The Correlation between Physical Activity with Body Mass Index in Obesity Patient with Knee Osteoarthritis

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Abstract: Obesity in Indonesia has significantly increased every year. Obesity occurs due to an imbalance of input and output of energy, causing the accumulation of body fat. Weight gain causes stress to knee joints and prone to osteoarthritis that will lead to pain during walking. Decreasing the level of physical activity (PAL) in obese patients with osteoarthritis will risk them to deconditioning syndrome which will aggravate obesity. The purpose of this study is to correlate the level of physical activity in obese patients with osteoarthritis of the knee who was treated at the obesity clinic at Cipto Mangunkusumo Hospital. A cross-sectional method with thirty-eight consecutive samples. Inclusion criteria are: early elderly patients, male and female, who were diagnosed with obesity with knee osteoarthritis, can walk independently without assistance, can communicate well. Anamnesis is conducted for one full day activity for three days a week, and the average energy expenditure is calculated. The basal metabolic rate is calculated by the Harris-Benedict equation and then the level of physical activity of the patient is determined. The results of this study are that there is a weak positive correlation between PAL and body mass index (BMI) in obese patients with knee osteoarthritis.

1 INTRODUCTION

Obesity is a disease caused by an imbalance of energy produced due to excessive energy intake and reduced-calorie use. However, the pathogenesis of obesity is very complex and not yet fully understood (Australian Government, 2013). Control of one's appetite and sensitivity is regulated by neural and neurohumoral mechanisms that are influenced by genetic, nutritional, environmental, and psychological. This mechanism is stimulated by a metabolic response that is centered on the hypothalamus. The neurohumoral mechanism is divided into three components: regulation of hormone secretion, the rate of energy expenditure, and control of hunger and satiety.

Obesity is caused by many factors, 40-70% of the most important factor is genetic in determining a person's weight. Besides lifestyle, environment, and socioeconomic status of a person can be a cause of obesity. In general, obesity appears at age > 30 years in men, whereas in women originating from childhood (Sugondo, 2006).

In people with obesity, more calories are consumed than is used and the appetite is not reduced to compensate for the increase in body energy stores. The amount of adipose tissue is tightly regulated through the transmission of humoral and neural signals to the brain. Failure of fat cells to transmit adequate signals or errors from the brain is responding to incoming signals that cause obesity (Berthoud, 2002). An effective system of regulation of energy balance, requiring sensors of energy storage in adipose tissue, a mechanism for delivering information to central control (hypothalamus) for further integration, which in turn will determine food intake and energy expenditure (Berthoud and Morrison, 2008).

The brain gets a signal about the amount of fat stored and secreted mainly by adipose, supplied by a peptide hormone called Leptin. Leptin mRNA is specifically expressed in fat cells. Leptin concentrations in circulation, proportional to fat reserves and BMI in normal subjects, and pulsatile secretions are inversely related to hydrocortisone levels. Glucocorticoids, estrogens and insulin and are reduced by β-adrenergic agonists, triggering

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leptin formation. Leptin reaches the brain and enters saturated transportation in the hypothalamus from fat storage (Diamond and Eichler, 2002). When hungry adipose tissue secretes leptin, CNS stimulation, cold exposure, and exercise. Obesity, glucocorticoids, glucose, and insulin can inhibit the secretion of leptin from adipose tissue. When leptin reaches the hypothalamus, NPY secretion is inhibited, which normally reduces energy expenditure, stimulates synthesis, stores fat, and increases appetite. Adiponectin sensitizes tissues for the effects of insulin. Obesity and insulin resistance negatively regulate adiponectin secretion from adipose tissue, where weight loss increases secretion (Diamond and Eichler, 2002).

Body mass index, formerly called the Quetelet index, is a measure to indicate nutritional status in adults. BMI measured by weight in kilograms (kg) divided by height in meters squared (kg / m2) (CDC USA, 2009). In Asians, the limit of overweight is ≥ 23.0 kg / m2 which is lower than WHO criteria. The suggested classification for Asians while still needs to be revised because of further validation and clinical symptoms. Some research that supports this limit comes from Chinese living in Hong Kong (ko et al 1999) where the risk of morbidity increases with a BMI> 23.0 kg / m2.

Osteoarthritis (OA) is a disease caused by mechanical and biological disorders that damage the stability of the normal series of degradation and synthesis of joint cartilage chondrocytes, extracellular matrix, and subchondral bone. This can occur due to various factors including genetic, developmental, metabolic and trauma factors. OA involves various tissues in the arthritic joints. OA manifestations include morphological, biochemical, molecular and biochemical changes in both cellular and bone matrix that cause softening, fibrillation, ulceration, loss of joint cartilage, sclerosis and subchondral bone eburnation, osteophytes and subchondral cysts. Clinically the symptoms that appear in patients with OA are joint pain and stiffness, limited mobility, crepitation, effusion, various signs of inflammation without accompanied by systemic effects (Sharma L, 2007).

Obesity is a risk factor for the development of osteoarthritis. The association of height weight with the incidence of OA is still said to be uncertain but may involve cartilage degeneration due to overload. Another mechanical factor is knee alignment. In patients with knee varus, BMI appears to be related to the severity of OA, especially medial tibiofemoral OA.

A very important factor in the pathomechanics of OA genu is the high and repeated burden on the knee joint during walking and activity. During walking, the load that passes through the knee joint is not transmitted equally between the medial and lateral compartments. The load on the medial compartment is about 2.5 times greater than the load on the lateral compartment. This is the reason for the high prevalence of OA genu media compartments (75% of all cases) rather than lateral compartments (Enohumah KO and Imarengiaye CO, 2008).

Also, there are changes in the synovial membrane and synovial fluid. Mild to moderate inflammatory reactions occur in the synovial membrane that contains cartilage articular fragments. Whereas in the synovial fluid there is a decrease in the concentration of molecular weight and abnormal production of hyaluronate. Impaired hyaluronate production and increased hyaluronate breakdown which causes a decrease in hyaluronate concentration. Changes in the synovial fluid also result from an increase in water content and an increase in pathological concentrations (Enohumah KO and Imarengiaye CO, 2008).

Physical activity is defined as body movements produced by skeletal muscles that require energy expenditure. The most commonly used way to be always active is by walking, cycling, recreation, and sports that can be done at any level of skill and pleasure ("WHO | Physical Activity," 2019). MET is a unit used to estimate the energy expended from each activity (Miles, 2007). Understanding the level of physical activity is the total energy needed (TEE) or used in 24 hours divided by the basal metabolic rate (BMR) for 24 hours.

The total energy needed in 24 hours can be calculated based on the activities carried out in one day and calculated the amount of energy needed for these activities, then added up. The amount of energy used can be seen based on the compendium of physical activity. The purpose of this study is to find whether there is a relationship between the level of physical activity and body mass index in obese patients with knee osteoarthritis. We hypothesize that a decrease in physical activity caused by an increase in BMI in patients with obesity and osteoarthritis of the knee who seek treatment at the obesity clinic.

2 METHODS

This study protocol was approved by the University of Indonesia Ethics Committee and written consent

was obtained from all the participants of the study. The design of this study was cross-sectional with consecutive sampling. The study was conducted on obese patients with knee OA at the Obesity Polyclinic of the Department of Medical Rehabilitation at the National Center General Hospital (Cipto Mangunkusumo Hospital/ University of Indonesia). The sample obtained was 37 women and 1 man based on the criteria for sample acceptance with a diagnosis of Overweight /obese (table 1) and OA of the knee, age > 50 years, never had knee surgery before, can walk independently without assistance, can communicate well, and are willing to fill out informed consent. The criteria for rejection in this study were patients with a history of knee surgery, using walking aids, having cardiorespiratory system disorders, having knee deformity > 15^0, experiencing cognitive impairment or mental health disorders, impaired balance, and were unwilling to participate in the study.

Table 1: Asia Pasific BMI Classification.

Classification	BMI (kg/m^2)	Risk of co-morbidities	
		Waist circumference	
Men Women		< 90 cm <80 cm	≥ 90 cm ≥ 80 cm
Underweight	< 18,5	Low	Average
Normal range	18,5 – 22,9	Average	Increased
Overweight	≥ 23		
At risk	23 – 24,9	Increased	Moderate
Obese I	25 – 29,9	Moderate	Severe
Obese II	≥ 30	Severe	Very severe

Samples that meet the inclusion criteria and do not meet the exclusion criteria are given background information on the research, objectives, and benefits of the study. They were asked to sign the informed consent provided if they agree to participate in this study. Then the researchers conducted anamnesis, height, and weight measurements, followed by interviews. Interview of physical activities carried out in one full day, starting from waking up, to going back to sleep. Retrieval of data at 3 days a week. 2 days between Monday to Friday, and 1 day between Saturday and Sunday.

Table 2: PAL Classification.

Category	PAL value
Sedentary or light activity lifestyle	1,40-1,69
Active or moderately active lifestyle	1,70-1,99
Vigorous or vigorously active lifestyle	2,00-2,40

All data in the 3 days were carried out with the Compendium physical activity, then totaled and divided by 3, then obtained the energy expended in one day. Furthermore, energy expenditure is calculated in one day by multiplication between the energy expended by weight. Each sample is calculated BMR with the Harris-Benedict formula. Then calculate the level of physical activity (table 2) with the division between energy expenditure (EE) / BMR.

3 RESULT

In this study, a total sample of 38 people was obtained. The largest sample in this study were women. Education levels in both bachelor and non-bachelor are in somewhat balanced proportion. This study reveals that most of the subjects received a rehabilitation program for more than one year.

Table 3: Subjects Characteristic.

Age	64.13 ± 5.34
Sex Male Female	 1 (2.6%) 37 (97.4%)
Height (cm)	152.55 ± 6.68
Weight (kg)	64.00 (63.78-69.53)
BMI	28.61 ± 3.05
Formal Education Bachelor Non-bachelor	 17 (44.7%) 21 (55.3%)
Information, Education, and Communication (IEC) < 6 Months 6 Mo – 1 Yr > 1 Yr	 6 (15.8%) 3 (7.9%) 29 (76.3%)
PAL	1.52 (1.52-1.62)

In this study, we want to find the correlation between PAL and BMI. On the normality test we found that the PAL variable is not normally distributed (Table 3), a non-parametric correlation test (spearman's) was used. In the Spearman test, there was a significant relationship (p = 0.016) between the PAL group and the BMI with a positive weak correlation (r = 0.390)(Figure 1).

Table 4: Correlation test.

	PAL (r)	
BMI	0.390	0.016[S]

[S] Spearman's

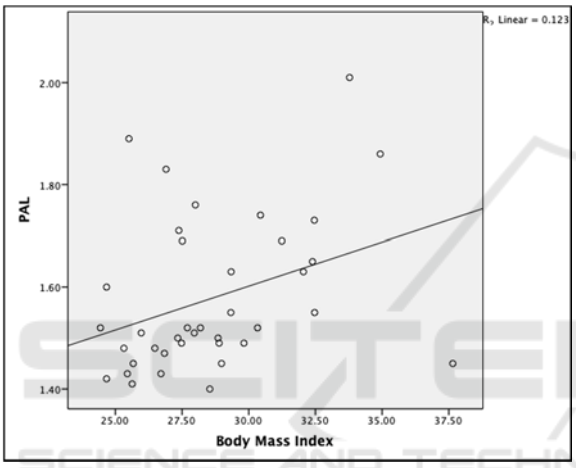

Figure 1: Scatterplots of the correlations BMI and PAL.

4 DISCUSSION

The largest sample in this study was women with the length of therapy in rehabilitation clinics for more than one year. 44.7%(17) of grade 1 obese samples had undergone rehabilitation for more than one year. It is a positive value of a patient's compliance with treatment.

Rehabilitation treatment is most important for the return of function in obese patients with OA (Lau et al., 2011), is to provide education and emotional approaches, so that patients have high motivation to carry out rehabilitation not only during treatment but also during daily activities. Some patients with obesity have active physical activity even very active, this proves that education to always do activities, applied by patients in daily life. In one study, an extra minute in the encounter discussing these issues was associated with a 2.5-fold increase inpatient recall. (Carroll et al., 2008) With comprehensive education, patient compliance will also increase In addition to increasing daily activities, food intake and calories must also be closely monitored.

Diet is an important factor if there are limitations in daily activities (Oenema and Brug, 2003). the sample we examined had an average age of 64 years, most of them only spending time at home and hospital. The differences in the associations between BMI and PA in obese vs non-obese people indicate that obesity may act as a barrier to PA (Hemmingsson and Ekelund, 2007). A recent longitudinal cohort study indeed suggested that obesity preceded low levels of PA, but not the commonly held notion that low levels of PA predicted the development of obesity (Petersen et al., 2004).

In this study, a significant relationship was seen between PAL and BMI. Our results show that one of the grade 2 obese patients with osteoarthritis of the knee has PAL which is very active. This shows that people with high BMI do not necessarily have low activity. This can be because the sample is an obese patient with knee OA who is undergoing treatment in an obesity clinic and get a lot of education. This result shows that people with higher BMI who have been visiting Obese Clinic routinely can have a high activity level. Highlighting the importance and effectiveness of proper rehabilitation treatment for obese patients.

More than 75% of patients have undergone rehabilitation for more than 1 year, where the duration of this treatment has an impact on increasing physical activity from the sample, making it difficult to get a strong correlation value. Our study has the advantage of researching health facilities which are referral centers from various regions. The rehabilitation program that is implemented already has measurable targets for patient achievement.

5 CONCLUSIONS

There is a significant relationship between physical activity level and body mass index of someone suffering from obesity with knee osteoarthritis with a weak correlation.

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