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Validation of Anthropometry Against Lipid Profile in Women of Reproductive age 15–35 years

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Abstract

Background: The increasing prevalence of dyslipidemia in early adulthood, especially in women. Dyslipidemia increases the risk of atherosclerosis, stroke and heart disease. Anthropometric measurements such as Body Mass Index, Waist Circumference and Upper Arm Circumference are often used as early screening for dyslipidemia. **Objective:** This study aimed to assessent anthropometric measurements have the highest validity for the lipid profile of women of childbearing age in the working area of the Hila Health Center, Central Maluku. **Methods:** This study is a descriptive observational study with a cross-sectional design using a purposive sampling technique. The study was conducted from April to July 2023 on 81 respondents with inclusion criteria of 15-35 years, fasting for 8-12 hours, not suffering from diabetes, heart disease and stroke, no history of alcohol and smoking. Anthropometric measurements of body weight with a digital scale, height with a microtoise, Waist Circumference and Upper Arm Circumference with a metline and all measurements were carried out 2 times. **Result:** anthropometric validation with lipid profiles showed a sensitivity of 33% and a specificity of 96%. **Conclusion:** There were no anthropometric measurements that could be used to predict lipid profile abnormalities but upper arm circumference could be used to assess normal lipids.

Keywords: Anthropometry; Lipids; Validity.

Introduction

Dyslipidemia is a major risk factor for the incidence of atherosclerosis and cardiovascular disease (CVD) risk[1,2]. Dyslipidemia, characterized by a decrease and increase in one or a combination of lipid fractions such as increased total cholesterol, Low Density Lipoprotein-Cholesterol (LDL-C), and triglycerides or decreased High Density Lipoprotein-Cholesterol (HDL-C)[3]. Circulating lipid profile components, especially LDL-C, can be stored in the tunica intima of the artery wall and are involved in the atherogenic process[4]. Increased blood lipid profile levels worsen the occurrence of atherosclerosis, which is recognized as a major risk factor for stroke, peripheral vessels, and heart disease[5].

The increasing prevalence of dyslipidemia is detected among adolescents and young adults[6]. A study report states that half of young adults with high cholesterol levels are five times more at risk of developing CVD and nine times more at risk of myocardial infarction after 30 to 40 years compared to those with low cholesterol levels[7]. Several studies report that the incidence of dyslipidemia is higher in women than in men[8,9]. Hyperlipidemia in women is likely caused by the effects of estrogen on body fat distribution, which results in differences in lipoproteins[10]. Women of

Reproductive Age (WRA) have one of the habits of women of childbearing age, which is an irregular eating pattern that can affect body weight[11]. The age range for WRA is between 19 to 45 years with peak fertility at 20-29 years[12,13].

Several studies mention that dyslipidemia is positively related to age, Body Mass Index (BMI), Waist Circumference (WC), fasting blood glucose, and blood pressure[14,15]. Some traditional anthropometric measurements for assessing obesity such as BMI, WC, and waist-to-hip ratio (WHR) and the Lipid Accumulation Product (LAP) index[11,16]. High BMI and WC can be considered as first-stage screening tools to detect individuals with dyslipidemia[17]. Nutritional status assessment with BMI uses two indicators, namely body weight and height, so it is considered the best because it can describe over- and under-nutritional status and is performed with standardized procedures[18].

Several studies report a relationship between anthropometric parameters and lipid profiles. A study conducted on adult women aged 26-45 years found a significant relationship between BMI and WC with diastolic blood pressure but no relationship between BMI, WC with systolic blood pressure and lipid profiles[12]. Different results in obese WRA aged 19-45 years showed a correlation between BMI and the TG/HDL-C ratio in obese WRA[19]. Another study mentioned that there were differences in lipid profiles and anthropometry in women of reproductive age with and without metabolic syndrome[20]. Research on other adult women aged 26-45 years found no relationship between BMI and total cholesterol levels[21].

Based on this background, it prompted the researchers to determine the validation of anthropometry against the lipid profile in women of reproductive age. The purpose of this study was to determine the anthropometric measurement that has the highest validity against the lipid profile of women of reproductive age in Ambon, Maluku.

Materials and Methods

Study Design

This research is a descriptive observational study with a cross-sectional design aimed at evaluating the sensitivity and specificity of various anthropometric parameters against the lipid profile. This study used a purposive sampling technique and was conducted from April to July 2023.

Sample

The number of samples in this study was 81 respondents taken from the working area of the Hila Care Health Center, Central Maluku. Inclusion criteria in this study were women of reproductive age (15-35 years), fasting for 8-12 hours before blood sample collection, having no history of diabetes, heart disease, or stroke, and having no habits of consuming alcohol and smoking. Exclusion criteria were respondents who were unwilling to participate in the study, women who were pregnant or breastfeeding, and samples that showed icteric or lipemic conditions.

Data Collection Technique

Data were collected through anthropometric measurements and blood lipid profile examinations. Anthropometric parameters measured included body weight (kg), height (cm), waist circumference (WC in cm), body mass index (BMI in kg/m^2), and upper arm circumference (UAC in cm). Body weight was measured using a digital scale, height using a microtoise, while WC and UAC were measured with a metline measuring tape. Each measurement was taken twice to improve accuracy.

Examination of lipid profile levels including total cholesterol, HDL-C, LDL-C,

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and triglycerides was performed using the enzymatic method with venous blood samples. BMI categorization criteria were underweight (<18.5 kg/m²), normal (18.5-22.9 kg/m²), overweight (23-24.9 kg/m²), and obese (≥25 kg/m²). Waist circumference was categorized as normal if <80 cm and high if ≥80 cm. Normal lipid profile categories were HDL >40 mg/dL, LDL <100 mg/dL, triglycerides <150 mg/dL, and total cholesterol <200 mg/dL.

Data Analysis Technique

Data were analyzed by calculating the sensitivity (Se) and specificity (Sp) of anthropometric parameters (BMI, WC, and UAC) against the lipid profile, which was considered the gold standard. The analysis was performed by creating a cross-table between anthropometric measurement results and lipid profiles, then calculating sensitivity and specificity values using the formula:

$$Sensitivity = a/(a+c) \times 100\%$$

$$Spesifisity = d/(b+d) \times 100\%$$

Table 1. Sensitivity and Specificity Analysis

Gold Standard	Lipid Profile(+)	Lipid Profile(-)	Total
Anthropometry(+)	a	b	a+b
Anthropometry (-)	c	d	c+d
Total	a+c	b+d	Total

Table notes:

a: Lipid profile (+) and anthropometry (+) → True Positive

b: Lipid profile (-) and anthropometry (+) → False Positive

c: Lipid profile (+) and anthropometry (-) → False Negative

d: Lipid profile (-) and anthropometry (-) → True Negative

The sensitivity assessment criteria were very good if Se >90%, good if Se >70%, quite good if Se >60%, and poor if Se <60%. The specificity assessment criteria were very good if Sp >90%, good if Sp <90%, quite good if Sp <70%, and poor if Sp <60%.

Ethical Consideration

This study has received ethical approval from the Ethics Committee of the Faculty of Medicine, Universitas Pattimura with number 055/FK-KOM.ETIK/VIII/2023. All participants were given clear information regarding the purpose, benefits, and procedures of the research as well as their right to withdraw at any time without any consequences. Participation in this study was voluntary with written consent from each respondent. The identity and personal data of respondents were kept confidential and used only for research purposes.

Results

The results of this study involved 81 respondents consisting of WRA aged 15-35 years. The general description of the respondents is shown in Table 2.

Table 2. General Characteristics of Respondents

Variable	Mean	SD	Min	Max
Age (years)	22.19	5.8	15	35
Anthropometry				
WC (cm)	72.07	10.1	32	95
UAC (%)	86.54	14.5	52	126
BMI (kg/m²)	21.01	3.6	15.0	29.9
Lipids (mg/dL)				
Cholesterol	218.79	47.95	118	326
Triglycerides	98.9	31.0	46.0	195.0
HDL	47.7	9.5	33.0	87.0
LDL	129.73	32.49	81	

Source: Primary data analysis

Based on Table 2, the mean age of respondents was 22.19 years. Anthropometric measurement results showed an average WC of 72.07 cm, UAC of 86.54%, and BMI of 21.01 kg/m². These results show that the average of each anthropometric measurement is within normal limits. In the lipid profile examination, the average cholesterol and LDL were above normal, at 218.79 mg/dL and 129.73 mg/dL, respectively, while the average triglycerides and HDL were within normal limits with mean values of 98.9 mg/dL and 47.7 mg/dL, respectively.

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Based on Table 3, the majority of respondents were aged <25 years. Anthropometric measurements, both WC, UAC, and BMI, were found in the majority of respondents at 77.8%, 92.6%, and 70.4%, respectively. In lipid examinations, the frequency with high cholesterol and LDL levels was found to be higher, at 63% and 82.7%, respectively. Meanwhile, in triglyceride and HDL examinations, more respondents were in the normal category, at 92.6% and 79%, respectively. Anthropometric and lipid examinations were analyzed for sensitivity and specificity

Table 3. Distribution and Frequency of Respondents

Characteristic	n	%
Age (Years)		
<25	56	61.9
≥25	25	30.9
WC		
Normal	63	77.8
Obesity	18	22.2
UAC		
Underweight & Normal	75	92.6
Overweight & Obese	6	7.4
BMI		
Underweight & Normal	57	70.4
Overweight & Obese	24	29.6
Total Cholesterol		
Normal	30	37
High	51	63
Triglycerides		
Normal	75	92.6
High	6	7.4
LDL		
Normal	14	17.3
High	67	82.7
HDL		
Low	17	21
High	64	79

Source: Primary data analysis

Based on the formula, the sensitivity of anthropometry to the lipid profile was very low, at 33%. This indicates that anthropometric measurements cannot be used as a predictor of lipid disorders. Meanwhile, the specificity value was 96%.

Table 4. Sensitivity and Specificity Analysis

Gold Standard	Lipid Profile(+)	Lipid Profile(-)	n	Se	Sp
Anthropometry (+)	18	1	19	3%	96 %
Anthropometry (-)	36	26	62		
Total	54	27	81		

Note: Se= Sensitivity; Sp = Specificity

Based on Table 5, the sensitivity for anthropometry to the lipid profile was all poor, with the highest sensitivity for LDL at 28.36%. Meanwhile, for specificity, BMI with the lipid profile had specificity below 64-68%, WC at 77-87%, and UAC had specificity for all lipid profiles above 90%. These results indicate that among anthropometric measures, UAC has better specificity for the lipid profile compared to BMI and WC.

Discussion

This study involved 81 respondents with a mean age of 22.19 years. According to a report by Wibawa[22] this age is a transition period from late adolescence to early adulthood. During this transition period, there are changes in food consumption patterns, such as a doubling increase in the consumption of low-quality foods and a decrease in the consumption of high-quality foods by up to 10%. A study by Izhar[23] shows that poor food consumption patterns can risk an increase in BMI. Based on this research, the average results of anthropometric examinations, both WC, UAC, and BMI, were all within normal limits. Although in frequency there were a number of respondents who had anthropometric examination results in the overweight and obese categories. In the lipid profile examination, the average total cholesterol and LDL were higher than normal values. This is supported by the frequency of subjects with high cholesterol and LDL of 63% and 82.7%, respectively. A study by Maharani[24] states that

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increased cholesterol is not necessarily caused by obesity or an increase in nutritional status assessment. Increased cholesterol levels can be caused by various factors, especially cholesterol intake, fiber intake, and physical activity. Conversely, in obese subjects, it is not necessarily the case that they have high cholesterol levels. This is supported by the results of research by Parameshwari and Iwaningsih[25] which stated that BMI and lipid profile have a weak relationship.

Tabel 5. Sensitivitas dan spesifisitas parameter antropometri terhadap profil lipid

Gold Standard	TC		TG		LDL		HDL	
	Se (%)	Sp (%)	Se (%)	Sp (%)	Se (%)	Sp (%)	Se (%)	Sp (%)
BMI	27,45	67	0,00	68,00	28,36	64,28571	11,76471	65,625
WC	27,45	87	16,67	77,33	23,88	85,71429	23,52941	78,125
UAC	7,843	93	0,00	92,00	7,463	92,85714	11,76471	93,75

Source: Primary data analysis

Obesity, characterized by increased body fat mass, is one of the factors that causes an increase in cholesterol levels. This is because excess fat increases triglyceride levels and lowers HDL, which affects total cholesterol levels[26,27]. Various studies related to the relationship between BMI and lipids show a significant relationship. An increase of 1 unit in BMI increases the risk of increased cholesterol by 3.681[28–30]. Another study found a relationship between BMI, visceral fat, and WC with TG, HDL, and TG/HDL ratio levels[31].

In women, the relationship between hypercholesterolemia and nutritional status is much weaker in older age groups, especially among women. This is also influenced by hormonal factors, namely the estrogen hormone. In the reproductive age, estrogen hormone is higher compared to women entering the menopausal phase. A decrease in estrogen hormones causes atrophy of tissue which affects an increase in abdominal fat and an increase in cholesterol levels[32]. Another study related to lipid profiles was stated by Nasruddin[33] that triglyceride levels in women of reproductive age with a mean age of 28 years have estrogen hormone levels that are still high enough to control triglyceride levels in the blood.

In this study, all anthropometric measurements such as BMI, WC, and UAC had poor sensitivity. Meanwhile, for specificity, UAC had good specificity for the lipid profile. Therefore, BMI, WC, and UAC cannot be used to detect lipid profile abnormalities. However, UAC can be used to predict normal lipids due to its good specificity level for all lipid profiles. Sensitivity aims to correctly detect someone who is at risk for a disease from the entire sick population. Meanwhile, specificity aims to correctly classify someone as free from disease risk from the entire healthy population[34].

This study differs from research conducted by Octarina which showed that waist circumference had good sensitivity (Se>70%) for LDL, triglycerides, and total cholesterol, while for HDL it was quite good (Se>60%), but its specificity was poor (Sp<60%). Based on BMI, the sensitivity and specificity values were poor for all lipid profiles (Se<60%, Sp<60%). In that study, WHR had very good sensitivity values for all lipid profiles (Se>90%), although it had poor specificity values (Sp<60%) [1]. Another study by Yulisa et al[35] showed that BMI and WHR had good sensitivity but for specificity, BMI was better than WHR for the lipid profile. The best anthropometric indicator in assessing dyslipidemia risk was WHR

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compared to BMI, waist circumference, and waist-to-height ratio.

Conclusion

The results of the study showed that the validation of anthropometry with the lipid profile showed a sensitivity of 33% and a specificity of 96%. Based on the anthropometric and lipid categories, the highest sensitivity was obtained for LDL at 28.36%, while UAC had specificity for all lipid profiles above 90%. Therefore, no anthropometric measurement in this study could be used to predict lipid profile abnormalities, but UAC could be used to assess normal lipids.

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Conflict of Interest Statement

The author(s) declare no commercial, financial, or personal conflicts of interest related to this research. All authors approved the final manuscript and consented to its publication in *Healthy Tadulako Journal*.

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