

The Correlation of Neck Circumference with the Metabolic Age of Obesity

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Abstract

Fat accumulation in obesity stimulates an increase in the production of pro-inflammatory mediators in the body chronically, causing the cell's metabolic age to be older than the chronological age. This situation can cause a decrease in metabolic rate; therefore, the body is at risk of cardiometabolic disease. Neck circumference (NC) is known as an anthropometry which is closely related to obesity, visceral fat, and metabolic syndrome. The purpose of this study was to determine the correlation of NC with increasing cell's metabolic age so that it can serve as a simple anthropometry in predicting cell's metabolic age. The study was conducted with a cross-sectional design. The sample of the study was adult male and female with age 30-59 years and following the inclusion and exclusion criteria. The anthropometric examination was carried out in the form of body mass index, neck circumference, and cell's metabolic age using Bioelectrical Impedance Analyzer. Total samples obtained were 94 obese subjects with a mean BMI, NC and metabolic age was 26.9 kg/m², NC 34.1 cm, and 50 years. There was a significant positive correlation between NC and cell's metabolic age ($p = 0.001$; $r = 0.42$). In conclusion, NC is useful as simple and practical anthropometry used to predict the increase in metabolic age of cells.

Keywords: neck circumference; the age of metabolic cells; obesity

Introduction

Obesity is a serious health problem, and its prevalence continues to increase in many developing countries. World Health Organization (WHO) data shows that the problem of obesity is increasing in developing countries with more than 115 million people suffering. In Indonesia, secondary data analysis from the National Health Survey (Riskesdas) in 2018 depicted an increase in the prevalence of obesity in adults aged > 18 years to 21.8% in 2018, while in 2007 it was only 10.8%.¹ An increase in the prevalence of obesity was also seen in Central Kalimantan Province, which was 15.2% in 2007 to 18.67% in 2018.¹ Obesity is one of the leading causes of metabolic diseases such as insulin resistance which then develops into fatty liver diabetes mellitus, cancer, and cardiovascular disease.² Fat accumulation

in obesity will increase the basal metabolic rate (BMR) and the deposits of subcutaneous and visceral fat. This situation will stimulate an increase in the production of pro-inflammatory mediators in the body in a chronic manner, causing a cell's metabolic age to be older than chronological age.³ The more aging cellular metabolic age, compared to the actual age of the patient, indicates a decrease in metabolic rate in the body and implies a risk of experiencing several significant health problems namely cardiometabolic disease.⁴

The gold standard for examining fat accumulation in obesity is computed tomography scans, in addition to indirect methods that are often used, which are anthropometric measurements such as body mass index, waist-hip circumference ratio, skinfold thickness, and upper arm circumference. These anthropometric measurements have advantages and disadvantages of each in predicting fat accumulation in obesity. Neck circumference serves as a relatively new anthropometric measurement.⁵⁻⁷ Several studies mention that neck circumference is closely related to obesity, visceral fat and metabolic syndrome.⁷⁻¹⁰ Examination of metabolic

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age of body cells is measured based on the basal metabolic rate which requires sophisticated tools such as indirect calorimetry, dual-energy X-ray absorptiometry (DXA) and bioelectrical impedance analyzer.^{11,12}

Based on the previous researches, no research has elicited the relationship of neck circumference with an increasing metabolic age of cells in obesity with the aim of producing an alternative measurement of cell's metabolic age that is practical, simple and minimizes radiation exposure so that it can solidify the prediction of cell's metabolic age which is related to cardiometabolic disease by the primary health workers.

Materials and Method

This research was conducted at the University of Palangka Raya and the working area of the Pahandut Public Health Center in Palangka Raya City, starting from May - July 2019. The sample in this study was male and female adults aged 30-59 years and was following the inclusion criteria ie, not undergoing diet program and not consuming steroids. The exclusion criteria included neck tumors, kyphosis, incomplete extremities, edema, and Cushing's syndrome. The research used a purposive sampling method, and 94 samples were obtained.

The stages in this study were carried out by measuring anthropometrics, namely by using body mass index (BMI) measurements with the formula below. We used WHO Asia pacific adult's cutoff point, $BMI \geq 25$

kg/m² for obesity.¹³

$$BMI = \frac{\text{Body weight (kg)}}{\text{Body height (m)} \times \text{Body height (m)}}$$

The neck circumference measurements were then performed on the cricoid cartilage, mid-neck length, between mid-cervical bone and mid-anterior neck using a non-elastic plastic measuring tape with a scale of 1 mm. The circumference of a man's neck was drawn just below the protrusion of Adam's apple. Measurement of cell's metabolic age and BMR were carried out using Bioelectrical Impedance Analyzer (BIA) (Omron Karada Scan professional spec HBF 701, Kyoto Japan).

Analysis of the data used in this study was the Pearson correlation bivariate test using SPSS (Statistical Package for the Social Sciences) version 23 (IBM Corporation, Armonk, NY, USA). Data interpretation based on the value of r arithmetic (Pearson correlations) $> r$ table means that this analysis is positive and has a relationship between the two variables.

Findings and Discussion

In this study, 94 subjects with obesity criteria were dominated by the female (72.3%) compared to men (27.7%). In addition, an average body mass index of obese subjects was 29.6 kg / m² with an age range of 30-57 years. Characteristics of the research subjects can be seen in Table 1 below.

Table 1. Subject characteristics (N = 94)

Variables	Total (%)	Mean ± SD	Min-max
Age (year)		41,6 ± 9,95	30-57
30-40	39 (41,4)	31,8 ± 2,5	30-37
41-50	14 (14,8)	47 ± 2,9	42-50
51-59	41 (43,8)	53,8 ± 1,7	51-57
Sex			
Male	26 (27,7)		
Female	68 (72,3)		
Body mass index (kg/m ²)		29,6 ± 3,7	25-41,3
25 – 30	59 (62,8)	26,9 ± 1,2	25-29,1
>30	35 (37,2)	33,2 ± 3,1	30,1-41,3
Neck circumference (cm)	94	34,1 ± 2,6	27,5-39,8
Cell's metabolic age (year)	94	50 ± 13	18-80
BMR (kcal/day)	94	1427,9±241,2	1021-2013

As per Table 2. Data NC and cells's metabolic age was achieved by using Pearson correlation test showed a significant relationship and positive linear correlation on neck circumference variables with cell's metabolic age ($p = 0.001$).

Table 2. Correlation between neck circumference and cell's metabolic age

Variable	Neck circumference	
	r	p
Cell's metabolic age	0,42	0,001

The results of this study indicate that neck circumference has a positive linear correlation with the cell's metabolic age with moderate correlation strength ($r = 0.42$, $p = 0.001$). This correlation indicates that the larger the size of the neck circumference, the metabolic age of cells increases or older than the chronological age in the obese individual bodies. The mechanism that is thought to cause this is the start of a positive energy balance in obesity, which causes an abnormal and excessive accumulation of fat in the body. The fat accumulation is stored mainly in the upper body adipose tissue.^{14,15}

The limitations of subcutaneous fat capacity in storing excess fat in obese individuals are causing fat to be stored in visceral tissue and ectopic tissue including the neck in the posterior and subcutaneous compartments, thereby increasing the size of the neck circumference in obese people.¹⁶ Adipose tissue in obesity is known to produce and release pro-inflammatory mediators such as tumor necrosis factor- α (TNF- α), interleukin 6 and reduce adiponectin production which then causes pro-inflammatory conditions and oxidative stress.¹⁷ Extra nutrient stimulation in adipose tissue is responded by performing hyperplasia and hypertrophy of adipocyte cells. Adipocyte cells that continue to grow cause the blood supply to these cells to decrease and trigger hypoxia.¹⁷ This hypoxia is the cause of cell necrosis and infiltration of macrophages into adipose tissue, which then stimulates overproduction of pro-inflammatory mediators. This situation causes local inflammation in adipose tissue which then becomes a systemic inflammation in obesity.^{17,18} This ongoing inflammatory condition in obesity is referred to as chronic low-grade inflammation and can change metabolic function.^{19,20}

However, tissue function restoration does not occur in obese individuals, and it is different from healthy individuals that can occur due to inflammation of tissue restoration. This situation is associated with the elaboration of cytokines and inflammatory mediators that trigger metabolic organ tissue dysfunction.¹⁹

The increased of adipose tissue in obesity will increase the BMR compared to individuals of normal weight.²¹ Increased BMR will increase the metabolic age of cells, rather than chronological age, and it is reflecting the physical health of obese individuals which leads to cell metabolic dysfunction.⁴

Conclusion

A large increase in neck circumference can be a predictor of the cell's metabolic age in obesity, which in line with an increase of fat accumulation in adipose tissue with obesity.

Ethical Clearance: Approval for the study was taken from the Ethics Committee of Faculty of Medicine, Palangka Raya University. Informed consent was taken from adults aged 30-59 years.

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Conflict of Interest: There are no conflicts of interest.

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