



Carbohydrate Intake, Fiber Intake, and Physical Activity in Relation to Central Obesity in Female Cigarette Factory Workers in Kudus, Central Java

Irma Wahyu Fikri Miftuchatul Laili¹, Purbowati^{1*}, Noor Hidayah¹, Nur Istifaizah²

¹Faculty of Health Sciences, University of Muhammadiyah Kudus, Indonesia

²PT Sukun Wartono Indonesia Kudus, Indonesia

*Correspondence: E-mail: purbowati@umkudus.ac.id

ABSTRACT

Background: Central obesity in female workers affects health and work productivity. Abdominal circumference is one of the parameters to determine central obesity. Central obesity is influenced by carbohydrate intake, fiber intake, and physical activity. The study aimed to determine the relationship between carbohydrate intake, fiber intake, and physical activity with abdominal circumference of female workers at the Sukun Cigarette Factory.

Research Methods: The design of this study is a correlation description with a cross-sectional approach. The instruments used are semi-quantitative food frequency questionnaire (SQ-FFQ) to measure carbohydrate and fiber intake, global physical activity questionnaire (GPAQ) to measure physical activity, and metline to measure waist circumference. The population is 2562 female workers in the production section. The sample is 346 people (based on the Slovin formula), taken using the cluster sampling technique for each section. Spearman rank data analysis to test the relationship between independent and dependent variables.

Research Result: The results showed that 80.9% of subjects had a deficit in carbohydrate intake, 86.4% had a deficit in fiber intake, 45.7% had moderate physical activity, and 67.6% had central obesity. There was no relationship between carbohydrate intake and abdominal circumference, but there was a relationship between fiber intake and physical activity and abdominal circumference.

Conclusion: Female workers at the Sukun Cigarette Factory need a balanced nutritious diet and increased physical activity to prevent central obesity.

ARTICLE INFO

Article History:

Submitted/Received June 2025

First Revised July 2025

Accepted November 2025

First Available online Des 2025

Publication Date Des 2025

Keyword:

Carbohydrate; Central Obesity, Fiber; Physical Activity; Female Worker

1. INTRODUCTION

Currently, Indonesia is facing a triple burden health problem, a condition in which a country experiences three types of malnutrition at once, namely undernutrition, overnutrition, and micronutrient deficiency. Overweight and obesity are conditions of the body where there is excessive accumulation of body fat. According to [Sudikno et al. \(2015\)](#), there are two types of obesity, namely central obesity and peripheral obesity. Central obesity is the accumulation of fat in the abdominal area, while peripheral obesity is the accumulation of fat in the buttocks, hips, and thighs. Riskesdas 2018 data shows that the prevalence of obesity in Indonesia aged >18 years is 21.8%, while the prevalence of central obesity in the age of ≥15 years nationally is 31%, an increase of 4.4% from 26.6% in 2013. Likewise in Central Java there was an increase in the prevalence of central obesity from 2013 by 24.7% to 28.8% in 2018 ([Kementrian Kesehatan RI, 2018](#)).

Central obesity is the main cause of metabolic syndrome, insulin resistance, type 2 diabetes mellitus, dyslipidemia, sleep apnea and is at risk of developing cardiovascular disease ([Sudikno et al., 2015](#)). In addition to its impact on the risk of non-communicable diseases, central obesity also affects physical appearance, decreased productivity and performance. [Puspitasari \(2018\)](#) study showed that women are 1.7 times more at risk of experiencing central obesity compared to men because women generally have lighter levels of physical activity and lower energy needs so that energy adequacy is excessive. Risk factors for central obesity are diet, genetics, age, gender, stress and physical activity. Excess carbohydrate intake including diet is one of the triggers for obesity. Research by [Nurali et al. \(2018\)](#) and [Purbowati and Afiatna \(2018\)](#) showed that there is a relationship between excess carbohydrate intake and the incidence of central obesity. Excessive carbohydrate intake causes glucose accumulation in muscle tissue (glycogen) and if not balanced with physical activity, fat accumulation occurs, especially in the abdominal area (stomach) causing central obesity.

Fiber intake can also affect obesity. Research by [Jeser and Santoso \(2021\)](#) showed a statistically significant relationship between low fiber intake in fruits and vegetables and the incidence of obesity where low fiber intake in fruits and vegetables is one of the risk factors for obesity. The same results were also obtained from the research by [Christina and Sartika \(2011\)](#) which showed a significant relationship between fiber intake in fruits and vegetables and obesity. Fiber that plays a role in controlling body weight and reducing the incidence of obesity is water-soluble fiber such as pectin (vegetables, fruits and nuts) and some insoluble fibers, namely hemicellulose (wheat cereals) ([Dai and Chau, 2017](#)). This fiber can retain water and form a thick fluid in the digestive tract. The stomach takes longer to digest if you consume foods high in fiber. Fiber also works by retaining water, providing a longer feeling of fullness and can prevent consuming large amounts of food ([Jeser and Santoso, 2021](#)).

Abdominal fat distribution parameters that have a close relationship with body mass index and an anthropometric measure used to determine central obesity are abdominal circumference. The criteria for anthropometric measurements of abdominal circumference that include central obesity are ≥ 90 cm for men and ≥ 80 cm for women. Measurement of abdominal circumference can describe the condition of dangerous fat in the abdominal wall three times greater than body mass index ([Arianti and Husna, 2018](#)).

Sukun Cigarette Factory is one of the large cigarette companies in Kudus Regency which has thousands of workers in various departments. The number of workers in the cigarette production department is 2562 people consisting of the rolling, cutting, and packaging departments. Most of the production workers (95%) are women and work six days a week for eight hours per day. The results of initial observations in 25, 68% were overweight (BMI). The

workers' eating patterns are irregular, they rarely eat lunch and bring makeshift lunch boxes. Based on this background, it is necessary to conduct research on food intake, physical activity and central obesity. This study aims to determine the relationship between carbohydrate intake, fiber intake, and physical activity with central obesity in female workers.

2. METHODS

2.1. Design, Time, and Location

The design of this study is correlation analysis with a cross-sectional approach. The variables measured consist of independent variables, namely carbohydrate intake, fiber intake, physical activity, and dependent variables, namely central obesity. The study was conducted in November-December 2023 at the Sukun Kudus Cigarette Factory.

2.2. Population and Sample

The population of the study was 2562 female workers in the production section of PR Sukun Kudus. The determination of the number of research subjects was based on the Slovin sample calculation formula with a result of 346 people. Sampling using the cluster sampling method in each production section.

2.3. Data Collection and Analysis

The data collected included carbohydrate intake, fiber intake, physical activity, and waist circumference. The instruments used were semi-quantitative food frequency questionnaire (SQ-FFQ) to measure carbohydrate intake and fiber intake, global physical activity questionnaire (GPAQ) to measure physical activity, and metline to measure waist circumference. The data generated was on a numeric scale. The data normality test (Kolmogorov-Smirnov test) showed that the data distribution was not normal, so to analyze the relationship between carbohydrate intake, fiber intake, and physical activity with waist circumference using the Spearman rank correlation test (Suryani et.al, 2019).

3. RESULTS AND DISCUSSION

The research results indicate a relationship between carbohydrate intake, fiber, physical activity, and waist circumference in female workers at PR. Sukun Kudus. Measurement of waist circumference is conducted to determine whether there is abdominal or central obesity. Waist circumference is a measurement of abdominal fat distribution that is closely related to body mass index.

3.1. The Relationship between Carbohydrate Intake and Waist Circumference

The research results indicate that there is no significant relationship between carbohydrate intake and waist circumference, with $p = 0.143 > 0.05$ and an r value (Correlation Coefficient) of 0.079. This falls within the range of $r = 0.00-0.25$ (weak correlation) and is positively correlated, meaning that as carbohydrate intake increases, waist circumference tends to increase as well.

Table 1. Carbohydrate Intake and Waist Circumference

Carbohydrate intake	Waist Circumference						p Value	Rho
	Not central obesity		Central obesity		Total			
	F	%	F	%	F	%		
Very low	58	16.8	99	28.6	157	45.4		
Low	39	11.3	84	24.3	123	35.5		

Carbohydrate intake	Waist Circumference						p Value	Rho
	Not central obesity		Central obesity		Total			
	F	%	F	%	F	%		
Moderate	7	2.0	48	13.9	55	15.9	0.143	0.079
High	8	2.3	3	0.9	11	3.2		
TOTAL	112	32.4	234	67.6	346	100		

Most respondents have a very low level of carbohydrate consumption (45.4%), averaging 253 grams per day. This indicates that most respondents do not meet their daily carbohydrate intake needs to provide the energy that should comprise 50-65% of total energy (Almatsier, 2019). The low carbohydrate consumption results from respondents' food intake not satisfying their daily requirements, as they often eat only twice a day. Meanwhile, according to the Indonesian Ministry of Health in 2018, it is recommended to eat three times a day to promote balanced nutrition. On one plate, it is advised to include staple foods, such as around 150 grams of rice (equivalent to 3 scoops of rice), or 3 medium-sized potatoes weighing a total of 300 grams, or 75 grams of noodles.

Based on the results of the interview using the SQFFQ, it was found that in the morning, respondents consumed only one scoop of rice, and some did not have breakfast. During lunch, respondents only had snacks and food provided by the factory, such as bread, arem arem, sweet tea, and packaged rice. In the evening, respondents again consumed only one scoop of rice, and some admitted to rarely having dinner. Thus, this contributes to the insufficient percentage of carbohydrate intake consumed by the respondents throughout the day.

Carbohydrates are one of the macronutrients that serve as a source of energy. Imbalanced carbohydrate consumption affects their storage in the body. When there is a deficiency of carbohydrates, the body becomes weak and uses protein and fat for energy. If our body lacks carbohydrates, it is likely that we will lack energy. Thus, this can affect stamina and performance at work (Reynolds et al., 2019). The results of this study support previous research that carbohydrate nutrient intake does not have a significant relationship with the incidence of obesity or central obesity (p -value > 0.05) (Sofa, 2018).

3.2. The Relationship between Fiber Intake and Waist Circumference

The research results indicate that most respondents have an insufficient fiber intake level. A significant relationship exists between fiber intake and the respondents' waist circumference. The statistical tests yielded a value of $r = -0.112$, suggesting a weak and negative relationship, meaning that higher fiber intake correlates with a smaller waist circumference. Workers who consume less fiber are 2.42 times more likely to be obese compared to those who consume adequate fiber.

Table 2. Fiber Intake and Waist Circumference

Fiber intake	Waist Circumference						P Value	Rho
	Not central obesity		Central obesity		Total			
	F	%	F	%	F	%		
Less	90	26.0	209	60.4	299	86.4	0.037	0.112
Moderate	21	6.1	22	6.4	43	12.4		
High	1	0.3	3	0.9	4	1.2		
TOTAL	112	32.4	234	67.6	346	100		

High consumption and the ability to control body weight and waist circumference arise because fiber can reduce energy intake by limiting nutrient absorption (Rahmandita and

Adriani, 2017). Fiber is difficult to digest, which means that high-fiber food requires longer chewing when it is in the oral cavity. This chewing process simultaneously stimulates saliva secretion and more enzyme production in the stomach, resulting in a prolonged feeling of fullness. Therefore, it is recommended to consume plenty of vegetables and fruits daily to lower the risk of chronic or degenerative diseases (Hardiansyah et al, 2018).

Fiber is related to waist circumference because dietary fiber is indigestible, causing the stomach to work longer to break it down. Additionally, fiber has a slippery texture, making it even more difficult for the stomach to break it down quickly (Putri, Suzan and Mulyadi, 2022). Since fiber remains in the stomach longer, this results in a longer gastric emptying time, leading to a prolonged feeling of fullness. This indirectly reduces the risk of obesity. In addition to beneficial substances, fiber can also absorb and bind harmful substances, such as excess cholesterol or glucose, which can lead to hypertension and increased fat, particularly in the abdominal area (Putri et al, 2022).

According to Putri et al., (2022), fiber intake can also influence waist circumference by affecting insulin sensitivity. Insulin sensitivity refers to the capability of the insulin hormone to lower blood sugar levels by inhibiting liver sugar production and stimulating glucose utilization in skeletal muscles and adipose tissue. When insulin sensitivity is reduced due to fiber deficiency, the insulin hormone's ability to capture glucose for cellular use diminishes, leading to glucose being stored in the body as fat deposits, often concentrated in the abdomen. When this storage surpasses normal limits, it is termed central obesity or abdominal obesity.

3.3. The Relationship between Physical Activity and Waist Circumference

The research results show a significant relationship between physical activity and waist circumference, with $p = 0.000 < 0.05$ and an r value (Correlation Coefficient) of -0.248 , indicating a weak negative correlation. This means that higher physical activity is associated with a smaller waist circumference. Physical activity can reduce the risk of central obesity, while a lack of it causes an energy imbalance. Energy not used by the body is stored as fat reserves (Arulmohi et al., 2017). Fat distribution predominantly occurs in the abdominal area, leading to central obesity. Sufficient physical activity can increase energy expenditure and burn fat, as every body movement, caused by skeletal muscle work, contributes to increased energy and power expenditure (Parinduri et al., 2021).

Table 3. Physical Activity and Waist Circumference

Physical Activity	Waist Circumference						P Value	Rho
	Not central obesity		Central obesity		Total			
	F	%	F	%	F	%		
Less	17	4.9	78	22.5	95	27.5		
Moderate	58	16.8	100	28.9	158	45.7		
High	37	10.7	56	16.2	93	26.9	0.000	-0.248
TOTAL	112	32.4	234	67.6	346	100		

Fat distribution is predominantly observed in the abdominal area, which leads to central obesity. Sufficient physical activity can increase energy expenditure and burn fat; every body movement caused by skeletal muscle work contributes to energy and power expenditure (Parinduri et al., 2021). Physical activity is known to play a role in the distribution of body fat by utilizing fat from the abdominal area due to adipose tissue redistribution. Inadequate physical activity results in an increase in body fat accumulation in the tissues (Ariani and AF, 2017).

This study is also supported by research (Maulani and Djuwita, 2023) in which the results of statistical tests indicate a relationship between physical activity and the incidence of central

obesity in individuals aged ≥ 40 years in Indonesia, with a p-value of 0.007 and PR 1.049, along with a 95% CI of 1.012-1.087. This means that individuals with less active lifestyles have a 1.049 times higher risk of developing central obesity compared to individuals with moderately active lifestyles, after controlling for the variable of gender. The Prevalence Ratio (PR) value indicates a weak relationship between physical activity and the occurrence of central obesity. These results are consistent with previous research conducted by [Sudikno et al. \(2015\)](#), which analyzed the risk factors for central obesity in adults (25-65 years) in Indonesia based on Riskesdas 2013 data. The findings indicate that individuals with less physical activity have a 1.68 times higher risk of experiencing central obesity compared to those who are moderately active.

Lack of physical activity will result in a positive energy balance, causing excess energy in the form of fat to be stored in adipose tissue. The accumulation of body fat will increase body mass, leading to obesity. If the accumulation of fat occurs predominantly in the abdominal cavity, it will increase the mass of visceral fat, and the waist circumference will also increase, resulting in central obesity.

4. CONCLUSION

Female workers at PR. Sukun Kudus has an average carbohydrate intake classified as very low, fiber intake classified as low, and physical activity categorized as moderate. Research shows no relationship between carbohydrate intake and waist circumference. However, a significant relationship is observed between fiber intake, physical activity, and waist circumference.

5. REFERENCES

- Ariani, N. L. and AF, S. M. (2017). Keterkaitan aktivitas fisik dengan indeks massa tubuh (IMT) siswa SD kota Malang. *Care: Jurnal Ilmiah Ilmu Kesehatan*, 5(3), 457. doi: 10.33366/cr.v5i3.712.
- Arianti, I. and Husna, C. A. (2018). Hubungan lingkaran pinggang dengan tekanan darah masyarakat di wilayah kerja Puskesmas Mon Geudong tahun 2015. *AVERROUS: Jurnal Kedokteran dan Kesehatan Malikussaleh*, 3(1), 56. doi: 10.29103/averrous.v3i1.449.
- Arulmohi, M., Vinayagamorthy, V. and R., D. A. (2017). Physical violence against doctors: A content analysis from online Indian newspapers. *Indian Journal of Community Medicine*, 42(1), 147–50. doi: 10.4103/ijcm.IJCM.
- Christina, D. and Sartika, R. A. D. (2011). Obesitas pada pekerja minyak dan gas. *Kesmas: National Public Health Journal*, 6(3), 104. doi: 10.21109/kesmas.v6i3.100.
- Dai, F. J. and Chau, C. F. (2017). Classification and regulatory perspectives of dietary fiber. *Journal of Food and Drug Analysis*, 25(1), 37–42. doi: 10.1016/j.jfda.2016.09.006.
- Hardiansyah, A., Hardiansyah, H. and Sukandar, D. (2018). Kesesuaian konsumsi pangan anak indonesia dengan pedoman gizi seimbang. *Nutri-Sains: Jurnal Gizi, Pangan dan Aplikasinya*, 1(2), 35. doi: 10.21580/ns.2017.1.2.2452.
- Jeser, J., T. and Santoso, A., S. (2021). Hubungan asupan serat dalam buah dan sayur dengan obesitas pada usia 20-45 tahun di puskesmas Kecamatan Grogol Petamburan Jakarta Barat. *Tarumanagara Medical Journal*, 4(1), 164–171.
- Kementerian Kesehatan RI. (2018). *Riskesdas Provinsi Jawa Tengah*. Jakarta: Kementerian Kesehatan
- Parinduri, K., Djokosujono, K., F. and Parinduri, S., K. (2021). Faktor dominan obesitas sentral pada usia 40-60 tahun di Indonesia (analisis data Indonesian family life survey 5 tahun 2014/2015). *Hearty*, 9(2), 58. doi: 10.32832/hearty.v9i2.5397.

- Nurali, W. O., Tasnim and Sunarsih (2018). Hubungan asupan karbohidrat dan lemak dengan obesitas sentral pada karyawan instansi di Kota Kendari. *Jurnal Gizi Ilmiah*, 5(1), 49–58.
- Purbowati and Afiatna, P. (2018). Hubungan asupan zat gizi makro dengan obesitas sentral pada tenaga kerja laki-laki. *Jurnal Gizi Dan Kesehatan*, 10(23), 80–86. doi: 10.35473/jgk.v10i23.46.
- Puspitasari, N. (2018). Kejadian obesitas sentral pada usia dewasa. *HIGEIA (Journal of Public Health Research and Development)*, 2(2), 249–259. doi: 10.15294/higeia.v2i2.21112.
- Putri, R. A., Suzan, R. and Mulyadi, D. (2022). Korelasi asupan serat terhadap rasio lingkaran pinggang-panggul dan tekanan darah pada overweight dan obesitas di civitas akademika Prodi Kedokteran FKIK Universitas Jambi. *Joms*, 2(2), 24–37.
- Rahmandita, A. P. and Adriani, M. (2017). Perbedaan tingkat konsumsi dan aktivitas fisik pada wanita (20-54 tahun) obesitas sentral dan non sentral. *Amerta Nutrition*, 1(4), 266. doi: 10.20473/amnt.v1i4.2017.266-274.
- Reynolds, A. et al. (2019). Carbohydrate quality and human health: a series of systematic reviews and meta-analyses. *The Lancet*, 393(10170), 434–445. doi: 10.1016/S0140-6736(18)31809-9.
- Sofa, I. M. (2018). Kejadian obesitas, obesitas sentral, dan kelebihan lemak visceral pada lansia wanita. *Amerta Nutrition*, 2(3), 228. doi: 10.20473/amnt.v2i3.2018.228-236.
- Sudikno et al. (2015). Faktor risiko obesitas sentral pada orang dewasa. *Analysis Data of Basic Health Research 2013*, 38(2), 111–120.
- Suryani, A. I., K, S. and Mursalam, M. (2019). Pengaruh penggunaan metode mind mapping terhadap hasil belajar ilmu pengetahuan sosial murid kelas V SDN no. 166 Inpres Bontorita Kabupaten Takalar. *JKPD (Jurnal Kajian Pendidikan Dasar)*, 4(166), 741–753.
- Maulani, S., A., D. and Djuwita, R. (2023). Hubungan Aktivitas fisik dengan kejadian obesitas sentral pada usia \geq 40 tahun di Indonesia (analisis data Indonesian family life survey 5). *Jurnal Vokasi Keperawatan (JVK)*, 6(2), 159–167. doi: 10.33369/jvk.v6i2.31047.