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# The Effectiveness of Virgin Coconut Oil and Extra Virgin Olive Oil on Weight Gain in Malnourished Rats

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## ABSTRACT

Malnutrition is characterized by inadequate food intake, posing significant health risks, especially in vulnerable populations such as children and adolescents. This study aimed to evaluate the effects of virgin coconut oil (VCO) and extra virgin olive oil (EVOO) on weight gain in malnourished white rats (*Rattus norvegicus*). This study used post-test only with control group design, with 24 male rats divided into four groups: negative control, VCO, EVOO, and VCO & EVOO combination. Treatment was given for 14 days, with weight measurements taken at baseline, day 7, and day 14. The results showed a significant increase in body weight in all treatment groups ($p < 0.05$). Although no significant difference was observed between the VCO and EVOO groups, a trend of greater weight gain was noted in the EVOO group. As conclusion, these findings indicate that VCO and EVOO can contribute to weight gain in white rats, although the effect is not significant. Further research is recommended to conduct long-term studies and include assessment of lipid profiles, glucose levels, and insulin to gain a deeper understanding of the effects of these oils.

**Keywords**: virgin coconut oil; extra virgin olive oil; body weight; *Rattus norvegicus*

## INTRODUCTION

Malnutrition, defined as consuming less than the required amount of food, can lead to serious biological disorders, including increased risks of infection, morbidity, and mortality, as well as declines in mental and cognitive development, particularly in early life.[1] Data from the World Health Organization (WHO) indicates that in 2014, 50 million children were malnourished, with 16 million suffering from severe malnutrition.[2] In Indonesia, particularly in South Sulawesi, the prevalence of malnutrition among toddlers reaches 25.6% and 6.6%.[2] This situation underscores the need for effective interventions to improve nutritional status, especially among vulnerable groups like children. In this context, virgin coconut oil (VCO) and extra virgin olive oil (EVOO) emerge as two products with potential health benefits, particularly in weight management. VCO is produced from fresh coconut meat without high heat processing, preserving many beneficial nutrients and bioactive compounds, including lauric acid, which has antimicrobial and anti-inflammatory properties.[3,4] EVOO, recognized for its health benefits, is rich in monounsaturated fatty acids and antioxidants that contribute to heart health and inflammation reduction.[5]

The comparison between VCO and EVOO in the context of weight management in white rats (*Rattus norvegicus*) is crucial, given the different compositions of fatty acids and bioactive compounds in these oils. Previous research indicates that EVOO has a higher polyphenol content, which enhances insulin sensitivity and reduces inflammation, while VCO is richer in medium-chain triglycerides that can boost energy and metabolism.[6–8] Research indicates that both VCO and EVOO function not only as food ingredients but also as potential therapeutic agents in weight management. The consumption of EVOO can reduce the risk of cardiovascular disease and improve blood lipid profiles, which are crucial for weight control.[8–10] Meanwhile, VCO has demonstrated positive effects in improving fat metabolism and reducing visceral fat in experimental animals.[6,11] An in-depth analysis of the chemical composition and mechanisms of action of VCO and EVOO is necessary to determine which oil is more effective in weight control and to understand the broader implications for public health.

This study aimed to explore how each oil affects body weight and composition in white rats, providing deeper insights into their effectiveness in weight management and the underlying mechanisms. Additionally, EVOO and VCO have been shown to improve lipid profiles and reduce inflammation, contributing to a lower risk of metabolic diseases.[8–10] Conversely, VCO can enhance fat metabolism and exert a thermogenic effect, aiding in weight reduction.[6,11] Understanding the synergistic potential between these oils is essential, especially given the rising prevalence of obesity and related diseases worldwide. This research is expected to provide new insights into effective weight management strategies and enhance our understanding of the role of vegetable oils in diet and health overall.

## METHODS

This research was a true experimental study with a post-test only design,[12,13] involving white rats (*Rattus norvegicus*) to evaluate the comparative effectiveness of VCO and EVOO on weight gain in malnourished rats. This study conducted at the Research Laboratory of the Faculty of Medicine, Universitas Muslim Indonesia, Makassar, from July to August 2024, the study involved 24 male white rats aged 2-3 months, weighing 150-200

grams. The rats were divided into 4 groups, namely group 1 as a negative control which was given a placebo in the form of 0.5% Na-CMC. Group 2 was the VCO group and was given high-fat, high-carbohydrate feed and a VCO dose of 1.8 ml/200 g body weight. Group 3 was the EVOO group and was given high-fat, high-carbohydrate feed with an EVOO dose of 1.8 ml/g body weight. Group 4 as a combination group of VCO & EVOO and feeding with a dose of VCO 1 ml/200 g body weight & dose of EVOO 1 ml/200 g body weight.

The rats were housed for one week for adaptation before the initial weight measurement and then treated for 7-14 days. Weight gain was measured as the dependent variable. Measurement of weight gain was carried out on white mice after placebo administration (H0), on the seventh day after treatment (H7) and on the fourteenth day (H14). Data were analyzed using SPSS,[14,15] with normality assessed using the Shapiro-Wilk test, followed by either a paired T-test or Kruskal-Wallis test based on the data distribution.[16] A one-way ANOVA and LSD post-test were used to compare body weight differences across groups.

Ethical approval was obtained from the Faculty of Medicine, Universitas Muslim Indonesia. This study aims to provide valid and reliable data on the effectiveness of VCO and EVOO in weight management, contributing evidence for healthier dietary practices.

## RESULTS

After conducting a data normality test with the Shapiro-Wilk test, 24 data were found to be normally distributed. Table 1 present the results of the body weight normality test in all groups, which overall had a p value of >0.05. Because all the data was normally distributed, the analysis used to compare body weight before and after treatment was the paired samples t-test.

Table 1. The results of normality test of body weight in all groups of white rats

| Group | Weight (gram) | | | | | |
|---|---|---|---|---|---|---|
| | H0 | | H7 | | H14 | |
| | Mean±standard deviation | p | Mean±standard deviation | p | Mean±standard deviation | p |
| Negative control | 144,66±3,38 | 0,698 | 162,16±12,70 | 0,379 | 192,16±5,45 | 0,491 |
| EVOO | 142,83±3,48 | 0,236 | 174,66±4,41 | 0,060 | 202,16±13,64 | 0,927 |
| VCO | 143,66±4,22 | 0,743 | 175,16±12,22 | 0,241 | 191,00±22,16 | 0,066 |
| EVOO & VCO | 141,66±6,62 | 0,213 | 174,16±19,08 | 0,100 | 185,66±30,25 | 0,439 |

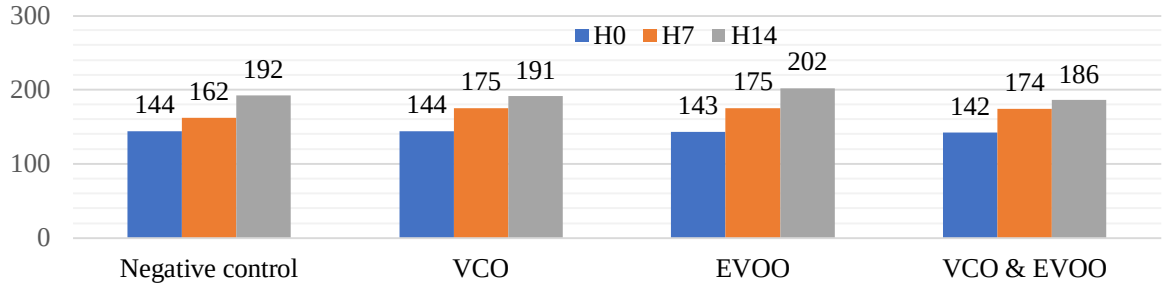


Figure 1. Graph of weight change before and after intervention

Table 2. Comparison of body weight in the negative control group

| Group | Time | Phase | Body weight (gram) | | p-value |
|---|---|---|---|---|---|
| | | | Mean±standard deviation | Mean difference | |
| Negative control | H0-7 | Before treatment | 144.66±3.38 | 17.500 | 0.013 |
| | | After treatment 7 days | 162.16±12.70 | | |
| | H0-14 | Before treatment | 144.66±3.38 | 47.500 | <0.001 |
| | | After treatment 14 days | 192.16±5.45 | | |
| | H7-14 | After treatment 7 days | 162.16±12.70 | 30.000 | 0.003 |
| | | After treatment 14 days | 192.16±5.45 | | |
| EVOO | H0-7 | Before treatment | 142.83±3.48 | 31.833 | <0.001 |
| | | After treatment 7 days | 174.66±4.41 | | |
| | H0-14 | Before treatment | 142.83±3.48 | 59.333 | <0.001 |
| | | After treatment 14 days | 202.16±13.64 | | |
| | H7-14 | After treatment 7 days | 174.66±4.41 | 27.500 | 0.009 |
| | | After treatment 14 days | 202.16±13.64 | | |
| VCO | H0-7 | Before treatment | 143.66±4.22 | 31.500 | 0.003 |
| | | After treatment 7 days | 175.16±12.22 | | |
| | H0-14 | Before treatment | 143.66±4.22 | 47.333 | 0.004 |
| | | After treatment 14 days | 191.00±22.16 | | |
| | H7-14 | After treatment 7 days | 175.16±12.22 | 15.833 | 0.018 |
| | | After treatment 14 days | 191.00±22.16 | | |
| EVOO & VCO | H0-7 | Before treatment | 141.66±6.62 | 32.500 | 0.015 |
| | | After treatment 7 days | 174.16±19.08 | | |
| | H0-14 | Before treatment | 141.66±6.62 | 44.000 | 0.019 |
| | | After treatment 14 days | 185.66±30.25 | | |
| | H7-14 | After treatment 7 days | 141.66±6.62 | 11.500 | 0.076 |
| | | After treatment 14 days | 185.66±30.25 | | |

Based on Table 2, in negative control group, there was a significant difference in body weight before treatment and after placebo induction for 7 days (p = 0.013), after placebo induction for 14 days (p <0.001), and after placebo induction for 14 days (p = 0.003). In EVOO group, there was a significant difference in body weight

before treatment and after induction for 7 days (p =<0.001), after induction for 14 days (p <0.001), and after induction for 14 days (p = 0.009). In VCO group, there was a significant difference in body weight before treatment and after induction for 7 days (p = 0.003), after induction for 14 days (p 0.004), and after induction for 14 days (p = 0.018). In EVOO & VCO group, there was a significant difference in body weight before treatment and after induction for 7 days (p = 0.015) and after induction for 14 days (p 0.019). But, there was not significant difference in body weight after induction for 14 days (p = 0.076).

Table 3. Comparison of body weight levels and mean difference between groups

| Time | Group | Body weight (gram) | p-value |
|---|---|---|---|
| | | Mean±standard deviation | |
| Before treatment (H0) | Negative control | 139.50±8.01 | 0.717 |
| | EVOO | 158.67±9.56 | |
| | VCO | 159.83±13.19 | |
| | VCO & EVOO | 143.67±8.71 | |
| After treatment for 7 days (H7) | Negative control | 172.67±10.50 | 0.346 |
| | EVOO | 172.67±10.50 | |
| | VCO | 169.83±12.95 | |
| | VCO & EVOO | 172.33±22.00 | |
| After treatment for 14 days (H14) | Negative control | 193.50±23.27 | 0.562 |
| | EVOO | 187.00±17.01 | |
| | VCO | 177.83±30.06 | |
| | VCO & EVOO | 190.83±33.79 | |
| Mean difference (H0-H7) | Negative control | -17.500 | 0.000 |
| | EVOO | -31.500 | |
| | VCO | -29.333 | |
| | VCO & EVOO | -32.500 | |
| Mean difference (H0-H14) | Negative control | -47.500 | 0.000 |
| | EVOO | -47.333 | |
| | VCO | -59.333 | |
| | VCO & EVOO | -44.000 | |
| Mean difference (H7-H14) | Negative control | -30.000 | 0.000 |
| | EVOO | -15.833 | |
| | VCO | -30.000 | |
| | VCO & EVOO | -11.500 | |

Table 3 present the that there was no significant difference in body weight before treatment (H0) (p <0.05), on day 7 (H7) (p <0.05), and on day 14 (H14) (p <0.05). But when measuring the difference in average body weight before treatment (H0-H7), a significant difference was found (p<0.05), furthermore (H0-H14) a significant difference was found (p<0.05), and (H7-H14) a significant difference was also found (p<0.05).

**DISCUSSION**

The VCO group showed a significant increase in body weight at all time intervals, which is in line with the theory that VCO is rich in medium chain fatty acids (MCFAs) which can increase energy metabolism and store some energy in the form of body fat. Although this increase in body weight is not significantly different from the control group, the unique benefits of VCO on body weight need to be reviewed further. The significant weight gain in the VCO group may be related to the MCFAs content which plays a role in energy metabolism, as well as its ability to activate GPCR84 receptors related to immunity and inflammatory pathways, which in turn may reduce inflammation. Research shows that VCO not only promotes weight gain under normal conditions, but also in pathological conditions such as diabetes. In addition, the fatty acid composition of VCO, which consists mainly of C12 and C14 fatty acids, contributes to greater weight gain compared to other oils. MCFAs also play a role in the prevention of obesity and type 2 diabetes, and show potential protection for the health of other organs. However, consumption of VCO in a high-fat diet can lead to lipid accumulation in the liver and adipose inflammation, which indicates the potential for negative effects that need to be considered.[17–23] Therefore, further research is needed to fully understand the impact of VCO on weight and overall health, as well as to explore the benefits and risks that may be associated with its use in the diet

The EVOO group showed a significant increase in body weight at all time intervals, supported by the content of oleic acid and phenolic compounds which can improve lipid metabolism, especially in conditions of malnutrition. Nevertheless, the change in body weight in the EVOO group was not significantly different from the negative control, indicating that the effect is moderate and requires further research for clinical validation. Previous research has shown that phenolic compounds in EVOO, such as hydroxytyrosol, have strong antioxidant properties and can affect lipid metabolism, while oleacein can improve inflammatory function which supports weight control. In addition, EVOO also has neuroprotective benefits that can help reduce oxidative stress and lipid peroxidation, contributing to the overall regulation of the body's metabolism. Although there was no significant difference in weight change between the EVOO and negative control groups, the positive effects of EVOO on lipid metabolism and overall health remained significant.[18,24–31] Therefore, although the results show insignificant variations in body weight compared to the negative control, the potential health benefits of EVOO remain an interesting area for further research

At baseline (H0), no significant differences were found between the control, VCO, and EVOO groups, which indicates that the rats in all groups had balanced initial conditions in terms of body weight and nutritional status, which is important for the validity of further analysis. Although there were no significant differences at baseline, previous studies have shown that a combination of VCO and EVOO (1:1) at a dose of 10 mL/kg of rat body weight is more effective at preventing an increase in biomarkers of heart damage than using each oil separately. After 14 days of intervention, although each group showed an increase in body weight, there was no significant difference between the control group, VCO, and EVOO, indicating that the two oils had a similar effect

on the body weight of white rats. Research shows that MCFAs in VCO can be converted into energy faster than other fats, while oleic acid in EVOO is more related to lipid metabolism regulation. However, in the short term, the effects of the two oils appear to be equivalent. In addition, VCO has been shown to be effective in improving the lipid profile in rats with diabetic dyslipidemia, lowering total and LDL cholesterol levels, and increasing HDL levels. The combination of VCO and EVOO has the potential to provide greater benefits than using each one separately, with the bioactive ingredients in both oils working synergistically to improve lipid metabolism and support organ health. Further research is needed to understand the mechanisms and effectiveness of these two oils in the broader context of health.[31–35]

Research reveals that EVOO and VCO have the potential to improve metabolism and reduce oxidative stress, where EVOO is more dominant in improving lipid balance, while VCO has thermogenic properties that can increase energy expenditure. The results showed that there were significant differences in the weight changes of white rats in all treatment groups, both in the H0-H7, H0-H14, and H7-H14 periods, indicating that the administration of these oils can significantly affect the metabolism of the rat body. In addition, the study found that the administration of EVOO and VCO in certain doses can reduce fat accumulation in the body of rats, although the metabolic response to these healthy oils can be individual and depends on certain physiological factors.[36–39] These findings provide a strong basis for understanding how these two types of oil can be used in nutritional interventions to manage body weight and improve metabolic health in experimental animals.

This research provides important implications for the development of weight management strategies through the use of vegetable oils such as Virgin Coconut Oil (VCO) and Extra Virgin Olive Oil (EVOO). These findings suggest that both types of oils can increase body weight in malnourished white rats, with significant effects on energy metabolism and lipid profiles. In the context of public health, the use of VCO and EVOO can potentially be an effective dietary intervention to improve nutritional status, particularly in individuals with fat metabolism problems. The use of a combination of VCO and EVOO also shows synergistic potential that can improve fat metabolism and support organ health. These findings could serve as a basis for further research and development of vegetable oil-based products that support long-term health, both in the prevention of obesity and other metabolic diseases.

This research has several limitations that need to be considered. First, the sample used was limited to 24 white mice, which may not be fully representative of the broader population. Second, the duration of the study lasting only 14 days may not be enough to observe the long-term impact of VCO and EVOO consumption on the weight and metabolic health of mice. Third, although VCO and EVOO oils show promising potential, this study did not consider other variables that could affect outcomes, such as genetic factors or the type of food given.

## CONCLUSION

Based on the results of the study, it can be concluded that there is a significant difference in body weight gain in the control group before and after placebo administration, as well as in the group that received VCO and EVOO in white rats. However, no significant difference was found in weight gain before intervention in all groups, nor after intervention. Nevertheless, there was a tendency for higher weight gain in the EVOO group compared to the VCO and control groups.

For further research, it is recommended that a long-term study be conducted to obtain more in-depth information on the effects of the two oils on weight gain, as well as adding observations on lipid profiles, glucose levels, or insulin. Researchers are also expected to test the dosage and frequency of VCO and EVOO administration to determine the optimal dosage that can provide the best results without increasing the risk of side effects or negative health impacts.

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