How to Cite:
Jasim, A. H., Ali, B. M., & Abbas, B. G. (2022). Effect of calcium supplementation on weight loss in overweight and obese women, Baghdad, 2021. *International Journal of Health Sciences*, *6*(S2), 14989–15002. https://doi.org/10.53730/ijhs.v6nS2.8978

Effect of calcium supplementation on weight loss in overweight and obese women, Baghdad, 2021

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***Abstract*---**Introduction: Obesity became a major public health burden worldwide and its prevalence rate in adults during the last forty years has been increasing in the developed and developing countries. Its prevalence among Iraqi women in 2020 was about 40%. Some studies suggested that calcium supplementation could accelerate weight loss and treat obesity. Objectives: To determine whether calcium intake during a weight loss program affects reduction of Iraqi women weight and whether there is a difference in the weight loss of both pre-menopausal and post-menopausal obese women after giving them calcium. Methods: An Interventional study was carried out on 50 overweight or obese Iraqi women "premenopausal or at least 3 years post-menopausal". They had been engaged in 6 month interventional program to reduce their weight through ingestion of calcium orally. Their BMI was measured in the beginning and in the end of that course. Results: The mean age among the participants was 45.4 ±17.3 years. 52% of them were premenopausal and 48% were postmenopausal. The reduction of BMI after 6 month calcium supplementation course was 74% among the whole women; which was significant, 88.5% among the premenopausal, which was also significant, and 58.3% among postmenopausal, which was not significant. Conclusion: Calcium supplementation for 6 months had

Manuscript submitted: 27 March 2022, Manuscript revised: 18 May 2022, Accepted for publication: 9 June 2022

led to a weight reduction among most of the whole obese women, significantly the premenopausal. It is needed to look for serum calcium among obese women, especially the premenopausal, and correct the hypocalcaemia if present through a dietary regimen for their weight reduction.

***Keywords*---**obesity, overweight, calcium, weight loss, weight reduction.

Introduction

Obesity has become a big public health burden all over the world and its prevalence is increasing worldwide. Its prevalence rate in adults (defined as Body Mass Index (BMI) over 30 kg/m^2) during the last forty years has been increasing at a rapid pace in both developed and developing countries. The number of obese adults in 1975 was 100 million (69 million women and 31 million men), while in 2016 it reached to 671 million (390 million women and 281 million men) [1]. It is defined as excessive fat deposition in the body, and it could be able to cause a wide range of comorbidities, or exacerbates them, including insulin resistance and type 2 diabetes mellitus (T2DM), dyslipidemia, cardiovascular disease, hypertension, non-alcoholic fatty liver disease, reproductive dysfunction, and cancer [2-19]. As a result, obesity could lead to many complications and could cause adverse effects on the quality of life and has marked economic consequences relating to increased healthcare costs [20,21]. For the reason of increasing its prevalence and the consequences of it, the interest in identifying effective and safe interventions and strategies to reduce excess body weight in obese people has been also increased. Although there are many factors that influence obesity and various interventions to treat it [22], evidences have demonstrated that dietary interventions and strategies are an effective and safe way to prevent or manage obesity [23–26]. National literatures explained that obesity is increasing in Iraq due to change in the life styles among the community and also due to the change in the economy in the country. The prevalence of obesity in Baghdad among adult women in 2017 was 35- 37%, and it was estimated in 2020 that 40.1% of Iraqi women were living with obesity [27–29].

As one of the micronutrients in the diet, calcium regulates many cellular processes, such as cell proliferation, differentiation, and bone formation [30-32]. As well as, dietary calcium has been included in prevention of obesity or treatment of it [33–37]. Generally calcium is considered as a key element for maintaining bone mineral homeostasis. It also plays a role in adipocyte lipid kinetics at the cellular level and in moderating fatness at the population level. Within adipocytes, the levels of intracellular calcium alter the balance between lipid synthesis and breakdown, favoring lipogenesis when cytosolic calcium levels are high. Scientific theories proposed that dietary calcium increases lipolysis and preserves thermogenesis, thereby accelerating weight loss. Evidences suggested an inverse association between calcium intake and BMI. There are some studies carried out to evaluate the effects of dietary calcium supplementation on body weight loss in humans and to measure the potential association between them [34,38,39,40]. The Institute of Medicine Dietary Reference Intake Committee set the recommended

dietary allowances at 1000–1200 mg/day (varying by age) for healthy adults [41]. Actually, most Iraqi people do not meet these recommendations yet.

Rational: (1) Generally, there are limited data on effect of calcium supplementation on weight loss. (2) There is no national protocol of giving calcium supplements in the current diet regime for overweight or obese persons in Iraq.
Objectives: (1) To determine whether calcium supplementation during a weight loss intervention program affects reduction of Iraqi women weight. (2) To determine whether there is a difference in the weight loss of both pre-menopausal and post-menopausal overweight or obese women after giving them calcium supplements.

Methodology

Study design: An Interventional study design.
Study setting: The study was carried out in an outpatient clinic in Baghdad (the capital of Iraq) and in the specialized center for endocrinology and diabetes in Baghdad/ Rusafa (the eastern side of Baghdad).

The Inclusion criteria

Obese and overweight women (either premenopausal or at least three years post-menopausal) with a BMI from 25 kg/ m^2 and above, with light physical activity, who did accept to participate in the study, were selected for our six-month special weight loss intervention program.

Exclusion criteria

(1) Any participant with high serum calcium level (above 10.5 mg/dl). (2) Any participant who was taking medications which could affect serum calcium level (hormonal replacement therapy or oral contraceptives, diuretics, Vitamin D3, tamoxifen, antacids, tonics containing calcium), within last month. (3) Any participant who had a disease state known to influence bone metabolism (ex: cancer or diabetes). (4) Pregnant or lactating within the previous year or had a history of irregular menstrual cycle for premenopausal women. (5) Those who did not take the calcium pills twice daily during the six- month program.

Sampling design

A convenience sampling was carried out for those with eligible criteria, where 54 participants were chosen during the specified period, among them only 50 were complied.

Tools of the study

(1) Measurement result of serum calcium level and measurement of physical activity for every participant were determined before conducting this study. (2) Questionnaire: - which was included the personal, socioeconomic, and gynecological characteristics "age, marital status, education, occupation, history of medications intake, and questions about menopause". (3) The six-month

intervention program in this work involved daily oral ingestion of calcium supplements for each participant, who were asked to consume two doses of 500 mg calcium carbonate pills; taken at breakfast and evening during that program. (4) Compliance was assessed by counting of calcium taking every two months. (5) Height and weight were taken on two occasions to calculate BMI for each participant; in the first interview, and the second one was done after completing the six-month intervention program.

Data management and statistical analysis

(1) Data were coded for each participant woman and analyzed by spss program. (2) Both the qualitative and quantitative data were summarized and presented as tables and charts. (3) A comparison was done for groups of pre-menopausal and post-menopausal women regarding the effect of calcium supplementation throughout six months on their weight loss by using the statistical paired t -test. (4) Mean and SD were calculated for quantitative data, while chi square and logistic regression tests were done to assess any statistical association. (5) p-value of 0.05 or less was considered to be significant.

Ethical and administrative consideration

(1) An approval to engage in this work was taken priorly for each woman. (2) Confidentiality was approved for each participant. (3) Administrative permission in each study setting was taken.

Results

The mean age among the participants in this study was 45.4 ±17.3 years, as appeared by table 1 , while the distribution of them according to their age groups is shown by figure 1.

Table 1: Age statistics among the participants, N=50

Age	Mean	Median	SD	Min.	Max.
(years)	45.46	43.50	17.350	17	70

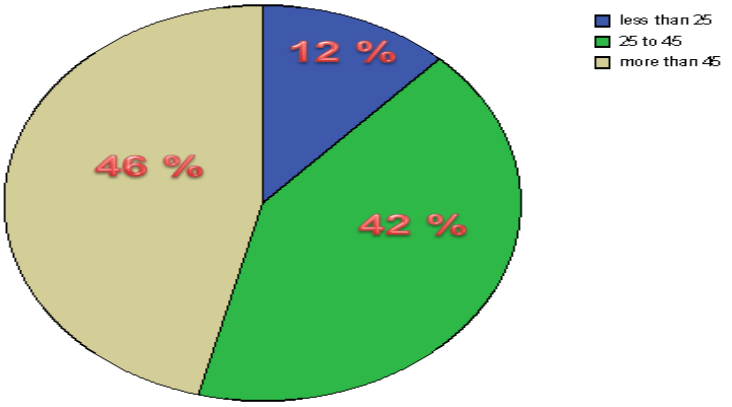

Figure 1: The distribution of the participants according to their age groups, N=50

The distribution of the sociodemographic and personal characteristics among the studied women is shown by table 2.

Table 2: Distribution of the sociodemographic and personal characteristics among the participants, N=50

Variable		Frequency	Percentage
Age (years)	Less than 25	6	12
	25-45	21	42
	More than 45	23	46
Marital status	Single	14	28
	Married	22	44
	Divorced	4	8
	Widowed	10	20
Living area	Urban	44	88
	Rural	6	12
Income (IQD)	Less than 500000	26	52
	500000-million	16	32
	More than 1 million	8	16
Education	Illiterate	9	18
	Read &write	8	16
	Primary school	5	10
	Secondary school	11	22
	Institute or university	15	30
	More than university	2	4
Occupation	Household or retired	27	54
	Private company	5	10
	Governmental work	16	32
	Own work	2	4
Menopausal status	Premenopausal	26	52
	Postmenopausal	24	48

Regarding changing in BMI for the all participants after six-month calcium supplementation course, 4% had no change in their BMI, 74% showed a reduction in their BMI, and 22% had increasing BMI, as appeared by figure 2.

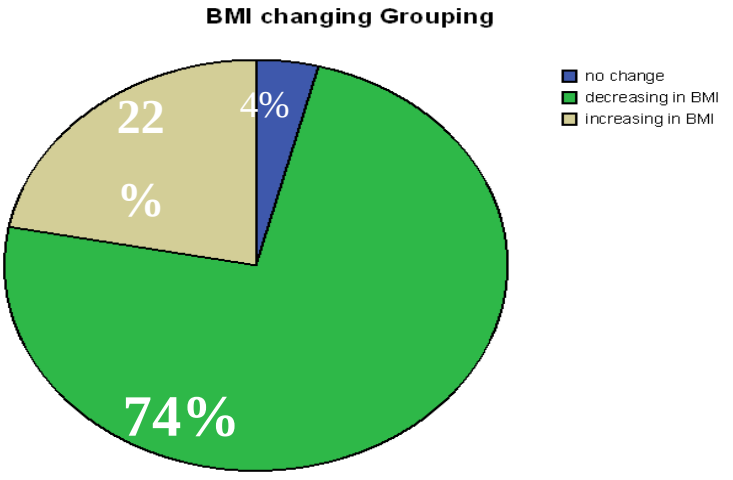

Figure 2: Changing of the BMI after six-month calcium supplementation course among all the participants, N=50

Concerning only the premenopausal women, 88.5% of them showed reduction in their BMI and 11.5% had increasing BMI after the six-month interventional course, as revealed by figure 3, while concerning the postmenopausal women, 58.3% of them showed reduction in their BMI, 33.3% had increasing BMI, and 8.4% of them had no change in their BMI after the six-month interventional course, as appeared by figure 4.

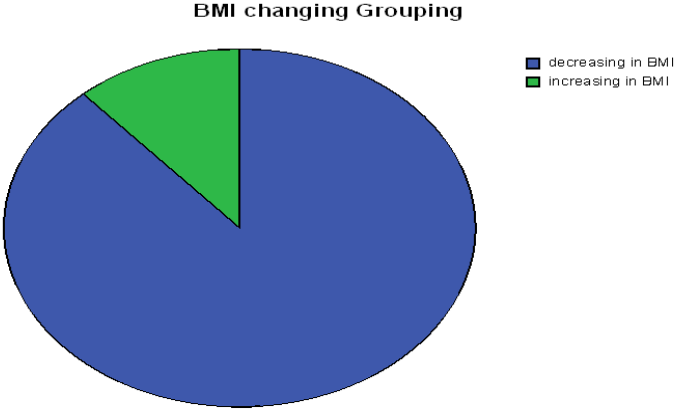

Figure 3: Changing of the BMI after six-month calcium supplementation course among the premenopausal participants, n=26

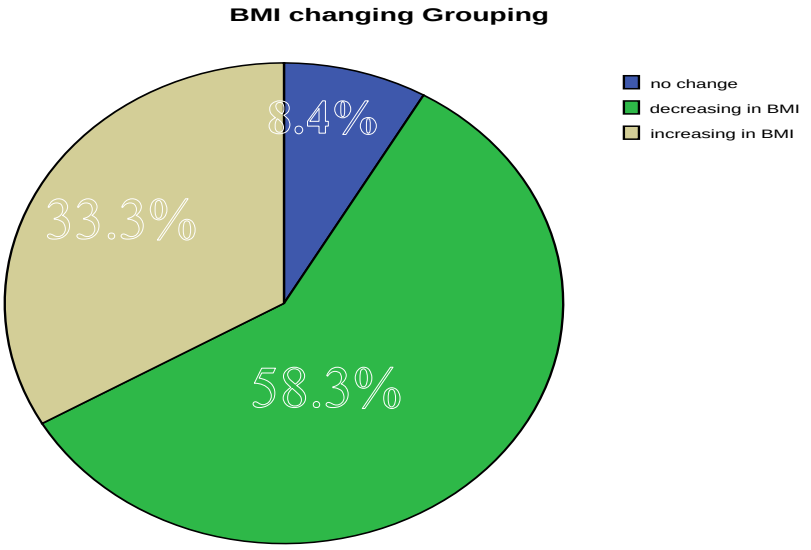

Figure 4: Changing of the BMI after six-month calcium supplementation course among the postmenopausal participants, n=24

That reduction in BMI of the whole participants was appeared to be statistically significant, after applying the paired t-test. Regarding only the premenopausal women in this study, the changing in their BMI after the interventional course also appeared to be statistically significant. On the other hand, the BMI changing among the postmenopausal participants appeared to have no significant association after applying that test, as manifested by table 3.

Table 3: Association between calcium supplementation and reduction in BMI among all of the participants, the premenopausal, and the postmenopausal groups

BMI at first interview and at the end of the course:	Paired Difference					t	df	p-value
	Mean	SD	Std. error	95% CI of the difference				
				Lower	Upper			
among all participants N=50	0.938	1.5785	0.2232	0.4894	1.3866	4.202	49	0.000 *
among premenopausal n=26	1.5385	1.5182	0.2977	0.9253	2.1517	5.167	25	0.000 *
among postmenopausal n=26	0.2875	1.3979	0.2853	-0.3028	0.8778	1.008	23	0.324
* : significant.								

After applying the logistic regression statistical test, it is appeared that the sociodemographic and personal variables had no effect on the changing of the BMI among the participants after the six-month calcium supplementation

interventional course, whether as a whole, premenopausal or postmenopausal groups, as shown by table 4, 5 and 6.

Table 4: Association between the sociodemographic- personal variables with the BMI changing after the six-month calcium course among all the participants, N=50

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1(a)	age_classification	1.158	.779	2.211	1	.137	3.184
	Marrital_Status	.462	.415	1.238	1	.266	1.587
	Living_Area	1.814	1.193	2.312	1	.128	6.138
	Income	-.230	.766	.090	1	.764	.795
	Education	-.178	.310	.328	1	.567	.837
	Occupation	.308	.710	.189	1	.664	1.361

Table 5: Association between the sociodemographic- personal variables with the BMI changing after the six-month calcium course among premenopausal women, n=26

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1(a)	age_classification	.589	1.574	.140	1	.708	1.803
	Marrital_Status	.262	1.417	.034	1	.853	1.299
	Living_Area	2.242	2.751	.664	1	.415	9.416
	Income	-1.819	1.677	1.177	1	.278	.162
	Education	-.939	1.106	.721	1	.396	.391
	Occupation	2.253	1.485	2.301	1	.129	9.519

Table 6: Association between the sociodemographic- personal variables with the BMI changing after the six-month Calcium course among postmenopausal women, n=24

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1(a)	age_classification	18.867	18228.275	.000	1	.999	156322474.873
	Marrital_Status	.354	.472	.561	1	.454	1.424
	Living_Area	21.870	27492.585	.000	1	.999	3147537255.262
	Income	.567	.924	.376	1	.540	1.762
	Education	.067	.351	.036	1	.849	1.069
	Occupation	-1.087	1.266	.738	1	.390	.337

Discussion

This study included fifty participants who were either obese or overweight, with mean age of 45.46 years. 42% of them aged between 25-45 years and 46% of

them were more than 45 years old, which is relatively convergent. 44% of the participants were married while 20% were widowed. It is appeared in this study that 88% of the participated women were living in urban areas; this could be due to the study settings which were located inside Baghdad city. Regarding the socioeconomic characteristics, about half of the studied women had monthly income of less than 500,000 Iraqi Dinars, about fifth of them were graduated from secondary school, about third of them were graduated from institute or university, and about half of them were either household or retired ladies. The ratio between premenopausal (52%) and postmenopausal women (48%) was approximate in our study. Most of the whole studied women (74%) had reduction in their BMI after the six-month calcium supplementation course; this reduction was statistically significant in the present study, which is agreed with a similar Chinese study [42] , and also approximate with a review study which stated that "although the findings suggest a statistically significant weight reduction in obese and overweight individuals after calcium supplementation for at least six months, but the clinical relevance of this finding is uncertain yet" [43] , although it is in contrast with another study done in the United States [44] . When we analyzed the effect of calcium supplementation on the weight of the two groups; the premenopausal and the postmenopausal women, "after the specified interventional course" we found that the majority of the studied premenopausal participants (88.5%) had a statistical significant reduction in their BMI, while only less than two thirds (58.3%) of the postmenopausal ladies in the present work had a reduction in their BMI after the end of that course, and the last reduction was insignificant statistically. These results are concordant with another study carried out in New Zealand which showed no relation between calcium supplementation and body weight in postmenopausal women [45].

A meta-analysis revealed the negative correlations between calcium supplementation and weight changes in either premenopausal or old (above 60 years old) women and suggested that increasing calcium intake could reduce body weight in these subjects [39]. Specifically, it has been demonstrated that each 300 mg increment in regular calcium intake is associated with approximately 1 kg less body fat in children and 2.5–3.0 kg lower body weight in adults [40]. Rosenblum et al. found that calcium and/or vitamin D supplementation contributed to a beneficial reduction of abdominal visceral adipose tissue in overweight and obese adults [46]. In contrast, Winzenberg et al. reported that there was no evidence to support the use of calcium supplementation as a public health intervention to reduce weight gain or body fat in healthy children [47]. Some studies stated that the source of calcium may also affect its anti-obesity effects. Consumption of a high calcium diet from dairy products for 12 weeks was effective in reducing abdominal adiposity in overweight patients with type 2 Diabetes [48]. Greater intake of high-fat, but not intake of low-fat, dairy products, was found to be associated with less weight gain in middle-aged and elderly women [49]. Lee et al. found that consumption of dairy products is associated with reduced risks of obesity and metabolic syndrome in Korean women but not in men [49]. Similarly, Moreira et al. reported an inverse relationship between calcium intake and BMI in only girls (7–9 years old) in Portugal [50]. The discrepancy in the effects of calcium on body weight loss could result from the different subjects, calcium intake amounts, calcium sources, and calcium intake periods. Thus, due to the various influencing factors, the anti-obesity effects of dietary calcium need

to be further studied in different subjects. The present study showed that after application of the six-month calcium supplementation interventional course, the sociodemographic and the personal variables had no effect on the changing of the BMI among the participants, which suggests that the observed weight reduction could be mainly due to the supplementation of calcium throughout that course.

Conclusion

1. Application of the interventional course of calcium supplementation for six months had led to a significant weight reduction among most of the whole studied women (both the premenopausal and the postmenopausal ladies).
2. Although application of the mentioned course had led to a significant weight loss among majority of the studied premenopausal ladies, it was not significant among the studied postmenopausal women who had a reduction in their weight after the end of that course.
3. The observed weight loss among the participated women after the interventional course could be mainly due to the supplementation of calcium during that course. The other sociodemographic and the personal variables (age, marital status, type of living area, income, educational level, and job) of the studied women had no effect on the changing of their BMI.

Recommendations

1. It is needed to look for serum calcium level among the overweight and obese women, especially the premenopausal ones, and correct the hypocalcaemia if present throughout any dietary regimen for their weight reduction.
2. The suggested doses of calcium supplement for low serum calcium patients on weight reduction regimen among the overweight and obese women are two doses of 500 mg calcium carbonate pills; taken at breakfast and evening during the program.

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