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Correlation between Macronutrient Intake and Body Weight among Adults and Elderly Prolanis Participants

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ABSTRACT

Prolanis is a chronic disease management program for seniors where the focus is on promoting and preventing chronic disease; however, currently limited research has examined the correlation between nutritional intake and body weight within elderly Prolanis participants. The objective of this study was to investigate the relationship between specific macronutrient intake therefore measuring energy, protein, fat, carbohydrates, and fibre and body weight for older Prolanis participants. This study employed a cross-sectional research design consisting of 42 elderly Prolanis participants from the Kedaton Public Health Centre in Bandar Lampung. Nutritional intake data were recorded using 2x24-hour food recall and analysed through a nutrition analysis program. Body weight was measured using a calibrated digital scale. Data from this study were evaluated using Pearson rank correlations and multiple linear regression analyses. Statistically significant associations were found between each type of macronutrient (energy - $p=0.034$; $r=0.328$), protein - $p=0.011$, $r=0.391$), fat - $p<0.001$, $r=0.578$), and fibre - $p=0.002$; $r=0.472$) and body weight. Of all the different types of macronutrients, fat intake was statistically the most important predictor of body weight in older adults ($p=0.008$). There was no statistically significant correlation between carbohydrate intake and body weight ($p=0.212$). Thus, among Prolanis participants, the intake of all types of macronutrients - in particular, fat intake - has statistically significant associations with body weight. Therefore, the Prolanis program has an opportunity to strengthen nutrition-based education and dietary monitoring to ensure that older adults maintain optimal nutritional status.

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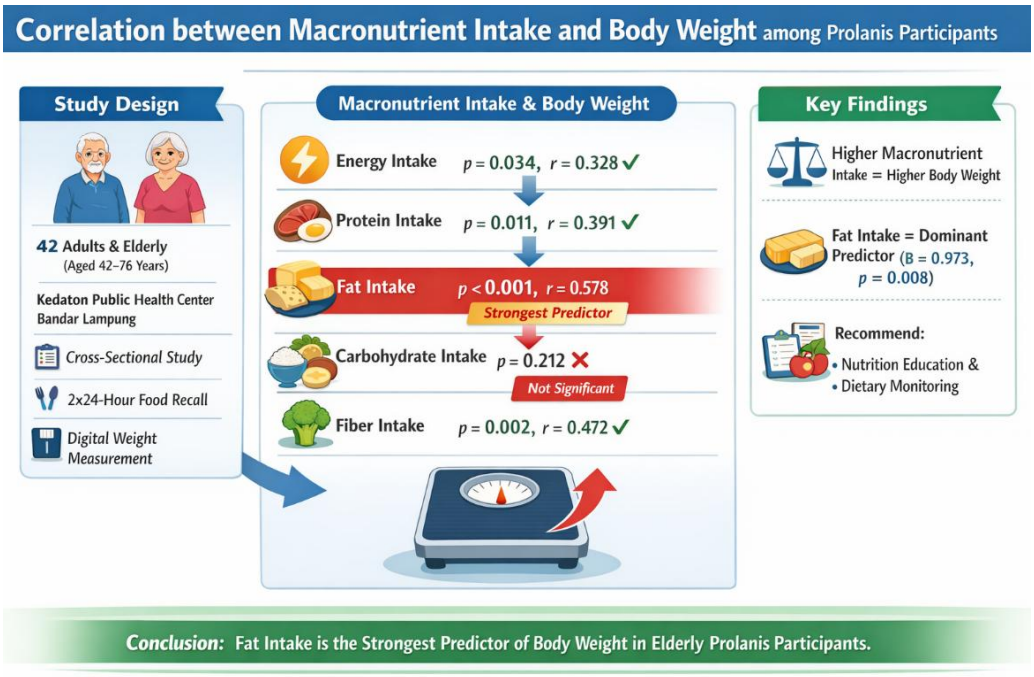
Key Messages:

- Macronutrient intake is significantly associated with body weight among Prolanis participants, particularly energy, protein, fat, and fiber intake.
- Fat intake is the strongest predictor of body weight in older adults, showing the highest correlation compared to other macronutrients.
- Nutrition education and dietary monitoring in Prolanis should emphasize fat control and balanced nutrient intake to support healthy aging and weight management.

GRAPICHAL ABSTRACT



INTRODUCTION

An increasing life expectancy indicates success in health development; nevertheless, it also presents new challenges resulting from an increase in the size of the elderly population (1). The global older adult population continues to grow, and this trend is expected to accelerate over the next several decades (2). Population aging is a growing phenomenon in Indonesia with a continuously increasing annual number of individuals aged 60 years and over (3). The ageing population also contributes to an increased prevalence of non-communicable diseases such as hypertension, diabetes and cardiovascular diseases, all of which are closely related to nutrition and dietary pattern (4).

Prolanis (Chronic Disease Management Program) participants with a high prevalence of nutrition problems were identified in Indonesia, particularly among those who were overweight or obese. Reports have shown that more than 50% of Prolanis members have either excess weight or obesity, and these two conditions greatly increase the risk of metabolic disorders/cardiovascular complications (5,6). There have also been findings that, in specific regions, including the Province of Lampung, people aged 60 years and older, who participate in Prolancis, have high levels of overweight and obesity, representing the increasing burden of nutrition-related chronic diseases in elderly populations (7). The prevalence of nutrition relation diseases in this make it imperative to investigate dietary factors that contribute to metabolic diseases in the Prolansis population. One of the primary dietary components that warrants attention concerning the relationship between fat consumption and metabolic disease is a high fat consumption related to the increase of energy consumed (i.e., caloric intake plus energy from non-caloric sources), thereby contributing to excess fat and metabolic disease (8,9). Furthermore, older individuals with low physical activity can lead to excess fat due to a lower metabolic rate and fat-burning capacity for those who have a higher fat dietary consumption (10). Therefore, it is important to consider the role of a macronutrient, particularly fat, when developing appropriate nutritional strategies to address Metabolic Disease and Excessive Weight among Older Adults who are involved in health management programs for chronic diseases.

As we age, our bodies undergo a variety of physiological changes. Significant among these are the loss of muscle mass (known as sarcopenia), higher levels of body fat mass and decreased basal metabolic rate (which all contribute to energy and nutrient needs) (11,12). In addition to experiencing these physiological changes, older people are also affected by changes to their digestive function, a reduction in appetite and impaired absorption of nutrients (13). The combination of these factors makes older adults a high-risk group for nutritional issues such as obesity and undernutrition.

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The dietary nutrients that make up the body's energy, protein, fat, and carbohydrate level play a role in preserving overall metabolic function and maintaining body weight and composition within a healthy range (14). There is evidence that not receiving enough energy from the diet can lead to weight loss; that low dietary protein intakes have been related to lower muscle mass and increased risk of frailty among older individuals. In contrast, too much dietary fat is associated with higher risks of both cardiovascular diseases and obesity, while a sufficient amount of dietary fiber can assist with both weight management as well as metabolic health (15–18).

The body weight is a single anthropometric indicator, used to assess a person's nutritional status, and indicates how well their energy intake matches their energy requirements (19). When living in the older person's community, wise ways to live help prevent unintended weight loss or excess body weight which can lead to increased risks for morbidity and chronic disease (20). Because of the importance of monitoring body weight in conjunction with dietary intake patterns for older people as part of both promotive and preventative health programs, it is essential to have a clear understanding of what constitutes a healthy lifestyle for an older person.

In Indonesia, the management of chronic disease in older people is done through BPJS Kesehatan's Chronic Disease Management Program (Prolanis) which provides health education, medical monitoring, and improved adherence to treatment through a promotive and preventative health-focused program (7). Although many researchers have studied how macronutrient intake affects body weight in those with chronic disease; very few studies have examined macronutrient intake as a factor that relates to the body weight of Prolanis participants. This information is needed as a basis for developing more effective nutritional interventions to help control chronic disease and improve the quality of life of older people. Thus, the study reported herein was conducted to evaluate the relationship between macronutrient intake and body weight among Prolanis participants.

METHODS

This research used an observational and analytical study with a cross-sectional design. This research was conducted with participants of the Chronic Disease Management Program (Prolanis) at Kedaton Community Health Center, Bandar Lampung. The population consisted of adults and elderly people, totaling 42 who met the criteria of inclusion into the study, that included being aged from 42 years to 76 years, and have actively participated in Prolanis, as well as being willing to be respondents for the study. The sampling was done through total sampling of all eligible respondents for the study. The data that were collected to describe subject characteristics, such as age, sex, education, and a history of nutrition counseling by the subjects were obtained from interviews with a structured format. Nutritional intake of macronutrients, including: energy, protein, fat, carbohydrate, and fiber, was collected using 2×24-hour dietary recall method on weekdays and holidays. Nutritional Analysis software was used to analyze the average daily intake of macronutrients using Indonesian food composition table (TKPI) 2020. Weight of the subjects was measured on a digital scale with an accuracy of 0.1 kg. Data were analyzed by univariate methods to analyze the data describing subjects' characteristics and mean macronutrient intake. The data was analyzed using bivariate methods using Pearson correlation coefficients to determine whether macronutrient intake is related to body weight. Use of multiple linear regression methods for multivariate analysis to identify the most significant predictors or contributing factors to body weight of elderly people. Statistical significance was evaluated for each variable at an alpha level of ≤ 0.05.

CODE OF HEALTH ETHICS

The study received ethical clearance from the Tanjungkarang Health Polytechnic of the Indonesian Ministry of Health with registration number 423/KEPK-TJK/V/2024. The participants provided informed consent prior to participation, ensuring their voluntary involvement in the study.

RESULTS

The demographic characteristics for the study subjects seen in Table 1 provide information on participants' distributions for age, sex, educational attainment, and experience receiving nutrition counselling. These demographics will provide a context in which understanding each Prolanis participant's nutritional intakes and bodyweight can be considered.

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Table 1. Characteristics of subjects

Characteristics	n	(%)
Age		
< 60 years	10	23.8
60–70 years	26	61.9
70–80 years	6	14.3
Sex		
Male	13	31
Female	29	69
Education Level		
Did not complete elementary school	1	2.4
Elementary school graduate	2	4.8
Junior high school	9	21.4
Senior high school	14	33.3
College/University	16	38.1
Nutrition Counseling		
Never	28	66.7
Ever	14	33.3

Based on Table 1, the majority of subjects were in the 60-70 year old range (with 26 subjects or 61.9%), followed by subjects under 60 (10 subjects or 23.8%), and then by much smaller number of subjects in the 70-80 year old range (6 subjects or 14.3%). With respect to sex distribution, the overwhelming majority of the participants were female (with 29 of the 42 subjects or 69%) while 13 of the 42 subjects (31%) were male. With respect to educational attainment, the majority of the subjects had a relatively high level of education (16 subjects or 38.1% had graduated from college or university and 14 subjects or 33.3% graduated from senior high school), while 9 subjects (21.4%) had graduated from junior high school, 2 subjects (4.8%) had graduated from elementary school, and one subject (2.4%) had never graduated from elementary school. In terms of nutrition counselling exposure, the majority of subjects reported that they had never before received any nutrition counselling (i.e., 28 subjects or 66.7%), while the remaining 14 subjects (33.3%) reported having previous exposure to nutrition counselling. These findings illustrate that the majority of the study participants were female, within the age range of 60-70 years, and possessed moderate to high educational attainment, and most had not yet been exposed to formal nutrition counseling.

Table 2. Correlation between macronutrient intake and body weight among prolanis participants

Macronutrient Intake	Mean	Std. Deviation	p	r
Energy	933.205	626.0214	0.034*	0.328
Protein	35.555	28.0834	0.011*	0.391
Fat	29.464	29.0140	<0.001*	0.578
Carbohydrates	118.612	65.3309	0.212	0.197
Fiber	6.252	5.0226	0.002*	0.472

*Pearson test, significant p<0.05

Table 2 displays how macronutrient consumption correlates to body weight in the Prolanis participants, along with the average consumption rates and standard deviations for each of the correlations. The average energy consumed by participants in Prolanis was 933.205 with a standard deviation of 626.0214. There was a statistically significant correlation between energy consumed and body weight (p=0.034) with a moderate positive correlation coefficient of r=0.328, indicating that as energy consumed increased, so did body weight. The average protein consumed was 35.555 with a standard deviation of 28.0834. The protein consumed was also statistically correlated with body weight (p=0.011) with a moderate positive correlation coefficient (0.391), indicating that participants who consumed more protein also tended to have a higher body weight. The average fat consumed was 29.464 with a standard deviation of 29.0140, and fat had the strongest correlation of the macronutrients when related to body weight. The relationship between fat consumed and body weight was statistically significant (p=0.000) and there was a relatively strong positive correlation coefficient (0.578), indicating that higher fat consumption was related to higher body weight.

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Mean carbohydrate consumption was 118.612; the standard deviation was 65.3309. The correlation analysis did show a statistically significant relationship between carbohydrate consumption and body weight (p=0.212), with the relationship being weakly (r=0.197) correlated. Therefore, carbohydrate consumption would not significantly affect how someone's body weight varied from other person's body weight in this sample. Mean fiber consumption was 6.252; the standard deviation was 5.0226. The analysis showed that there was a statistically significant positive correlation between fiber consumption and body weight (p=0.002), and moderate (r=0.472) correlation. This means that individuals who consumed a greater amount of fiber tended to have a higher body weight. In general, the study's results indicate that energy consumed, protein consumed, fat consumed, and fiber consumed were significantly related to the body weight of Prolanis participants, with fat consumption having the greatest relationship; while there were no significant relationships between carbohydrate consumption and body weight.

Table 3. Factors affecting body weight in the elderly

Macronutrient Intake	B	p	OR
Constant	59.749	0.034	–
Fat	0.973	0.008*	0.499 (0.141–0.857)

* Multiple linear regression, significant p<0.05

The results of the multivariate analysis reported in Table 3 determine how body weight is influenced by various predictors among older adult Prolanis participants. In the regression model, fat intake was found to be a significant predictor of body weight after other variables in the regression model were controlled for. The regression constant was calculated to be 59.749 with a p=.034, indicating that this regression model was statistically significant. This number represents the estimated body weight in the absence of independent variable (fat intake) being equal to 0. The fat intake regression coefficient (B) was 0.973 with a statistically significant p=.008 indicating that for every unit (kg) of fat increase there would be approximately 0.973 (kg) units of increase in body weight, all other things being equal. The fat intake regression coefficient is positive which indicates that there was a direct relationship between the amount of fat that the elderly participants consumed and their body weight. Fat intake had an odds ratio (OR) of 0.499 with a 95% confidence interval of 0.141 to 0.857 and since the OR < 1, and since the confidence interval we determined does not cross 1 and is also statistically significant, it can be determined that the amount of fat was independently associated with body weight of elderly Prolanis participants for this study. Thus, the multivariate analysis shows that fat was the most influential macronutrient affecting the body weight of elderly participants of this study. This result reinforces the findings from the bivariate analysis, highlighting fat consumption as the dominant dietary factor associated with variations in body weight in this study.

DISCUSSION

In this study, there were very notable positions connecting an elderly Prolanis participant’s body weight to their intake of energy, protein, fat and fibre; with consumption of fat being identified as the primary force behind them. These results support the energy balance theory which states that a person's body weight is the result of the interplay between how much energy a person has taken in and how energetically active they are (21). An older person has a much slower basal metabolic rate as compared to younger persons along with quite a reduction in physical activity (10). Thus, they will have considerably lower energy requirements when compared to younger persons and are subsequently much more likely to gain body fat when they have a surplus of energy (22). In conclusion, this study has shown that an older person's intake of energy on a daily basis is related to their relationship with their energy have highly likely have an additional 6% body fat each year if they eat more energy than they need on any given day based upon comparisons made with their eating habits over the last 10 years with the eating habits of older adults (23). Hence, an older adult will increase their body fat level by 6% each year when they consistently consume energy beyond what their basic energy needs are when consuming more than enough food to provide them with energy.

Protein intake also showed a significant positive correlation with body weight (24). Protein plays a crucial role in maintaining muscle mass and preventing sarcopenia in older adults (25). A recent meta-analysis reported that adequate protein intake is associated with improved lean body mass and a lower risk of sarcopenia among the elderly (26). In the context of this study, the positive correlation may indicate that elderly individuals

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with higher protein intake tend to have better overall body mass, including both fat and muscle components.

In the study's multivariate analysis, fat intake was found to be the most influential factor associated with body weight. This is due to the fact that fat has the greatest energy density of all macronutrients (i.e., 9 Kcal/gram) compared to both protein and carbohydrate (i.e., 4 Kcal/gram), so a greater amount of fat consumed increases total caloric intake greatly. Previous research has indicated that high fat dietary patterns are positively correlated with being overweight/obese and having higher body mass index in both adult and older populations (27,28). For older adults who have very low levels of physical activity, increased fat intake may promote storage of body fat and lead to weight gain. On the other hand, carbohydrate consumption in this study was not significantly related to body weight. One possible reason for this finding is the types of carbohydrates consumed (i.e. simple vs. complex). Prior literature suggests that not just the amount, but also the type of carbohydrate consumed, e.g. glycemic index, fibre content; have an impact on weight management (29).

Older adults who are very inactive tend to have higher body fat proportions from dietary fats because of multiple physiological and metabolic changes that occur as part of the aging process. Although the basal metabolic rate (BMR) declines with age because of the significant loss of skeletal muscle mass (sarcopenia), resulting in lower energy needs, the excess amount of energy consumed can ultimately be stored as body fat instead of being used for energy through the metabolic process (30). This increased ability to store dietary fats as a result of the energy density of fat (9 kcal/g) can be an efficient method of energy storage and will occur as long as dietary fat is consumed, broken down (into fatty acids) by the gut, absorbed into the bloodstream by enterocytes, re-esterified into triglycerides inside enterocytes, and transported as part of a chylomicron in the bloodstream (31). Adipose tissue has an enzyme called lipoprotein lipase (LPL) that breaks down these triglycerides into fatty acids, which then enter the adipocyte (fat cell) where they are reassembled into triglycerides (32).

Additionally, older adults experience a loss of the ability to oxidize fatty acids for energy because mitochondrial function is lost and oxidation of fatty acids is less efficient (10,33). In addition to the loss of energy, low levels of daily physical activity lead to reduced total daily energy expenditure through muscle use and thus limit the oxidative metabolism of circulating fatty acids and therefore increase the amount of fatty acids stored in adipose tissue (34). Age related hormonal changes also increase fat accumulation by decreasing levels of hormones that stimulate fat burning and increasing levels of hormones that promote fat storage (35,36). For example, growth hormone, testosterone, estrogen and insulin act collaboratively to limit the amount of fat stored within the body (37). So, due to the combination of age-related physiological/metabolic changes and low amounts of physical activity in older adults, dietary fat is more easily converted to triglycerides and stored as fat tissue. Therefore, older adults with low levels of physical activity are at a greater risk of developing additional body fat and/or metabolic diseases.

The results from the current study demonstrate that there is a positive correlation between fiber consumption like vegetables and fruits and body mass index (BMI). It has been argued that fiber is associated with body weight control in part because of its capacity to promote satiety and may therefore reduce total caloric intake (i.e., energy consumed). However, this positive association between fiber intake and BMI in this study may be due to individuals who consume larger quantities of food (total caloric amount) also consuming greater amounts of fiber. Accordingly, fiber intake in this particular instance may merely serve as an overall measure of dietary volume instead of providing a direct protective effect on body weight. This finding is consistent with previous studies which found that overall dietary patterns appear to have a greater impact on an individual's nutritional status compared to specific nutrients (38).

Based on these findings and the importance of whole body weight management through macronutrient composition, the significant contribution made by fat intake suggests that there is value in furthering nutrition and wellness education aimed at moderating fat intake and establishing energy balance to achieve a healthy body weight and reduce risks for complications(from) chronic diseases through the Prolanis program. There are some limitations to the study that needs to be acknowledged in the interpretation of the findings. The limitation of this study is that it focused specifically on macronutrient intake, and other factors that affect body weight were not considered, such as level of physical activity, presence of disease, or general quality of diet. In this study body weight was the sole measure used as a proxy for nutritional status. For older adults, body weight alone may not adequately represent nutrition status, because an older person may experience a change in body composition (e.g., loss of muscle mass, gain of fat-mass) without having a significant change in their body weight. For future research, researchers suggest using Body Mass Index (BMI) or body composition (fat mass vs muscle mass) to

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see the nutritional status of Prolanis participants more comprehensively.

CONCLUSION

This research reveals how the intake of macronutrients is related to the weight of aged people in Prolanis study. Their energy, protein, fat and fibre intakes have all positively correlated to their weights. Their carbohydrate intake, however, did not have any significant relationship with their weight. All of the macronutrients we analysed were significant in predicting a person's weight but fat was the most strongly related when we carried out our multivariate analysis. Therefore, this suggests that the composition of a person's diet especially fat helps determine someone's weight as they age. The higher a person consumes energy dense nutrients their body weight will be higher particularly for older adults who are generally considered to have a decreasing metabolism and lower levels of activity. Adequate amounts of protein can also help an individual to maintain their body mass and likely reflect an individual's total amount of body fat and muscle. In addition, the findings from this research indicate that chronic disease management programs such as Prolanis need to incorporate more nutrition education and diet monitoring especially when it comes to achieving an adequate amount of energy in the diet and controlling fat intake. By implementing early nutritional intervention and providing routine dietary assessments older adults may maintain an optimal body weight and achieve healthier aging. Researchers recommend that community health centers provide special nutritional counseling sessions that focus on limiting saturated fat, considering that fat was found to be the strongest predictor of body weight in this study.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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