World Nutrition Journal |eISSN 2580-7013

ORIGINAL PAPER

Correlation of energy intake and physical activity with visceral fat in obese office workers

Fika Dwi Sasri[1], Fiastuti Witjaksono[1] ,Nani Cahyani Sudarsono[2]

1. *Department of Nutrition, Faculty of Medicine Universitas Indonesia, Dr. Cipto Mangunkusumo Hospital, Jakarta, Indonesia*
2. *Sports Medicine Divisions, Department of Community Medicine. Faculty of Medicine, Dr. Cipto Mangunkusumo Hospital, Jakarta, Indonesia*

Received 8 March 2023
Accepted 29 May 2023
Published 31August 2023

Link to DOI:
10.25220/WNJ.V07.i1.0006

Citation: Sasri F D, Witjaksono F, Sudarsono N C. Correlation Of Energy Intake And Physical Activity With Visceral Fat In Obese Office. World Nutrition Journal. 2023 August 31, 7(i1): 30-35.

Website :
http://www.worldnutrijournal.org/

Abstract

Background: Obesity is a global health problem with a continuing trend of increasing population. A positive energy balance, where energy intake is more remarkable than energy expenditure, will cause fat accumulation. Obesity due to the expansion of fat, especially visceral fat, is a risk factor for noncommunicable diseases. Office employees can become obese with a high-calorie diet and a sedentary lifestyle. This study aims to determine the correlation between energy intake and physical activity with visceral fat in obese office workers.

Methods: This cross-sectional study was conducted on obese office staff at RSCM. Energy intake was assessed with 3 x 24-h food recalls. Physical activity was assessed with the GPAQ questionnaire, and visceral fat was considered with multifrequency BIA.

Results: A total of 66 study subjects with an average age of 41 years were women and included in the category of obesity degree I. Almost all subjects had abnormal visceral fat volume with a median of 2.95 L (1.3 – 8.5 L). Most have more energy intake, with an average intake of 2196 ± 467 kcal. Most had moderate physical activity with a median value of 1850 MET (120 – 4680 MET). There was a moderate correlation between energy intake and visceral fat (r=0.554, p<0.001) and a weak correlation between physical activity and visceral fat (r=-324, P=0.008).

Conclusion: There was a moderate correlation between energy intake and visceral fat and a weak correlation between physical activity and visceral fat.

Keywords: obese, workers, visceral fat, energy intake, physical activity, 24-h food recall, GPAQ

Introduction

Obesity is a public health problem worldwide and a severe problem in developing countries.[1] Obesity occurs due to excess accumulation of body fat. Visceral fat accumulation is associated with central obesity. Increased visceral fat will result in insulin resistance, which is the basis of abnormalities in metabolic syndrome.[2] Metabolic syndrome due to visceral fat is a risk factor for non-communicable diseases, such as cardiovascular disease, hypertension, and diabetes mellitus.[3] The World Health Organization (WHO) states that noncommunicable diseases acquired from metabolic syndrome are the most significant cause of death worldwide, which causes 41 million deaths each year or 71% of causes of death globally.[4]

Fat accumulation in obesity results from energy imbalance when energy intake from food or diet is higher than energy expenditure. Energy expenditure consists of basal metabolism,

Corresponding author:
Fika Dwi Sasri
Department of Nutrition, Faculty of Medicine, Universitas Indonesia – dr. Cipto Mangunkusumo General Hospital, Jakarta
Email: fikadwisasri@gmail.com

thermogenesis, and physical activity.[5] Positive energy balance that occurs continuously will lead to obesity and fat accumulation, especially abdominal or central obesity.[6] Research conducted by Widiantini et al. of office employees with a State Civil Apparatus status of 1,119 employees, 48.3% were obese, where office employees had a lifestyle with a high-calorie diet and a sedentary lifestyle. In this study, physical activity was found to have a significant relationship with obesity with a value of p = 0.000, but there was no significant relationship between energy intake and obesity.[7] This differs from the results of a study conducted by Christina et al.,[8] which shows a significant relationship between energy intake and obesity in-office employees. Strategies for preventing and managing central obesity with a negative energy balance are associated with decreased visceral fat. Still, whether physical activity has a role or diet is hypocaloric is unclear. [9]

Methods

Study population and design

A cross-sectional study was conducted on office workers in dr. Cipto Mangunkusumo Hospital, Jakarta, Indonesia, from August 2022 to September 2022. Subjects were recruited using consecutive sampling, with the inclusion criteria being older than 18 years old and a body mass index (BMI) ≥ 25 kg/m^2. Subjects who cannot be checked for body composition (pacemaker, prosthesis, unable to stand, oedema), pregnant, taking drugs that can inhibit the absorption of nutrients and physical disabilities are excluded. This study's primary outcome was the correlation between energy intake and physical activity with visceral fat in an obese office worker.

Data collection

Subjects were interviewed for age, sex, ethnicity, and smoking status. Weight measurement was taken using an electronic scale (SECA) with a precision of 0.1 kg, and height measurement was taken using a stadiometer. Body mass index (BMI) was calculated as weight in kilograms per height in meters squared (kg/m^2). Visceral fat was assessed with Multifrequency bioelectrical impedance analysis (BIA) under SECA Body Composition Analyzer 525. SECA Analytics 115 software will read the subject's body composition. Food intake was analyzed using a 3x24-hours food recall. Food book photos were used to visualize the food intake and gave aid in the food portion size estimation. The food intake data was put into Nutrisurvey using the United States Department of Agriculture (USDA) database. Physical activity was assessed using the Global physical activity questionnaire (GPAQ).

Ethical approval

Ethical permission was obtained from Committee for Ethics in Research, Faculty of Medicine Universitas Indonesia (No. KET-977/UN2.F1/ETIK/PPM.00.02/2021 and protocol number 21-10-1069).

Statistical analysis

Data were analyzed using Windows's Statistical Package for the Social Sciences (SPSS) version 26. Normal data distribution was assessed if the p-value >0.05 using the Kolmogorov-Smirnov test. Mean and standard deviation was used to describe normally distributed data, and median with minimum-maximum values was used otherwise. Pearson or Spearman correlation tests were used to analyze the correlation between variables, with a p-value <0.05 considered significant. A linear regression test was used to ascertain the variables.

Results

A total of 66 participants were enrolled in this study. The total number of RSCM employees in 2022 is 5,148 people. The mean age of the research subjects was 41 years. The subjects came from the Javanese tribe (60.6%). There were 17 people (25.8%) who had smoking habits. The results of the anthropometric distribution showed that the

Table 1. Characteristics of the study participants

Characteristics	n = 66
Age (year)	41,97 ± 9,57*
Sex (n, %)	
Male	30 (45,5%)
Female	36 (54,5%)
Weight (kg)	74,1 (58,5 – 129,4) †
Height (cm)	160,3 ± 8,3*
Smoking (n,%)	
No	49 (74,2%)
Yes	17 (25,8%)
BMI (kg/m^2)	29,5 (25 – 48,5) †
Obese class I (n, %)	35 (53%)
Obese class II (n,%)	31 (47%)
Visceral fat (L)	2,95 (1,3 – 8,5) †
Normal (n, %)	5 (7,6%)
Upnormal (n, %)	61 (92,4%)
Physical activity score (MET)	1850 (120 – 4680) †
Light	18 (27,3%)
Medium	33 (50%)
Vigorous	15 (22,7%)
Energy intake (kcal)	2196 ± 467*
Insufficient	4 (6%)
Sufficient	17 (26%)
Excessive	45 (65%)
Protein (g/kg)	1 (0,5 – 1,8)†
Fat (%)	34 ± 4*
Carbohydrate	54 ± 5*

median value of BMI was 29.5 kg/m2; 35 people (53%) had grade I obesity nutritional status, and the rest had grade II. The results of the distribution of visceral fat values were 2.95 L. Sixty-one subjects (92.4%) had abnormal (increased) visceral fat, and the rest were normal. Subjects' physical activity values showed a median of 1850 MET, and most had moderate physical activity. Characteristics of the participants can be seen in **Table 1** above.

The correlation between energy intake and physical activity with visceral fat is presented in **Table 2**. There was a statistically significant correlation using the Rank Spearman correlation test.

Table 2. Correlation between energy intake and physical activity with visceral fat

Variable	Visceral fat	
	Correlation coefficient	P value
Energy intake	0,554	<0,001
Visceral fat	-0,324	0,008

**statistically significant (*p<0.05)*

Discussion

Participants were mostly female, 41 years old, and obese grade I. Prevalence study on American women, 65% of them are obese at the age of 40 to 59 years, and 73.8% are obese after entering the age of 60 years.[10] Women who enter perimenopause, namely aged 40-59 years, there will be a decrease in ovarian function which results in a reduction of energy expenditure, and if energy intake is not reduced, it will result in an increase in fat mass and redistribution of abdominal fat.[11]

There were 17 subjects (25.8%) who had smoking habits. Obesity and smoking have the pathogenesis of inflammatory disorders with almost the same characteristics, so they mutually increase oxidative stress. Chronic exposure to toxic substances and inhaled particulate matter from second-hand smoke is an important effector of oxidative stress during smoking. In obesity, especially characterized by metabolic disorders, greater accumulation of fatty acids in adipose tissue alters the metabolic profile of cells, increasing free fatty acids, which activate stress signals, inflammatory processes, and the production of inflammatory mediators. Molecular signalling, smoke-induced inflammation, and obesity involve increased oxidative stress, followed by activation of innate immune responses, particularly affecting adipose tissue in obesity and airway epithelial cells in smokers, which have important roles in the pathogenesis of the disease.[12]

The subject's median BMI was 29.5 kg/m2, with the lowest BMI of 25 kg/m2 and the highest BMI of 48.5 kg/m2. The number of subjects with obese class I was 35 people (53%). The study by Kunyahamu et al.[13] showed a fairly high prevalence of obesity among health workers, reaching 54.2%. An increase in a person's BMI will increase the risk of suffering from DM and cardiovascular disease.[14] In the last two years, the government has implemented work-from-home regulations (WFH) to prevent transmission of COVID-19 during a pandemic. Coskun study et al. show an increase in the average BMI from 24 kg/m2 before the pandemic to 24.9 kg/m2 during the pandemic, as well as an increase in the amount of time doing sedentary activities from 7.7 hours/day before the pandemic to 10.6 hours /day during the pandemic.[15] The median value of the subject's visceral fat volume was 2.95 L, with a range of values from 1.3 to 8.5 L. In this study, 61 subjects (92.4%) had increased or abnormal visceral fat volume. Westphal et al.[16] study assessed body composition using the BIA SECA 252 and obtained an average Asian ethnic visceral fat volume of 1.9 ± 1.1 L.

Subjects had less energy intake by 6% but had a nutritional status of obesity. Various factors could cause this, including because the subject reported food intake that was less than actual food intake (flat slope syndrome) or lower energy expenditure that resulted in a positive energy balance which made the subject become obese.[17] Sixty-five percent of the subjects in this study had excess energy intake, and the subjects had a habit of eating foods with high-calorie density at breakfast, lunch, and dinner. At breakfast and lunch, the subjects bought food around the RSCM environment, so a strategy is needed in community settings to regulate the intake of employees at RSCM. According to a study by Onufrak et al.[18] the food available at work had low dietary quality providing unhealthy food in vending machines, canteens, and catering available at work.

One factor that has been known to trigger obesity is unhealthy food with a high energy density of food, namely the energy content of more than 225 – 275 kcal per 100 g of food. Fast food causes obesity (obesogenic) because it has a high energy density and a composition that contains high levels of saturated fatty acids and trans fats, processed starch, and added sugar.[6] Health promotion programs to promote healthy behaviour, such as nutritional counselling, setting up smoking-free area policies in the workplace, insurance, and work environment support in providing healthy food choices in canteens or cafeterias, have proven effective in changing healthy behaviour among employees.[18]

The median value of the subject's physical activity was 1850 MET with a minimum value of 120 MET and a maximum value of 4680 MET. 18 subjects (27.3%) were included in the light physical activity category, 33 subjects (50%) were categorized in moderate physical activity, 15 subjects (22.7%) were included in the heavy physical activity category. In the study conducted by Saridi et al. on the subject of health workers in a Middle Eastern country, it was known that 37.8% of administrative employees had light physical activity, 48.6% had moderate physical activity, 13.5% did vigorous physical activity.[19]

According to existing literature, physical activity and nutrition interventions involving counselling, education, and group work activities showed significant changes in sedentary behaviour and eating habits, improving physical and mental

health, thereby reducing health care costs and employee absenteeism.[20] There was a significant moderate correlation between energy intake and visceral fat (r=0.554, p<0,001); this was consistent with a study in India in a population of women with a BMI of more than 24.9 kg/m2 (r=0.451, p≤0.05).[21] There was a significant correlation between energy intake and visceral fat. Still, it has a moderate correlation strength in this study. The population of women aged 40–50 years can experience a decrease in estrogen, which affects BMR. [11] BMR has a significant relationship with visceral fat (r=0.332, p=0.018).[22]

Each excess energy from food intake of 1% per day is estimated to cause an increase of 10 kg of fat mass in a decade.[23] There was a significant weak correlation between energy intake and visceral fat (r=-0.324, p=0,008); this was consistent with Lagzdina and Rumaka[24] study found a weak negative correlation between physical activity and visceral fat with a value of r = -0.379. The results of this study follow previous research conducted by Rosa and Riamawati[25] on office employees, namely that there is a significant relationship between physical activity and the incidence of central obesity, which is a physical manifestation of high levels of visceral fat (p=0.028; OR=5.40). This differs from the research conducted by Kurniasanti[26] which found a non-significant relationship between physical activity and visceral fat (p>0.05). One of the systematic studies by Andos et al.[27] reported that individuals and the social environment had a relationship to sedentary behaviour. Based on cross-sectional studies and longitudinal studies, smoking habits, drinking alcohol, and short sleep periods affect physical activity carried out during free time.

Conclusion

There was a significant moderate correlation between energy intake and visceral fat and a significant low correlation between physical activity and visceral fat in obese office workers. This study aligns with the guidelines for managing obesity: energy intake and physical activity have a role in reducing body weight and fat mass. Currently, obesity therapy management emphasizes comprehensive lifestyle change interventions, primarily by reducing energy intake, eating a healthy diet with balanced nutrition, and increasing physical activity.[28]

Conflict of Interest

The authors have no conflict of interest in this study. No educational grant is provided to the authors.

Open Access

References

1. Harbuwono DS, Pramono LA, Yunir E, Subekti I. Obesity and central obesity in indonesia: Evidence from a national health survey. *Medical Journal of Indonesia*. 2018;27:53–9.
2. Nurmalasari Y, Hayatuddini IL. Hubungan Antara Indeks Massa Tubuh dengan Lemak Visceral pada Pasien Diabetes Melitus Tipe 2 di Poliklinik Penyakit Dalam Rumah Sakit Pertamina Bintang Amin Tahun 2017. *Jurnal Ilmu Kedokteran Dan Kesehatan*. 2018;5:99–106.
3. Dhawan D, Sharma S. Abdominal Obesity, Adipokines and Non-communicable Diseases. Vol. 203, *Journal of Steroid Biochemistry and Molecular Biology.* Elsevier Ltd; 2020.
4. WHO. Noncommunicable diseases. 2021. [internet]. [diakses 12 November 2021]. Tersedia pada: Noncommunicable diseases (who.int).
5. LaCaille, L., Patino-Fernandez, A. M., Monaco, J., et al. Energy: Expenditure, Intake, Lack of. Encyclopedia of Behavioral Medicine. 2013: 699–700. doi:10.1007/978-1-4419-1005-9_454 .
6. Romieu I, Dossus L, Barquera S, Blottière HM, Franks PW, Gunter M, et al. Energy balance and obesity: what are the main drivers? Cancer Causes and Control. 2017 Mar 1;28(3):247–58.
7. Windiantini W, Tafal Z. Aktivitas fisik, stress dan obesitas pada pegawai negri sipil. *Kesmas Jurnal Kesehatan Masyarakat Nasional* 2014;8:330–6.

8. Christina D, Sartika RAD. Obesitas pada pekerja minyak dan gas. *Kesmas Jurnal Kesehatan Masyarakat Nasional* 2011;6:104–10.
9. Verheggen RJHM, Maessen MFH, Green DJ, Hermus ARMM, Hopman MTE, Thijssen DHT. A systematic review and meta-analysis on the effects of exercise training versus hypocaloric diet: distinct effects on body weight and visceral adipose tissue. Vol. 17, *Obesity Reviews*. Blackwell Publishing Ltd; 2016. p. 664–90.
10. Lizcano F, Guzmán G. Estrogen deficiency and the origin of obesity during menopause. Vol. 2014, *BioMed Research International*. Hindawi Publishing Corporation; 2014.
11. Davis SR, Castelo-Branco C, Chedraui P, Lumsden MA, Nappi RE, Shah D, et al. Understanding weight gain at menopause. Vol. 15, *Climacteric*. 2012. p. 419–29.
12. Batatinha HAP, et all. Inflammatory features of obesity and smoke exposure and the immunologic. 2019;96–111.
13. Kunyahamu MS, Daud A, Jusoh N. Obesity among health-care workers: Which occupations are at higher risk of being obese? *Int J Environ Res Public Health.* 2021 Apr 2;18.
14. Gray N, Picone G, Sloan F, Yashkin A. Relation between BMI and diabetes mellitus and its complications among US older adults. *South Med J*. 2015;108:29–36.
15. Coşkun MG, Öztürk Rİ, Tak AY, Sanlier N. Working from Home during the COVID-19 Pandemic and Its Effects on Diet, Sedentary Lifestyle, and Stress. *Nutrients*. 2022 Oct 1;14.
16. Bosy-Westphal A, Jensen B, Braun W, Pourhassan M, Gallagher D, Müller MJ. Quantification of whole-body and segmental skeletal muscle mass using phase-sensitive 8-electrode medical bioelectrical impedance devices. *Eur J Clin Nutr.* 2017 Sep 1;71:1061–7.
17. Flegal KM. Evaluating epidemiologic evidence of the effects of food and nutrient exposures. *Am J Clin Nutr* 1999;69:1339S-1344S.
18. Onufrak SJ, Zaganjor H, Pan L, Lee-Kwan SH, Park S, Harris DM. Foods and Beverages Obtained at Worksites in the United States. *J Acad Nutr Diet*. 2019 Jun 1;119(6):999–1008.
19. Saridi M, Filippopoulou T, Tzitzikos G, Sarafis P, Souliotis K, Karakatsani D. Correlating physical activity and quality of life of healthcare workers. *BMC Res Notes*. 2019 Apr 4;12.
20. Grimani A, Aboagye E, Kwak L. The effectiveness of workplace nutrition and physical activity interventions in improving productivity, work performance and workability: A systematic review. Vol. 19, *BMC Public Health*. BioMed Central; 2019.
21. N. Suresh; R. Reddy. Effect of Lifestyle on Body Fat Percentage and Visceral Fat in Indian Women with Above Normal Body Mass Index. *Int J Curr Res Rev*. 2017.
22. Sampath Kumar A, Arun Maiya G, Shastry BA, Vaishali K, Maiya S, Umakanth S. Correlation between basal metabolic rate, visceral fat and insulin resistance among type 2 diabetes mellitus with peripheral neuropathy. Diabetes and Metabolic Syndrome: *Clinical Research and Reviews*. 2019 Jan 1;13:344–8.
23. Kayser B, Verges S. Hypoxia, energy balance, and obesity: An update. *Obesity Reviews*. 2021 Mar 1;22(S2).
24. Lagzdina R, Rumaka M. Physical activity in healthy urban adults and its association with body composition parameters. SHS Web of Conferences. 2019;68:02010.
25. Rosa S, Riamawati L. Hubungan Asupan Kalsium, Air, dan Aktivitas Fisik dengan Kejadian Obesitas Sentral pada Pekerja Bagian Perkantoran Correlation between Calcium, Water Intake, Physical Activity and Central Obesity in Office Workers. *Amerta Nutr*. 2019;33–9.
26. Kurniasanti P. Hubungan Asupan Energi, Lemak, Serat, dan Aktivitas Fisik dengan Visceral Fat Pada Pegawai Uin Walisongo Semarang. Nutri-Sains: *Jurnal Gizi, Pangan dan Aplikasinya.* 2020 Nov 20;4:139–52.
27. Ando S, Koyama T, Kuriyama N, Ozaki E, Uehara R. The Association of Daily Physical Activity Behaviors with Visceral Fat. *Obes Res Clin Pract*. 2020 Nov 1;14:531–5.
28. Lewin Group T. VA/DoD clinical practice guideline for management of adult overweight and obesity. Department of Veterans Affairs Department of Defense. [Internet]. 2020. Available from: www.tricare.mil