comfortable allowing unknown enumerators into their living or working place for anthropometric measurements. Some participants also furthered their studies or worked in another region that made a hindrance in data collection.

CONCLUSION

In general, the adolescents were able to report their height and weight precisely. Hence, this study provides evidence that self-reported data could be considered for use in large epidemiology surveys or studies as well as surveillance systems. The late adolescent's height that was measured before them leaving schools at the age 17-18 years may remain the same throughout adulthood. The current study has shown self-reported weight and height are suggested to be used at population level among Malaysian late adolescents and also during adulthood. This is important to assist with future large studies in monitoring population weight and height.

ACKNOWLEDGEMENT

Hazreen Abdul Majid conceptualized the study and secured the funding. Kong Pun Pun conceptualized the study and went for data collection, called the participants and analyzed the data. The manuscript was written by Kong Pun Pun and Nithiah Thangiah.

CONFLICT OF INTEREST AND FUNDING DISCLOSURE

This research was funded by IF017-2017. The authors declared no conflict of interest.

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