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Women osteoporosis prevention by protein, fat, vitamin D, phosphorus intake and chicken feet cookies consumption as source of calcium

Pencegahan osteoporosis pada perempuan dengan asupan protein, lemak, vitamin D, fosfor dan konsumsi cookies ceker ayam sebagai sumber kalsium

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Abstract

Osteoporosis as a major health problem has four times risk in women than men. Protein, fat, vitamin D, and phosphorus are the main nutrients in bone development. Through this study, it can be known protein, fat, vitamin D, and phosphorus changes from the consumption of cookies chicken feet flour (Gallus domesticus), containing 130 mg calcium, equivalent to 15% of RDA to prevent osteoporosis due to low calcium intake with a quasi-experimental pre-test and post-test approach with control in women early adulthood for 14 days in Health Office of Tasikmalaya District in June 2022, with 102 people as sample based on Slovin's calculation with 10% of margin error through the multistage sampling method, which consists of cluster random sampling and simple random sampling. Observation of protein, fat, vitamin D, and phosphorus using the semi food frequency questionnaire. Data analysis used Post Hoc LSD. Based on data analysis, it is known that the difference in protein, vitamin D, and phosphorus intake significantly different with p> 0,05 of the three groups each other. While the difference in fat intake significantly different from the positive and negative control groups with p> 0,05. Consumption of cookies can increase protein, fat, vitamin D, and phosphorus intake.

Keywords: Calcium source, chicken feet, cookies, food consumption, osteoporosis,

Abstrak

Osteoporosis sebagai masalah kesehatan utama empat kali lebih berisiko terjadi pada perempuan dibandingkan laki-laki. Protein, lemak, vitamin D, dan fosfor merupakan zat gizi utama perkembangan tulang. Melalui penelitian ini dapat diketahui perubahan protein, lemak, vitamin D, dan fosfor dari konsumsi *cookies* dengan komposisi utama tepung ceker ayam ras (*Gallus domesticus*) yang mengandung 130 mg kalsium, setara 15% AKG kalsium untuk mencegahan osteoporosis akibat asupan kalsium rendah dengan metode penelitian kuasi eksperimental dengan pendekatan *pre-test and post-test with control* pada perempuan usia dewasa awal selama 14 hari di wilayah kerja Dinas Kesehatan Kabupaten Tasikmalaya pada bulan Juni tahun 2022, dengan sampel 102 orang berdasarkan perhitungan *Slovin* dengan *margin of error* 10% melalui metode *multistage sampling*, yang terdiri dari *cluster random sampling* berupa *cluster* Puskesmas, dan *simple random sampling.* Pengamatan protein, lemak, vitamin D, dan fosfor menggunakan metode survey konsumsi pangan semi *food frequency questionnaire*. Analisis data menggunakan *Post Hoc LSD*. Berdasarkan analisis data diketahui perbedaan asupan protein, vitamin D, dan fosfor ketiga kelompok berbeda signifikan satu sama lain dengan p > 0,05. sedangkan perbedaan asupan lemak kelompok intervensi berbeda signifikan dengan kelompok

kontrol positif dan negatif dengan p > 0,05. Konsumsi *cookies* mampu meningkatkan asupan protein, lemak, vitamin D, dan fosfor.
Kata Kunci: Ceker ayam, *cookies*, konsumsi makanan, sumber kalsium, osteoporosis

Introduction

Osteoporosis is a public health problem characterized by low bone density, damage to bone tissue, and disruption of the bone microarchitecture, which can cause bone fragility and increase the risk of fractures (Sozen et al., 2017). The inability of the body to regulate the mineral content in the bones interferes with the bone metabolic process (Sani et al., 2020). According to the National Health Consensus Institutional Development Conference in Samudro & Yusril (2020), osteoponrosis is a bone disorder characterized by reduced bone strength, resulting in an increased risk of fracture. Osteoporosis is a combination of bone conditions that become thin, brittle, porous, and have a tendency to break owing to reduced bone density over a long time. Osteoprosis occurs because the process of bone erosion and formation is unbalanced. Bone erod-ing cells, such as osteoclasts, make holes in the bone faster than osteoblasts, which makes new bone fill the holes, so that the bone decreases in density and becomes brittle and easily broken (Samudro & Yusril, 2020; Sani et al., 2020).

Everyone is at risk of losing bone density and will progress to osteoporosis if no immediate action is taken (Faizah & Fitranti, 2015). A person's bone density is determined by several factors, such as genetic factors; physical factors, such as physical activity and body weight; and nutritional factors, including protein, calcium, and phosphorus. Genetic factors play a role in 70-75% of bone mineral mass, while environmental factors, such as physical activity and nutritional factors play only 25-30% (Noprisanti et al., 2018). Immutable factors that can affect bone density include sex, age, genetics, and hormones (Faizah & Fitranti, 2015). Every ten-year increase in age increases the risk by 1,4 to 1,8 times (Samudro & Yusril, 2020). Indicators of osteoporosis incidence include spinal cord injury or fracture and long-term sustained back pain (Pusdatin, 2020).

Osteoporosis is ranked second, behind heart disease, as the world's leading health problem (Cooper & Ferrari, 2019), and the global prevalence of osteoporosis was 200 million in 2009. The prevalence of osteoporosis in Indonesia was 10,3% in 2005. In addition, the prevalence of early osteoporosis in Indonesia is 41,7%; therefore, two out of five Indonesians are at a risk of osteoporosis (Pusdatin, 2020). An increasing incidence of osteoporosis is associated with increasing age and poor eating habits (Khai-rani et al., 2018).

Osteoporosis can occur in both women and men; however, women are four times more likely to suffer from osteoporosis than men (Alswat, 2017). The incidence of osteoporosis is more striking in women because it is related to a progressive decline in the function of the hormone estrogen (Humaryanto & Syauqy, 2019). In addition, women tend to lose bone density faster at a younger age, so women have twice the incidence of early osteoporosis compared to men (Alswat, 2017). Currently, osteoporosis is a disease that requires serious attention because it can cause disability, fractures, and death. Treatment of osteoporosis requires a long time, high cost, and prolonged suffering. Osteoporosis is at a level that should be monitored (Nopi et al., 2020). Long-term low calcium intake leads to in-creased reduction in bone density resulting in

Bone fragility and increased risk of fractures have been reported (Akkawi & Zmerly, 2018). Low calcium intake is an environmental factor affecting the incidence of osteoporosis (Samudro & Yusril, 2020).

Research conducted by Faizah & Fitranti (2015) showed that 90% of peak bone development occurs at ages starting from 18 years for women and starting from 20 years for men; therefore, it is known that peak bone development occurs before the age of 30 years and is the best time to invest in bone density. Managing dietary intake in adult women is a more effective osteoporosis prevention target (Karim et al., 2023). Non-pharmacological interventions for osteoporosis include maintaining adequate calcium, vitamin D, and protein intake (Samudro & Yusril, 2020). CalCa is the most abundant mineral in the human body.

Calcium is essential for maximizing peak bone formation during adolescence. Calcium absorption varies greatly depending on age and body condition. During the growth period, approximately 50-70% of the digested calcium can be absorbed, and the absorption ability is higher during the growth period (Faizah & Fitranti, 2015).

The formation of healthy bones is not only achieved by consuming enough calcium, but other substances are also needed to improve the mineral distribution process and balance nutritional needs. These nutrients consist of vitamins such as vitamin D, and minerals such as phosphorus (Samudro & Yusril, 2020). According to Pusdatin (2020), calcium, protein, and phosphorus are also nutrients that make up bones. Phosphorus is one of the elements of bone formation because it is needed in the bone mineralization process. Phosphorus intake has a fairly important role in bone formation during growth. Low serum phosphate levels limit bone formation and mineralization. Phosphorus can also help balance the nutritional needs of bones (Samudro & Yusril, 2020). Vitamin D intake can impair bone development (Ristati et al., 2015; Ristati et al. 2017). If the body lacks vitamin D both from food intake and from the body with the help of sunlight, calcium absorption can be disrupted and then the bone mineralization process is also disrupted (Karim et al., 2023). Vitamin D plays a role in calcium absorption, and fat can increase food transit time to increase calcium absorption time (Almatsier, 2009; Audina, 2019).

Chicken feet cookies are an innovative functional food product claimed to be a calcium source product. Chicken feet cookies made from chicken feet flour (*Gallus domesticus*), per serving, contain 130 mg of calcium, equivalent to 15% of the calcium RDA for early adulthood. Chicken feet cookies were made based on the best formulation from research conducted by Ramadhania (2020) and then came to an intervention in this study as an alternative to prevent osteoporosis due to low calcium intake. This study aimed to examine changes in protein, fat, vitamin D, and phosphorus intake with the consumption of chicken foot cookies. Through this study, the interaction of calcium with protein, fat, vitamin D, and phosphorus on the prevention of osteoporosis can be elucidated.

Methods

This was a quasi-experimental study with a pre-test and post-test design and a control approach. This study was conducted on women in early adulthood in the working area of the Tasikmalaya District Health Office in June 2022.

Based on data on the total population by age group and sex in Tasikmalaya Regency, it is known that the number of women in the early adult age group is 245,374 people, so sampling was carried out using a multistage sampling method, namely the cluster random sampling method in the form of cluster health centers in the Tasikmalaya District Health Office work area, and a simple random sampling method with the following inclusion and exclusion criteria: Inclusion criteria consisted of women aged 18 to 35 years, living in Tasikmalaya Regency, not having food allergies, not taking calcium supplements, and willing to participate in the study. The exclusion criteria were pregnancy, breastfeeding, BMI <18,5, active smoking, consuming alcoholic beverages, having a history of fractures, suffering from anorexia and/or bulimia eating disorders, having celiac disease and/or Crohn’s disease, and taking corticosteroid medication.

The sample size calculation used the Slovin formula with a margin of error set at 10% or 0,1. The calculation of the sample size with a population of 245,374 people is as follows:

$n = N/(1+(Nxe^2))$

$n = 245{,}374/(1+(245{,}374x0{,}1^2))$

$n = 245{,}374/(1+(245{,}374x0{,}01))$

$n = 245{,}374/(1+2453{,}74)$

$n = 245{,}374/2454{,}74$

$n = 99{,}95$

Description:
n : Sample size
N : Population size
e : Margin of error

If rounded, the minimum sample size at a margin of error of 10% or 0,1 is 102 people.

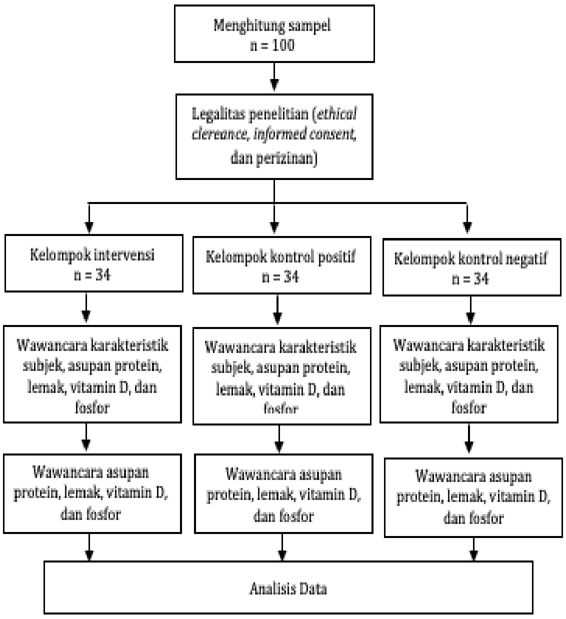

Figure 1. Research flow framework

The sample was divided into three groups: the intervention, positive control, and negative control groups. The intervention group was given chicken feet cookies as much as three servings per serving per day to fulfill the calcium source nutrient content of 15% ALG according to the Food and Drug Administration. (BPOM RI, 2019). The positive control group was given commercial products in the form of biscuits with a calcium content of 180 mg per serving, whereas the negative control group was given nothing. Consumption of chicken feet cookies and commercial products was monitored in the form of daily consumption records in the chicken feet cookies consumption form and biscuit consumption form.

In an effort to fulfill the legality of the research, the author made ethical clearance with No. 16/KEPK/EC/IV/2022 issued by the Bandung Polytechnic Health Research Ethics Commission and Research Licensing. Informed consent was obtained from all participants. The study continued with data collection using the interview method with the help of research instruments in the form of sample characteristic forms and semi-food frequency questionnaire forms.

The study was conducted for 14 days based on previous research conducted by Ka-malah & Tina (2022) to observe changes in protein, fat, vitamin D, and phosphorus intake with the consumption of chicken feet cookies. Changes in protein, fat, vitamin D, and phosphorus intake can be seen by examining the difference in intake before and after the intervention. Thus, the pretest was conducted at H0, and the posttest was conducted at H15. The data obtained in the form of primary data were seen one by one carefully observed and then entered into a computer program for processing, and the results of data analysis were obtained. The data analysis used was frequency distribution calculation, Kolmogorov–Smirnov test, and Post Hoc LSD.

Result and Discussion

The sample was screened based on the inclusion and exclusion criteria, obtained as many as 102 women in the early adult age group in the working area of the Tasikmalaya District Health Office spread across several Public Health Center (PHC) based on the results of randomization of all PHC operating in the working area of the Tasikmalaya District Health Office spread across several PHC. Some PHC operating in the working area of the Tasikmalaya District Health Office were selected in an effort to represent three areas in Tasikmalaya District in the form of agricultural, coastal, and forestry areas. The Tasikmalaya district was selected as the research location based on the data of average bone density and calcium intake below the recommended normal limit based on postmenopausal women in the Tasikmalaya district.

Most of the samples from the intervention, positive control, and negative control groups were 20 years old. Based on occupation, most of the samples from the intervention, positive control, and negative control groups were students. Further-more, based on the last level of education of both the intervention group, positive control group, and negative control group.

The sample's last level of education was a high school graduate. The physical activity of the samples from the intervention, positive control, and negative control groups were classified as moderate physical activity. The nutritional status of the intervention, positive control, and negative control groups was mostly normal.

Using the Kolmogorov–Smirnov test for normality testing with a p-value on sample characteristics, it is known that the p-value for sample characteristics is <0,05, so it is stated that the sample characteristics have an abnormal data distribution.

Table 1. Sample cCharacteristics

Characteristic	f	%	P[a]
Age (Year)			
18	8	7,8	0,010
19	25	24,5	
20	30	29,4	
21	29	28,4	
22	4	3,9	
23	6	5,9	
Last Education			
High school/equivalent	86	84,3	0,001
College	16	15,7	
Work			
Students	98	96,1	0,001
Doesn't work	4	3,9	
Physical Activity			
Light	24	23,5	0,001
Currently	76	74,5	
Heavy	2	2	
Nutritional status			
Normal	62	60,8	0,001
Overweight	15	14,7	
Obesity I	18	17,6	
Obesity II	7	6,9	

Source: Primary Data (2023)
a) (p > 0,05) *Kolmogrof Smirnov* Test

Age is a high-risk factor for the incidence of osteoporosis; the process of bone development only lasts up to the age of 25 years. (An-darini *et al.*, 2020; Martanti *et al.,* 2018). As we age, the body's metabolism tends to decrease (Nurrahmawati & Fatmaningrum, 2018). Bones not only function as body supports but also play a role in maintaining homeostasis of calcium levels in plasma and extracellular fluid (Jemima & Fitriani, 2021).

Education is a guide for individuals to obtain information to expand their knowledge; knowledge is the ability to apply information so that their lives are of higher quality. The level of education will determine the selection of individual food consumption, in this case food consumption as an effort to prevent osteoporosis events, because the level of education affects the concern for prevention in the form of minimizing the risk of osteoporosis events (Dimyati, 2017). Education also influences the decision to have a slim body, so that a strict diet carried out by women in general during adolescence with the aim of losing weight triggers a decrease in estrogen hormones, causing the peak of bone development to be suboptimal (Faizah & Fitranti, 2015). Most of the sample's education level is high school graduates; these conditions affect knowledge about osteoporosis in this case, so the potential for osteoporosis is high if information about osteoporosis is not obtained.

Work is related to the regularity of the duration and intensity of physical activity carried out in individuals who are not productive; physical activity tends to be less when compared with productive individuals. The more regular the duration and intensity of physical activity, the lower the risk of osteoporosis (Dimyati, 2017). In this study, most of the participants were students, so it can be seen that the sample was classified as productive because it engaged in regular physical activity.

Physical activity is the average energy in kcal units expended in 24 h, calculated based on the type and length of activity per unit formed (Faizah & Fitranti, 2015). Physical activity involves a coordinated body movement process that can affect metabolic balance and bone development (Dimyati, 2017). Physical activity can influence bone density values, and adequate physical activity can optimize bone density (Faizah & Fitranti, 2015). Lack of physical activity in young individuals has an impact on bone density in old age (Marjan & Marliyati, 2015). When exercising, muscles will contract and urge bone tissue so that stress occurs in bone tissue, this can stimulate classification which triggers osteoblast work and an increase in bone density (Faizah & Fitranti, 2015). One of the causes of physical activity is a sedentary lifestyle, which has become a modern lifestyle (Dimyati, 2017). Most participants' physical activity is moderate.

Most of the nutritional status of the samples was normal, this was influenced by the author's efforts in screening samples which were limited by inclusion criteria and exclusion criteria, in this case BMI < 18,5 was part of the exclusion criteria. In line with the research conducted by Andarini et al. (2020), undernutrition is a risk factor for osteoporosis.

Nutrient intake, including protein, fat, vitamin D, and phosphorus intake, can change with the incidence of osteoporosis. Adequate intake can optimize bone density (Noprisanti et al., 2018). To determine intake, a food intake interview using the semi food frequency questionnaire method was conducted twice, namely during the pre-test and post-test (H0 and H15). The pre- and post-test results are presented in different tables.

Table 2. Overview of pre-test and post-test protein, fat, vitamin D, and phosphorus intake

Kelompok	Pre-Test			Post-Test		
	Less(%)	Normal(%)	Over(%)	Less(%)	Normal(%)	Over(%)
Protein (g)						
Intervention Group	19 (55,9)	5 (14,7)	10 (29,4)	7 (20,6)	10 (29,4)	17 (50)
Positive Control Group	26 (76,5)	4 (11,8)	4 (11,8)	15 (44,1)	9 (26,5)	10 (29,4)
Negative Control Group	27 (79,4)	5 (14,7)	2 (5,9)	30 (88,2)	3 (8,8)	1 (2,9)
Fat (g)						
Intervention Group	28 (82,4)	3 (8,8)	3 (8,8)	18 (52,9)	9 (26,5)	7 (20,6)
Positive Control Group	33 (97,1)	1 (2,9)	0 (0)	30 (88,2)	2 (5,9)	2 (5,9)
Negative Control Group	33 (97,1)	1 (2,9)	0 (0)	32 (94,1)	2 (5,9)	0 (0)
Vitamin D (μg)						
Intervention Group	34 (100)	0 (0)	0 (0)	34 (100)	0 (0)	0 (0)
Positive Control Group	34 (100)	0 (0)	0 (0)	34 (100)	0 (0)	0 (0)
Negative Control Group	34 (100)	0 (0)	0 (0)	34 (100)	0 (0)	0 (0)
Phosphor (mg)						
Intervention Group	17 (50)	6 (17,6)	11 (32,4)	3 (8,8)	8 (23,5)	23 (67,6)
Positive Control Group	22 (64,7)	5 (14,7)	7 (20,6)	14 (41,2)	5 (14,7)	15 (44,1)
Negative Control Group	20 (58,5)	7 (20,6)	7 (20,6)	30 (88,2)	1 (2,9)	3 (8,8)

Pre-test protein, fat, and phosphorus intake was mostly deficient in all three groups. Pretest vitamin D intake was mostly deficient in all three groups. Pre-tests in all three groups showed that protein, fat, and phosphorus intakes were mostly deficient. However, vitamin D intake was entirely deficient.

The post-test protein intake of the positive control and negative control groups was mostly classified as low, except for the intervention group, which was mostly classified as high. Fat intake was mostly deficient in all the three groups. Posttest vitamin D intake was mostly deficient in all three groups. Post-test phosphorus intake was mostly higher, except for the negative control group, which was mostly lower.

The results of the post-test protein intake of the positive control group and the negative control group were mostly lower, while the treatment group was mostly higher. The difference in protein intake between the positive control group, negative control group, and treatment group is thought to be due to the treatment group being given the intervention of consuming chicken feet cookies that were not consumed by the positive and negative control groups.

Protein intake is very important for bones because one-third of the bone mass is formed by protein and will continue to undergo remodeling. Many collagen fragments are released during proteolysis during the remodeling process and cannot be reused into new bone matrix; therefore, humans need protein every day (Faizah & Fitranti, 2015). Protein is one of the nutrients needed to achieve bone density by stimulating the formation of collagen in the bone matrix. Low protein intake can result in low bone density. However, high protein intake also has a conflicting effect on the calcium balance (Noprisanti et al., 2018). Excessive intake of both animal and vegetable proteins can trigger an acid-base balance response. High protein intake increases the risk of osteoporosis; however, the effect of protein intake on reducing bone density does not occur if calcium intake meets these needs. Calcium acts as a balancer for acid formation (Faizah & Fitranti, 2015). Calcium is the main ingredient in bone formation and plays a role in bone hardening (Noprosanti et al., 2018).

Fat intake was mostly deficient in all the three groups. Lack of fat intake can cause a decrease in gonadotropin levels in serum and urine influenced by fat; if fat intake is lacking, then gonadotropins and their secretion patterns will decrease, resulting in a disturbance in FSH and LH as well as estrogen and progesterone hormones, which can then result in the incidence of osteoporosis. Overall, if the intake of macronutrients is more than needed, it will be converted into fat stores, and high body fat stores can cause disturbances, but can return to normal if the intake of other nutrients is balanced according to needs (Athifah & Endayani, 2022).

Vitamin D intake was deficient in all three groups. There was no change in fat or vitamin D intake. If there is little vitamin D obtained by the body, calcium absorption will be less optimal (Jemima & Fitriani, 2021).

Phosphorus intake plays an important role in bone formation, the mineral phosphorus is the mineral part of bone. CalCa and phosphorus crystals form hydroxyapatite crystals that harden the bone. Low calcium and phosphorus intake, namely ≤ 0,5, disrupts calcium balance and increases bone resorption, characterized by increased PTH and calcium excretion in the urine (Faizah & Fitranti, 2015). Phosphorus is abundant in food; therefore, it is generally rare for individuals to experience phosphorus deficiency, except in conditions involving certain diseases (Marjan & Marliyati, 2015).

The results showed that the intake of protein, fat, vitamin D, and phosphorus changed with the consumption of chicken foot cookies. It has been proven that protein, fat, vitamin D, and phosphorus intake play a role in the consumption of chicken foot cookies as a source of calcium.

Table 3. Data distribution of protein, fat, vitamin D, and phosphorus intake

Group	p^a	p^b
Protein (g)		
Intervention Group	0,949	0,277
Positive Control Group	0,446	0,287
Negative Control Group	0,679	0,470
Lemak (g)		
Intervention Group	0,462	0,459
Positive Control Group	0,506	0,116
Negative Control Group	0,638	0,434
Vitamin D (µg)		
Intervention Group	0,101	0,593
Positive Control Group	0,110	0,919
Negative Control Group	0,107	0,438
Fosfor (mg)		
Intervention Group	0,620	0,327
Positive Control Group	0,444	0,936
Negative Control Group	0,860	0,817

a) Pre-Test (p>0,05) Kolmogrof Smirnov Test
b) Post-Test (p > 0,05) Kolmogrof Smirnov Test

From Table, 3, the results of testing the normality of protein, fat, vitamin D, and phosphorus intake in the three groups obtained a p-value> 0,05, so that all groups were declared to have normal data distribution.

Table 4. Differences in protein, fat, vitamin D, and phosphorus intake at pre-test and post-test

Variable		Group	Pre-Test		Post-Test	
			Difference	p	Different	p
Protein (g)	Intervention Group	Positive Control Group	6,52	0,137	14,38	0,006*
		Negative Control Group	10,71	0,015	35,91	0,001*
	Positive Control Group	Intervention Group	-6,52	0,137	-14,38	0,006*
		Negative Control Group	4,19	0,337	21,53	0,001*
	Negative Control Group	Intervention Group	-10,7	0,015	-35,91	0,001*
		Positive Control Group	-4,19	0,337	-21,53	0,001*
Fat (g)	Intervention Group	Positive Control Group	6,38	0,110	13,15	0,006*
		Negative Control Group	10,65	0,008	20,82	0,001*
	Positive Control Group	Intervention Group	-6,38	0,110	-13,15	0,006*
		Negative Control Group	4,27	0,283	7,67	0,104
	Negative Control Group	Intervention Group	-10,65	0,008	-20,82	0,001*
		Positive Control Group	-4,27	0,283	7,67	0,104
Vitamin D (µg)	Intervention Group	Positive Control Group	0,21	0,523	1,73	0,001*
		Negative Control Group	0,43	0,198	3,58	0,001*
	Positive Control Group	Intervention Group	-0,21	0,523	-1,73	0,001*
		Negative Control Group	0,22	0,504	1,85	0,001*

Phosphor (mg)	Negative Control Group	Intervention Group	-0,43	0,198	-3,58	0,001*
		Positive Control Group	-0,22	0,504	-1,85	0,001*
	Intervention Group	Positive Control Group	94,73	0,185	234,07	0,001*
		Negative Control Group	98,80	0,167	523,96	0,001*
	Positive Control Group	Intervention Group	-94,73	0,185	-234,07	0,001*
		Negative Control Group	4,06	0,954	289,89	0,001*
	Negative Control Group	Intervention Group	98,80	0,167	523,96	0,001*
		Positive Control Group	-4,06	0,954	-289,89	0,001*

*) There is a significant difference
p) LSD Post Hoc Test (p > 0,05)

Based on the results of data analysis using the Post Hoc LSD test, it is known that the differences in protein, vitamin D, and phosphorus intake of the three groups were significantly different from each other, while it is known that the difference in fat intake of the intervention group was significantly different from that of the positive control and negative control groups.

The limitations of this study lie in the type of research in the form of quasi-experiments, so that there are still variables that the authors cannot control, which can affect the results of the study. In addition, the number of samples taken was only a minimum sample owing to the limited time, energy, and costs owned by the author, which became another research limitation in this study.

Conclusion

The post-test intake of protein, fat, vitamin D, and phosphorous in the intervention group showed a higher change compared to the positive control group and the negative control group; therefore, it can be concluded that there are differences in the intake of protein, fat, vitamin D, and phosphorus at the time of the post-test. The intervention group had a higher intake of protein, fat, vitamin D, and phosphorus than the positive control group in the form of chicken feet flour cookies (*Gallus domesticus*) and the negative control group in the form of commercial calcium source products.

Further research should test the influence of the variables. It is necessary to conduct a broader study of the scope of factors affecting osteoporosis so that it can be a consideration or comparison for policy makers' program planning.

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