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The Relationship of Macronutrient Intake and Sleep Duration to Nutritional Status in Students

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Abstract

Nutritional status is a state of health in a person's body which is caused by consumption, absorption and use of food nutrients. Based on the results of the 2023 Indonesian Health Survey, it shows that Central Java province is one of the provinces that has a prevalence of underweight adults (age > 18 years) above the national prevalence of 8.9%. The adult population has 9.0% undernutrition or underweight, 13.5% overnutrition and 22.5% obesity. Nutritional status can also be influenced by sleep duration. Sleep duration is an important regulator of body weight and metabolism. Objective: To determine the relationship between macronutrient intake and sleep duration on nutritional status. This type of research was observational using cross-sectional. The number of research subjects was 101 students taken by random sampling. The data used in this study were primary data such as age, gender, food intake for 3 non-consecutive days, sleep duration and nutritional status. Statistical tests use the Chi-Square test. Students with poor protein intake and normal status were (35.4%). Students with poor fat intake and underweight nutritional status were (38.1%). Students with good carbohydrate intake and normal nutritional status were (64.9%). And students with a sleep duration of >6 hours with normal nutritional status were (48.8%). There is a relationship between protein intake (p=0.028), fat (p=0.003), carbohydrates (p=0.024) and sleep duration (p=0.048) on nutritional status.

Introduction

Students are included in the early adult category who are 18-25 years old (Hulukati & Djibran, 2018). Poor student food intake and lack of sleep duration have a bad impact. Nutritional status is a state of health in a person's body that results from the consumption, absorption and use of food nutrients (Almatsier S., 2009). Nutritional status can also be affected by sleep duration. Sleep duration is an important regulator in weight and metabolism (Damayanti et al., 2019)

Indonesia is experiencing the Triple Burden of Malnutrition (TBM) where overweight coexists with malnutrition and micronutrient deficiencies. The Asia-Pacific region ranks the highest number of overweight and obese people globally at approximately 1 billion, or 40% of the total population (FAO, 2021). Based on the results of the Indonesia Health Survey (SKI) 2023 shows that Central Java province is included in the provinces that have a thin adult population (>18 years old) above the national prevalence of 8.9%. The adult population who have undernourished or emaciated status is 9.0%, over-nutrition status is 13.5% and obesity is 22.5%. The prevalence of nutritional status in 2018 was 13.0% and obesity was 20.4%. When compared to the 2018 riskesdas, the nutritional status is more and obesity has increased. For

the Surakarta city area itself, obesity is 9.98%. Urban areas have a lower prevalence of lean nutritional status (8.7%) compared to villages (10.1%), while more nutritional status (14.6%) and obesity (25.1%) are higher than villages (12.2% and 17.8%).

Energy intake from proteins, fats and carbohydrates is converted in the energy source. The imbalance of food intake with the energy expended causes obesity (Damayanti, 2022). However, if macro intake does not meet needs, it will cause malnutrition (Fatie et al., 2021). Excessive carbohydrate intake will cause liver cells to turn into fat. This results in adipose tissue experiencing fat accumulation and obesity (Listianasari & Putra, 2023). Likewise, the excess amount of protein in the body results in deaminase, the body will release nitrogen and convert carbon bonds into acetyl CoA. Acetyl CoA is synthesized through the lipogenesis cycle into triglycerides. If the consumption of protein is very excessive, it will be stored as fat (Ardiyan et al., 2021). Excess fat intake also results in more nutrition. Fats sent to adipose are stored as energy. Fat is stored around the abdomen, kidneys and under the skin (Permanasari & Aditianti, 2017). In the research Telisa et al., (2020) protein (OR: 3.49; 95%CI: 1,432 – 8,505), fat (OR: 6.57; 95%CI: 2,757 – 15,659); Carbohydrates (OR: 2.00; 95%CI: 0.919 – 4.367) have an increased risk of nutritional status.

Sleep duration is the length of time a person sleeps and rests his body (Damayanti et al., 2019). In the research conducted by Amrynia & Prameswari, (2022) showed a relationship between sleep duration and Body Mass Index (BMI) (p= 0.011). Metabolic disorders caused by lack of sleep duration affect the appetite regulating hormone, namely high ghrelin (stimulating appetite) and low levels of the hormone leptin (suppressing hunger) so that it affects nutritional status (Duraccio et al., 2019) Macronutrient intake is an essential nutrient that is needed in relatively large quantities (macro) consisting of carbohydrates, proteins, and fats (Tidar et al., 2023) Research shows that excess nutritional status occurs due to excessive energy intake (Telisa et al., 2020), lack of physical activity (Agustina et al., 2023), genetic susceptibility (Aprilia et al., 2015), lifestyle or habits such as sleep deprivation (Faizi et al., 2015) and fast food consumption (Sutrisno et al., 2018). Based on this background, the researcher intends to conduct a study on the Relationship between Macronutrient Intake and Sleep Duration to Nutritional Status in Students of the University of Muhammadiyah Surakarta.

Methods

This study was an observational quantitative with a cross sectional research design. The research was carried out in 2024 at the University of Muhammadiyah Surakarta. The number of research subjects was 101 samples. Sleep duration data was collected using a questionnaire and 24-hour recall using a food recall questionnaire. The intake of protein, fat, carbohydrates obtained from daily intake taken in 3 non-consecutive days is then divided by 3, the result is divided by the daily adequacy of the respondent according to Harris Benedict's calculation then the result is multiplied by 100%. Nutritional status measurement includes measuring height using a stadiometer and weight using a digital scale.

The inclusion criteria set were non-health students of the University of Muhammadiyah Surakarta. This research was carried out after receiving an Ethical Clearance (EC) from the Research and Development Ethics Commission of FIK UMS with the number .416/KEPK-FIK/VII/2024. The sampling method used random sampling techniques. Nutritional status data was categorized into 3 categories according to the provisions of the Ministry of Health, namely thin (<18.4 kg/m2), normal (18.5 – 25.0 kg/m2) and obese (>25.1 kg/m2). Macronutrient intake was categorized into 2, namely good (<120%) and bad (>120%). And for sleep duration, it was categorized into 2, namely <5 hours and >6 hours. The data analysis used was the chi square test.

Result and Discussion

Characteristics of the Research Subject

The subjects involved in this study are students of the University of Muhammadiyah Surakarta aged 19-24 years with a sample size of 101 students.

Table 1. Characteristics of the Research Subject

Age	**n**	**%**
19 Year	35	34,7
20 Year	46	45,5
21 Year	9	8,9
22 Year	6	5,9
23 Year	4	4,0
24 Year	1	1,0
Gender	**n**	**%**
Man	48	47,5
Woman	53	52,5
Residence	**n**	**%**
Nourishment	57	56,4
House	44	43,6
Program Studi	**n**	**%**
Geography	2	2,0
Law	17	16,8
Sharia Economic Law	9	8,9
Islamic Religious Education	13	12,9
Accounting Education	2	2,0
United Kingdom Education	10	9,9
Geography Education	6	5,9
Civic Education	7	6,9
Mathematics Education	6	5,9
Sports Education	12	11,9
Informatics Engineering Education	13	12,9
Primary Teacher Education	4	4,0
Monthly Pocket Money	**n**	**%**
>Rp2.000.000	2	2,0
Rp1.000.000-2.000.000	36	35,6
Rp500.000-1.000.000	63	62,4
Transportation to Campus	**n**	**%**
Walk	7	6,9
Private Vehicles	91	90,1
Public Transportation	2	2,0
Bicycle	1	1,0
Cooking Facilities	**n**	**%**
Available	94	93,1
None	7	6,9
Nutritional Status	n	%
Thin	27	26,7
Normal	45	44,6
Fat	29	28,7
Total	**101**	**100,0**

Table 1 shows that the age distribution among students of the University of Muhammadiyah Surakarta is dominated by 46 respondents (45.5%) who are 20 years old. Students are included in the early adulthood category, early adulthood has an age range between 19-24 years old (Bonnie et al., 2015). gender in students of the University of Muhammadiyah Surakarta who are female is more numerous, namely 53 respondents (52.5%). Nutritional needs between men and women are different. So that there is a relationship between gender and nutritional status (Anjeli, 2024). The protein needs of men aged 19-29 years are 65 grams, fat 75 grams and carbohydrates 430 grams. Meanwhile, women aged 19-29 years have a need of 60 grams of protein, 65 grams of fat and 360 grams of carbohydrates (Kemenkes, 2019).

In the distribution of housing, it is dominated by living in boarding houses, which is 57 respondents (56.4%). The study program taken was dominated by the law study program of the faculty of law as many as 17 respondents (16.8%). This is because the faculty of law only has 1 study program. distribution based on pocket money, the majority is around Rp500,000-1,000,000, which is as many as 63 respondents (62.4%). In the distribution of transportation used to campus, the majority used private vehicles as many as 91 respondents (90.1%). And as many as 94 (93.1%) students have cooking facilities. So it can be said that the majority of students can cook in their residence. The results of the analysis of respondent data according to nutritional status were divided into 3 categories, namely thin, normal, and obese.

Based on the table, it is known that out of 101 respondents, there are 45 (44.6%) respondents who have normal nutritional status. This prevalence is higher when compared to the prevalence of the city of Surakarta itself in 2023, according to Indonesia's health survey data (Kemenkes RI, 2023) mentioned that obesity was 9.98%. This shows that the prevalence of obesity and poor nutritional status at the University of Muhammadiyah Surakarta is higher when compared to the prevalence of obesity in the city of Surakarta

Subject Characteristics Based on Protein, Fat, Carbohydrate Intake, and Sleep Duration

Characteristics of Subjects Based on Protein Intake

Table 2. Student Distribution Based on Protein Intake

Asupan Protein	**n**	**%**
Less	60	59,4
Enough	35	35,6
More	5	5,0
Total	**101**	**100,0**

Based on table 2, it can be concluded that there are 60 (59.4%) respondents who have insufficient protein intake with a calculation of 15% of total calories. Respondents who had poor protein intake due to lack or excess intake consumed during food recall interviews.

Table 3. Overview of Daily Dietary Protein Intake

	Median (Min-Max)	**Mean**	**Std. Deviasi**
Asupan Protein	62,9 (32,16 – 112,50)	63.62	18,37

Based on table 3, the average protein intake is 63.62 grams and the minimum value is 32.16 grams and the maximum value is 112.50 grams. The standard deviation in protein intake was obtained at 18.37. For comparison, 62.9 grams of protein is the same as 1 chicken egg, which weighs 60 grams (Kemenkes, 2019).

Table 4. Overview of Student Protein Intake Per Day

	Min-Max	**Mean**	**Std. Deviasi**	**n (101)**	**%**
Chicken	30-65	49,46	6,10	84	83,2
Chicken Eggs	60-60	60	0,0	55	54,5

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Tempe	20-95	34,99	15,12	54	53,5
Beef	15-150	48,85	23,46	26	26,7
Tahu	23-70	36,95	12,82	25	24,8
Bandeng	15-50	24,55	11,71	11	10,9
Catfish	70-70	70	0,0	7	6,9
Goat Meat	(30-50	44	8,21	5	5

The food sources consumed in table 4 come from animal proteins such as chicken, beef, eggs and fish. As for vegetable protein, it comes from tofu and tempeh. The most student consumption results were chicken meat as many as 84 students (83.2%) from 101 respondents. The average intake of chicken protein sources is 49.46 grams with a niminum value of 30 grams and a maximum value of 65 grams. The minimum value is 70 grams and the maximum value is 70 grams. The average consumption of students is not much different from URT. Chicken meat of 49.46 grams has a URT of 1 piece. Then for catfish in the URT, which is 70 grams, has 1 URT.

Protein is the largest part of the body after water. Lack of protein intake causes inhibition of the formation of new cells in the body. Enzymes, hormones, nutrient transporters and blood are proteins (Periselo & Anwar, 2024). Protein is an energy source equivalent to carbohydrates. If the body lacks energy sources, carbohydrates and fats, the body will use protein as energy (Gropper & Smith, 2016).

Characteristics of Subjects Based on Fat Intake

Table 5. Student Distribution Based on Fat Intake

Fat Intake	**n**	**%**
Less	35	34,7
Enough	38	37,6
More	28	27,7
Total	**101**	**100,0**

Based on table 5, fat intake was dominated by adequate intake of 38 respondents (37.6%) with a calculation of 25% of total calories.

Table 6. Overview of Daily Dietary Fat Intake

	Median (Min-Max)	**Mean**	**Std. Deviasi**
Fat Intake	59,1 (19,13 – 123,30)	60,19	19,55

Based on table 6, the average fat intake is 60.19 grams and the minimum value is 19.13 grams and the maximum value is 123.30 grams. The standard deviation in fat intake was obtained at 19.55.

Table 7. Overview of Student Fat Intake Per Day

	(Min-Max)	**Mean**	**Std. Deviasi**	**n (101)**	**%**
Chicken	(31-60)	46,46	6,41	77	76,2
Chicken Eggs	(60-60)	60	0	43	42,6
Tempe	(15-50)	33,57	11,57	43	42,6
Chips	(5-50)	26,79	12,95	14	13,9
Tahu	(20-55)	41,43	11,99	14	13,9
Milk	(200-200)	200	0	11	10,9
Bakwan	(30-50)	45	7,55	8	7,9
Catfish	(70-70)	70	0	7	6,9

Based on table 7, the average intake of chicken meat sources has an average of 46.46 grams with a minimum value of 31 and a maximum of 60 and a standard deviation of 6.41. The highest source of fat intake is in milk with an average of 200 ml and a minimum value of 200 grams and a maximum value of 200 grams. This is not much different from the URT that has been determined by the Ministry of Health. In chicken meat 46.46 grams has a URT of 1 piece of chicken and in 200 ml of milk has a URT of 1 cup.

Fat functions as a solvent for vitamins A,D,E,K (Zuccotti *et al*., 2020). Lack of fat causes disturbances in vitamin absorption leading to the risk of vitamin deficiency symptoms such as swollen gums, easy bruising, depression, and muscle pain (Kim *et al*., 2015). With that, it is necessary to have a balanced intake so that the function of nutrients, especially fats, can work optimally.

Characteristics of Subjerk Based on Carbohydrate Intake

Table 8. Student Distribution based on Carbohydrate Intake

Achupan in Carbhidra	n	%
Less	60	59,4
Enough	27	26,7
More	14	13,9
Total	**101**	**100,0**

Based on Table 8, there are 60 (59.4%) respondents who have insufficient carbohydrate intake. Insufficient carbohydrate intake is caused by a lack of carbohydrate intake consumed during the interview and also caused by errors in estimating the portion consumed so that it causes excess or deficiency.

Table 9. Overview of Carbohydrate Intake Per Day

	Median (Min-Max)	Mean	Std. Deviasi
Fat Intake	228,9 (105,5 – 548,60)	249,47	103,7

Based on Table 9, the average carbohydrate intake is 249.47 grams and the minimum value is 105.5 grams and the maximum value is 548.60 grams. The standard deviation in carbohydrate intake was obtained 103.7.

Table 10. Overview of Student Carbohydrate Intake Per Day

	(Min-Max)	Mean	Std. Deviasi	n	%
Our	(43-279)	168,93	55,30	101	101
Mie	(10-120)	58,88	28,92	47	45,6
Bread	(21-80)	49,14	14,89	34	33,7
Cilok	(25-65)	39,69	11,61	16	15,8
Potato	(10-90)	37,92	21,68	12	11,9
Bihun	(10-120)	48,92	39,28	6	5,9
Bubur	(250-250)	250	0	4	4
Perkedel	(20-20)	20	0	3	3

Based on table 10, the most student consumption results were obtained namely rice with a total consumption of 101 students. Rice is a staple food of the people of Indonesia, especially in the city of Surakarta, with which all students consume rice as their staple food. that the average intake of the highest carbohydrate source was rice with a yield of 168.93 grams and a minimum value of 43 grams and a maximum value of 279 grams. The standard deviation in carbohydrate intake was obtained 50.30. This is in accordance with the URT issued by the Ministry of Health. At 168.93 grams of rice, it is equivalent to 1 serving of medium plates or 3 spoons of rice cooker.

Carbohydrates are the main source of energy in the body. The role of carbohydrates in the body is to prevent the growth of ketosis, break down excess protein and help metabolic processes in the body (Fitri & Fitriana, 2020). However, if you consume too many carbohydrates, it causes lethargy and fatigue. This is because tryptophan enters the brain more easily due to the consumption of carbohydrates that stimulate insulin. Thus binding albumin maintains tryptophan and produces serotonin (Daujat & Kot, 2020).

Characteristics of Subjerk Based on Sleep Duration

Table 11. Distribution of Students Based on Sleep Duration

Sleep Duration	n	%
≥ 6 clock	80	79,2
≤ 5 clock	21	20,8
Total	**101**	**100,0**

Based on table 11 on the sleep duration component, as many as 80 students (79.2%) had a sleep duration of ≥ 6 hours. Meanwhile, according to the National Sleep Foundation, at the age of 18-25 years, the recommended sleep duration is 7-9 hours and less sleep duration can affect the occurrence of sleep decline. In the research Erwin & Salimi (2024) stated that the majority of PGSD students as many as 39 respondents were found to have 46.2% of students sleep for 6-7 hours, 33.3% of students sleep for 5-6 hours, 15.4% of students sleep for 4-5 hours, and 5.1% of students sleep for less than 4 hours. This shows that the majority of students sleep >6 hours. Students who have a sleep duration of <5 hours have a higher risk of obesity, diabetes, injury, poor mental health or negative impact on emotional development, attention and behavioral problems (Wheaton *et al*., 2016).

Relationship between Protein, Fat, Carbohydrate Intake and Sleep Duration with Nutritional Status

Relationship between Protein Intake and Nutritional Status

Table 12. The Relationship between Protein Intake and Nutritional Status

Asupan Protein	Nutritional Status						Total		*P Value*
	Thin		Normal		Fat				
	n	%	n	%	n	%	n	%	
Bad	22	33,8	23	35,4	20	30,8	65	100	**0,028**
Good	5	13,9	22	61,1	9	25,0	32	100	

Based on table 12, it is known that 22 respondents (33.8%) had poor protein intake and lean nutritional status and 9 respondents (25.0%) had good protein intake with obese nutritional status. The results of the *Chi Square* test , in the variable of protein intake with nutritional status, it is known that *the value of p* is 0.028 where p<0.05 means that there is a relationship between protein intake and nutritional status in students of the University of Muhammadiyah Surakarta. This is in line with the research conducted by the Research Khairani *et al*., (2021) which shows that there is a significant relationship between protein intake and nutritional status. Excessive protein consumption can cause deaminase, the body releases nitrogen and then converts carbon bonds into acetyl CoA. Acetyl CoA is synthesized through the lipogenesis cycle into triglycerides. If the consumption of protein is excessive, it is stored as fat (Ardiyan et al., 2021).

Protein consumption is used to support growth and development (Zuhriyah, 2021) Protein functions to repair body tissues. In protein deficiency, it causes thymus atrophy so that it interferes with the production of T cells. Protein deficiency can also interfere with the production of antibodies as humoral immunity (Gropper & Smith, 2016). Therefore, the body becomes more susceptible to infections that can be a factor causing malnutrition and have an

impact on nutritional status (Adawiyah & Farhat, 2018). In the research conducted by Ilham *et al.*,(2017) also showed a significant relationship between protein intake and body mass index. Body mass index or BMI is one of the simple ways to determine whether a person is overnourished or undernourished, which is commonly called nutritional status (Zamzami Hasibuan, 2021). Nutritional status comes from the balance of the amount of food intake and nutritional adequacy. Protein consumption is used to support growth and development (Zuhriyah, 2021).

Relationship between Fat Intake and Nutritional Status

Table 13. The Relationship between Fat Intake and Nutritional Status

Asupan lemak	Nutritional Status						Total		*P Value*
	Thin		Normal		Fat				
	n	%	n	%	n	%	n	%	
Bad	24	38,1	22	34,9	17	27,0	63	100	0,003
Good	5	13,9	22	61,1	9	25,0	32	100	

Based on table 13, it can be seen that 24 respondents (38.1%) had poor fat intake and lean nutritional status. The results of the *Chi Square* test , in the variable of fat intake with nutritional status, it is known that *the p value* is 0.003 where p<0.05 means that there is a relationship between fat intake and nutritional status in students of the University of Muhammadiyah Surakarta. Fat serves as the largest contributor of energy, 1 gram of fat contributes as much as 9 kcal. Fat is stored around the abdomen, kidneys and under the skin (Permanasari & Aditianti, 2017). This is in line with Periselo's (2024) research, which obtained a p value of p=0.000 (<0.05) which shows that there is a relationship between fat intake and nutritional status.

Cells in the body need energy, the lipase enzyme in adipose cells will hydrolyze trigiserase into glycerol and fatty acids are released into the blood vessels, then these components are burned to be able to produce energy (Siregar & Makmur, 2020). Triglycerides are an indicator of fat in the blood (Siregar et al., 2020). Excess fat is not good for the body, excess fat intake can lead to more nutritional status (Chen et al., 2024). In conditions of excess fat metabolism causes a buildup in adipose tissue and can increase cholesterol in the blood (Listianasari & Putra, 2023). In conditions of insufficient fat intake, fat metabolism causes a secondary immune deficiency of cells in the body composed of two layers of fatty acids. So that the content contained in food affects the cell membrane. This results in the state of the cell membrane in immunocompetent cells affecting the immune response. Poor immunity causes infection. So that this can be a direct factor in the nutritional status (Adawiyah & Farhat, 2018).

In the research conducted by Nurul Afifah (2024) It also showed that there was a significant relationship between fat intake and nutritional status. Fat intake comes from the food consumed. If fat intake is not enough, it will have an impact on energy intake during the activity and metabolism process (Diniyyah & Nindya, 2017).

The Relationship Between Carbohydrate Intake and Nutritional Status

Table 14. The Relationship between Carbohydrate Intake and Nutritional Status

Achupan in Carbhidra	Nutritional Status				Total	*P Value*		*RP (CI 95%)*
	Abnormal		Normal					
	n	%	n	%	n	%		
Bad	26	35,1	48	64,9	74	100,0	0,024	0,231 (0,06-0,84)
Good	3	11,1	24	88,9	27	100,0		

Based on table 14, it is known that 48 respondents (64.9%) had poor carbohydrate intake and normal nutritional status. The results of the Fisher's Excat Test on the variable of carbohydrate intake with nutritional status are known to have a value of p<024 where p0.05 means that there is a relationship between carbohydrate intake and nutritional status in students of the University of Muhammadiyah Surakarta. This is in line with research conducted by Periselo (2024) that concluded that there is a relationship between carbohydrate intake and nutritional status in S1 nutrition students of Stikes Bhakti Pertiwiluwu Raya Palopo. Carbohydrates are the body's main source of energy that can produce energy (Gropper & Smith, 2016). Carbohydrates can cause obesity. Excessive carbohydrate intake causes liver cells to turn them into fat (Gillespie, 2021).

In the research conducted by Rokhmah et al., (2017) stated that there is a relationship between carbohydrate intake and nutritional status. Energy is the result of the metabolism of proteins, fats and carbohydrates. The incoming and outgoing energies must be balanced. An imbalance between incoming energy and outgoing energy that lasts for a long time can cause nutritional problems. So that it can affect their nutritional status (Cakrawati et al., 2014).

In excess of carbohydrates, it can promote metabolism towards fat biosynthesis (Gillespie, 2021). Fat synthesis from carbohydrates begins with the breakdown of glucose into pyruvic acid which is then converted into glycerol (Umbu Henggu & Nurdiansyah, 2022). A number of carbohydrates eaten are converted into triglycerides and then stored and used as triglycerides for energy. So more than half of the total energy used by cells is supplied with fatty acids derived from triglycerides or indirectly from carbohydrates (F. A. Siregar & Makmur, 2020). Excessive carbohydrate intake will cause liver cells to turn into fat. This results in adipose tissue experiencing fat accumulation and obesity (Listianasari & Putra, 2023).

In conditions of carbohydrate deficit, it can cause the body to be weak so that the body uses protein and fat to be processed and used as energy (Seulina, 2024). The process of breaking down fat into energy causes the accumulation of ketone elements in the blood. If this happens continuously, it can lead to ketosis (Pina & Ayu, 2023). Ketosis causes dizziness, weakness, nausea and dehydration. In addition, carbohydrate deficiency is at risk of the body lacking other nutrients that are important for body function (Kirkpatrick *et al*., 2019).

The Relationship Between Sleep Duration and Nutritional Status

Table 15. The Relationship between Sleep Duration and Nutritional Status

Sleep duration	**Nutritional Status**						**Total**		***P Value***
	Thin		**Normal**		**Fat**				
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	
≤5 clock	10	47,6	6	28,6	5	23,8	21	100	0,048
≥6 clock	17	21,2	39	48,8	24	30,0	80	100	

In table 15, it is known that 39 respondents (48.8%) had a sleep duration of >6 hours with normal nutritional status. The results of the Chi Square test, in the variable of sleep duration with nutritional status, it is known that the p value is 0.048 where p>0.05 means that there is a relationship between sleep duration and nutritional status in students of the University of Muhammadiyah Surakarta.

In the research conducted by Faizi et al., (2015) Adult respondents in India showed a significant relationship between sleep duration and nutritional status. Lack of sleep causes the hormone ghrelin to increase and decrease the hormone leptin which functions to suppress satiety (Duraccio et al., 2019). Ghrelin is a hormone that is released in the stomach to send hunger signals to the brain. Levels of this hormone usually increase when the stomach is empty (Howick et al., 2017). Meanwhile, leptin is a hormone released from fat cells to suppress hunger and send satiety signals to the brain (AlHussaniy et al., 2021).

In the research Amrynia & Prameswari (2022) stated that there was a significant relationship between sleep duration and nutritional status. Lack of sleep duration (2-4 hours/day) results in a loss of 18% leptin and an increase in ghrelin by 28% so that it can lead to an increase in appetite of approximately 23-24% (Afriani et al., 2019). Lack of sleep can also cause increased levels of the hormone cortisol. Cortisol levels are another metabolic hormone that affects the duration of a short night's sleep. An increase in the hormone cortisol encourages a person to overeat (Chiu et al., 2024). This affects insulin levels in the blood so that fat deposits increase (Hirotsu et al., 2015).

Conclusion

There was a relationship between protein intake (p=0.028), fat (p=0.003), carbohydrate (p=0.024) and sleep duration (p=0.048) on nutritional status. For students, it is hoped that students will know what factors can affect nutritional status, including maintaining food intake because it can affect health in the future. And for the next researcher, it is hoped that it can develop other factors that affect nutritional status such as lifestyle, physical activity, psychological factors, body fat composition and micronutrient intake.

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