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The increase of dairy intake is the main dietary factor associated with reduction of body weight in overweight adults after lifestyle change program

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Abstract

This study evaluated which was the main nutritional change associated with weight reduction of overweight adult participants of a lifestyle change program. It was hypothesized that increases in dairy intake could be an important nutrition intervention in a lifestyle change program. 117 individuals, male (19.5%) and female (80.5%), with a minimum age of 36 years (54.2±10.4). All study participants were enrolled in a lifestyle change program consisting of nutritional counseling and physical activity during 20 weeks. All participants were grouped in three groups according to Body Mass Index (BMI) delta median (-0.87 kg/m^2) of individuals that showed weight loss: G1 – lost more than 0.87 kg/m^2 of BMI (n=38); G2 – lost 0 to 0.87 kg/m^2 of BMI (n=36); and G3 – increased BMI (n=43). G1 increased dairy, fruit and vegetables intake and after forward stepwise multiple regression analysis, it was noted that an increase in dairy product intake of 0.40 servings per day had an impact of 9.6% on the loss of one kg/m^2 of BMI. In conclusion, an increase in dairy product intake was the main dietary factor associated with reductions in body weight in overweight adults after 20 weeks of lifestyle change program.

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Key words: *Obesity. Dairy products. Intervention. Diet. Lifestyle.*

EL AUMENTO DE LA INGESTA DE LÁCTEOS ES EL PRINCIPAL FACTOR DIETÉTICO ASOCIADO CON LA REDUCCIÓN DEL PESO CORPORAL EN ADULTOS CON SOBREPESO DESPUÉS DE UN PROGRAMA DE CAMBIO DE ESTILO DE VIDA

Resumen

Este estudio evaluó cuál era el cambio nutricional principal asociado con la reducción de peso de los participantes adultos con sobrepeso de un programa de cambio de estilo de vida. La hipótesis era que el aumento de la ingesta de lácteos podría ser una importante intervención nutricional en un programa de cambio de estilo de vida. 117 personas, de sexo masculino (19,5%) y mujeres (80,5%), con una edad mínima de 36 años (54,2±10,4). Todos los participantes en el estudio fueron incluidos en un programa de cambio de estilo de vida que consiste en el asesoramiento nutricional y la actividad física durante 20 semanas. Todos los participantes fueron agrupados en tres grupos de acuerdo con el Índice de Masa Corporal (IMC) medio delta (-0,87 kg/m^2): G1 – perdieron más de 0,87 kg/m^2 (n=38); G2 – perdió 0-0,87 kg/m^2 (n=36); y G3 – aumentó el IMC (n=43). El G1 aumentó lácteos, frutas y verduras y después de un análisis de regresión múltiple por pasos hacia adelante se observó un aumento en la ingesta de productos lácteos de 0,40 porciones por día que tuvo un impacto del 9,6% en la pérdida de un kg/m^2 de IMC. En conclusión, el aumento en la ingesta de productos lácteos fue el principal factor dietético asociado con reducciones en el peso corporal en adultos con sobrepeso después de 20 semanas de programa de cambio de estilo de vida.

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Palabras clave: *Obesidad. Productos lácteos. De intervención. Dieta. Estilo de vida.*

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Introduction

The prevalence of obesity is growing globally[1,2] and one of the main causes of obesity is an inappropriate diet[3]. In addition to an active lifestyle adherence, the decrease of processed meat, refined grains, fried meat, and sugar-based desserts intake; and the increase of vegetables, fruit, legumes, whole grain, fiber, fish, lean meat, poultry and fat-free dairy products intake should be the choice of therapy for weight loss[4-7]. However, the adherence to such changes is the greatest challenge for this population[8].

Dairy products are a food group that seems to help to regulate body weight[9-15]. The role of dairy intake for weight loss is still not elucidated. In a recent study evaluating intakes of dairy products and obesity in Korean Adults it was found that high consumption of dairy products was associated with a lower prevalence of obesity[16]. On the other hand, a meta-analysis showed no beneficial effect of increasing dairy consumption on body weight and fat loss in long-term studies, but a modest effect for weight loss was found in short-term (<1 year) and energy-restriction studies[17] and new studies are important to evaluate the effect of dairy intake for weight control.

The main component responsible for these benefits has yet to be identified. Some researchers have looked into calcium[13-15,18-20], others into protein[21-27], but perhaps both work synergistically[28]. The protein portion of the milk contains two proteins: casein (80%), which is absorbed slowly and delays gastric emptying, and whey protein (20%), which is absorbed quickly and is rich in branched-chain amino acids that activate some satiety hormones, namely glucagon-like peptide-1 (GLP-1) and peptide YY (PYY)[29].

Many food groups can influence weight loss[4-6], however, it is not clear which can be the main nutritional intervention for this objective in a lifestyle change program. Considering that obesity prevalence is growing[1] and treatment of this disease presents a high rate of failure, whereas the majority of obesity individuals don't adhere to dietary programs[30], the adherence to increase food groups that are helpful to weight loss could be a better intervention than recommendation to decrease foods groups that increase the risk of obesity, like refined grains, fried foods and sugar intake.

Given the evidence that dairy intake presents some components that can help to regulate body weight, the objective of the present study was to evaluate which is the main nutritional factor associated with weight reduction of overweight adult participants of a lifestyle change program. We hypothesized that increases in dairy intake could be an important nutrition intervention in a lifestyle change program.

Methods

Individuals

This 20-week longitudinal study assessed 117 individuals, male (19.5%) and female (80.5%), with a minimum age of 36 years and a mean age and standard deviation of 54.2 ± 10.4 years from 2007 to 2011. All study participants were enrolled in a lifestyle change program consisting of nutritional counseling and physical activity. This study was conducted in accordance with the Declaration of Helsinki (1964). Subjects gave their written consent to participate in the study, which was approved by Medical Ethics Committee of Sao Paulo State University –School of Medicine, Botucatu/SP.

Intervention protocol

The participants were encouraged to improve their diets, provided by a dietitian, by increasing their intakes of fruits, non-starchy vegetables, dairy products, and water, and decreasing their intakes of processed foods, deep-fried foods, and high-fat foods, in compliance with the Brazilian food pyramid[31].

In addition to nutritional counseling, supervised physical activity classes, supervised by a sport trainer, were provided 5x/week consisting of 20 minutes of stretching exercises, 20 minutes of warm-up, and a 40-minute of aerobic exercise 3x/week; and 10 minutes of stretching exercises and 40 minutes of resistance training 2x/week[32]. Only the participants who attended the classes at least 3x/week were included in the study.

Aerobic exercise session were performed at 60-70% VO_{2max}. Resistance training included 3 series of 8-12 repetitions with loads of 60-80% of one-repetition maximum (1RM).

Food intake

The 24-hour food recall was used for collecting food intake data. The software NutWin (2002) version 1.5 calculated the macronutrient intakes. The participants also answered the adapted Healthy Eating Index (HEI)[33], with the foods grouped according to the Brazilian Food Pyramid food groups[31]. The mixed foods were disassembled and their ingredients placed in the respective food groups.

All components received a score from 0 to 10. The components were: food groups (grains, breads, and tubers and roots; non-starchy vegetables; fruits; dairy products; and meats, eggs, and beans), total fats, saturated fats, cholesterol, sodium, and diet variety represented by the number of different foods consumed daily.

Food intake variables were assessed at baseline (M0) and 20 weeks later (M1).

Body composition

A portable stadiometer with an accuracy of 0.1 cm measured the height of the participants standing bare-

foot with the feet together. A digital scale (Filizola® Personal PL 200) with an accuracy of 100 grams measured the weight of the participants standing barefoot in light clothes. The body mass index (BMI) of each participant was calculated and the nutritional status classified as recommended by the World Health Organization (WHO)[34]. An inelastic tape measure (2-meter Sanny® Medical Anthropometry SN-4010) measured waist circumference (WC) at the midpoint between the last rib and iliac crest. WC was classified according to the associated cardiovascular risk[35].

The bioelectrical impedance analyzer Biodynamics® Model 450 (USA) determined the percentage of body fat (%BF) of the participants by measuring their body's resistance, in ohms, to an electric current. The fat-free mass (FFM) was then calculated[36].

The absolute fat (AF) was calculated by subtracting the FFM from the body weight. The %BF was then given by the formula %BF=AF x 100/body weight. The reference values for the percentage of body fat for females range from 20% to 35% and for males, from 15% to 25%[37]. Muscle mass was obtained by Janssen *et al*.[38] equation.

All body composition variables were measured at baseline (M0) and after 20 weeks (M1).

Groups

All participants were grouped on how much their BMI changed during 20 weeks of lifestyle change program. The change in BMI between M0 and M1 was classified according to BMI delta median (-0.87 kg/m^2) of individuals that showed weight loss, as follows: G1 – lost more than 0.87 BMI kg/m^2 (n=38); G2 – lost 0 to 0.87 BMI kg/m^2 (n=36); and G3 – increased BMI (n=43).

Statistical analysis

All data are expressed as means±standard deviation. The Kolmogorov-Smirnov test tested normality. Student's t-test were performed to compare the variables between the moments in each group. Two-way analysis of variance (ANOVA two-way) and Tukey's test compared delta values (M1-M0) of variables among the groups. Forward stepwise multiple regression analysis of all dietary variables determined how each dietary change affected BMI. The data were performed by the software SAS version 9.1 and the significant level adopted was $<5\%$.

Results

All the three groups presented BMI over than 25 kg/m^2 and G1 showed higher values than G2 and G3 groups ($p<0.05$). As expected, the groups G1 and G2 decrease weight, percentage of body fat, and waist circumference. No differences in muscle mass were observed in all groups after intervention. Additionally, G1 increased dietary variety, dairy, fruits, vegetables, and fiber intake. On the other hand, G3 did not change their diet and percentage of body fat increased significantly (Table I).

Comparing delta values of groups, it was noted an increase of servings of fruit intake in G1, compared with G3, with no difference in G2. All other variables showed no difference (Table II).

Analysis of the influence of dietary changes on BMI showed that the only dietary factor associated with changes in BMI was an increase of dairy intake. The increase in intake of 0.40 servings per day of dairy can influence in 9.6% on the loss of one kg/m^2 of BMI (Table III).

Discussion

The main finding of present study was that an increase in dairy product intake was associated with a reduction in BMI in overweight individuals after lifestyle change program. Individuals who reduced BMI also increased their intake of fruits, and this could be a confounding factor, because higher intake of dietary fiber sources may also promote weight loss[39]. However, after regression analysis, fruits intake lost their significance, and only an increase in dairy product intake affected inversely BMI values.

It is important to note that despite of increase in dairy intake, individuals had not reached the recommendation of 3 servings of dairy products per day[31] and we demonstrated that although dairy consumption are still low, a small increase in the consumption contributed to reduce BMI and waist circumference. Furthermore, a nutritional intervention based on increase of dairy products may have a positive impact for prevention and control of overweight on this community. An important data is that those who lost more weight also decrease percentage of body fat and waist circumference, with no changes in muscle mass, which showed that changes in BMI were related mainly with fat changes.

The inverse association between dairy intake and body weight was already found in other studies[9-14,28,40]. Thus, the increase in dairy products intake may be an option for nutritional intervention and developing action plans for prevention and control of overweight and obesity[41].

The component in dairy products responsible for these benefits has not yet been elucidated. Dairy products are important protein sources. Proteins increase food-induced thermogenesis more than other macronutrients[24,42]. Furthermore, high-protein foods reduce the desire to eat[22,43] and increase satiety[24,44-47]. Research on the different protein types and their action on body weight regulation is ongoing[48], but animal protein seems to result in higher energy expenditure for as much as 24 hours after intake[49].

Table I
Body composition and dietary variables at M0 and M1 of the study of groups G1, G2 and G3

Variables	*G1 (lost more than 0.87 units)*		*G2 (lost 0 to 0.87 BMI units)*		*G3 (gained more than 0.1 BMI units)*	
	M0	*M1*	*M0*	*M1*	*M0*	*M1*
Age (years)	51.76±10.89		57.64±11.09		53.47±8.82	
Weight (kg)	87.13±21.26	82.01±20.34*	76.91±17.09	75.78±16.67*	75.73±18.75	77.14±18.87*
Body mass index (kg/m²)	34.78±6.36	32.74±6.16*	30.42±4.35	29.98±4.29*	29.11±6.26	29.66±6.30*
Body fat (%)	40.80±8.01	38.40±8.32*	37.41±7.93	36.09±7.70*	33.28±9.21	34.56±9.91*
Waist circumference (cm)	104.21±15.83	99.49±14.95*	96.64±13.29	94.64±12.27*	95.43±15.22	94.68±14.64
Muscle mass (kg)	22.5±6.3	22.3±6.6	20.4±5.4	20.7±5,6	21.9±5.8	22.2±5.9
Healthy eating index score	76.85±15.35	83.73±13.13	72.39±13.62	78.66±13.57	80.32±13.57	81.09±15.30
Variety (items)	11.37±2.92	14.03±4.54*	12.49±3.63	12.97±4.31	13.39±4.64	16.35±12.38
Energy (kcal)	1443.80±685.21	1412.99±588.13	1293.42±511.02	1361.98±664.74	1510.92±611.00	1546.14±612.09
Carbohydrates (%)	51.23±9.14	52.70±7.66	52.92±9.09	53.35±11.35	55.15±10.16	53.16±7.67
Proteins (%)	19.37±4.69	19.86±5.38	17.18±5.25	17.72±6.46	17.07±5.19	18.05±4.94
Total fats (%)	29.53±10.11	27.43±7.29	29.90±7.78	28.52±8.26	27.78±7.78	28.78±7.20
Saturated fats (%)	8.57±3.82	7.70±2.95	9.80±3.93	8.14±3.93	8.40±3.92	8.64±3.18
Monounsaturated fats (%)	8.92±3.42	7.64±2.26	9.08±4.00	8.50±4.16	9.00±4.38	9.10±3.49
Polyunsaturated fats (%)	7.47±2.99	7.17±2.92	7.19±3.67	7.50±3.30	6.02±2.88	7.13±2.41
Dietary cholesterol (mg)	163.48±115.18	163.94±87.66	168.02±100.13	178.77±137.41	180.06±128.54	166.81±103.71
Fibers (g)	13.21±7.32	22.04±12.81*	12.06±6.44	14.10±7.35	16.84±8.62	20.71±14.52
Fruits (g)	135.36±211.29	340.21±373.73*	140.32±151.49	180.21±189.98	278.40±225.04	234.53±220.00
Fruits (servings)	1.40±2.42	4.16±6.10*	1.26±1.40	1.47±1.39	2.33±1.77	2.34±2.25
Non-starchy vegetables (g)	89.89±71.78	123.14±102.13	104.60±115.76	120.28±93.04	121.12±105.37	102.28±79.41
Non-starchy vegetables (servings)	1.44±1.89	2.02±2.15*	1.58±1.95	1.82±1.32	1.81±1.67	1.55±1.10
Grains (servings)	3.03±1.36	2.68±1.12	3.18±1.50	3.15±1.20	3.48±1.58	3.47±1.94
Legumes (servings)	1.24±1.13	1.44±1.48	1.14±1.77	0.92±0.76	1.20±1.31	1.42±1.70
Dairy products (servings)	1.03±0.74	1.36±0.96*	1.15±0.81	0.97±0.70	1.57±1.49	1.52±1.03
Meats (servings)	2.00±1.61	1.52±0.91	1.16±0.97	1.55±2.46	1.47±1.14	1.56±1.20
Sweets (servings)	1.59±2.43	0.69±1.02	1.52±1.89	0.83±0.99	1.33±1.92	1.27±1.51
Oil (servings)	2.32±2.23	1.85±1.34	1.57±1.12	1.89±1.13	1.78±1.29	1.95±1.14

Data expressed as mean±standard deviation. * = $p < 0.05$ between moments at the same group.

Table II
Comparison of Body composition and dietary variables deltas (M1-M0) of groups G1, G2, and G3.

	G1	*G2*	*G3*
	Delta	*Delta*	*Delta*
BMI (kg/m^2)	-2.04 ± 1.08[a]	-0.44 ± 0.23[b]	0.55 ± 0.46[c]
Weight (kg)	-5.12 ± 2.79[a]	-1.14 ± 0.71[b]	1.41 ± 1.22[c]
Waist circumference (cm)	-4.72 ± 4.15[a]	0.68 ± 16.87[a]	-0.30 ± 5.18[a]
Muscle mass (kg)	-0.26 ± 1.33[a]	-0.19 ± 1.73[a]	0.26 ± 1.23[a]
Energy (kcal)	69.41 ± 502.71[a]	71.00 ± 581.79[a]	10.42 ± 527.22[a]
Carbohydrates (%)	1.21 ± 11.99[a]	-0.93 ± 9.58[a]	-2.11 ± 14.36[a]
Proteins (%)	0.31 ± 5.81[a]	0.54 ± 5.73[a]	1.01 ± 8.14[a]
Total fats (%)	-1.67 ± 11.85[a]	-0.05 ± 6.79[a]	1.09 ± 11.15[a]
Saturated fats (%)	-1.01 ± 4.20[a]	-1.12 ± 4.40[a]	0.41 ± 4.92[a]
Monounsaturated fats (%)	-1.51 ± 4.33[a]	-0.16 ± 3.71[a]	0.04 ± 5.87[a]
Polyunsaturated fats (%)	-0.33 ± 4.15[a]	0.90 ± 4.26[a]	0.99 ± 4.22[a]
Fibers (g)	8.77 ± 12.84[a]	1.62 ± 10.21[a]	3.79 ± 15.06[a]
Fruits (servings)	2.61 ± 6.66[a]	0.03 ± 2.13[ab]	0.00 ± 2.39[b]
Non-starchy vegetables (servings)	0.73 ± 2.00[a]	0.44 ± 2.14[a]	-0.33 ± 1.53[a]
Legumes (servings)	0.16 ± 1.71[a]	-0.29 ± 1.96[a]	0.23 ± 1.62[a]
Dairy products (servings)	0.47 ± 1.02[a]	-0.14 ± 1.05[a]	0.04 ± 1.31[a]
Meats (servings)	-0.40 ± 1.55[a]	0.43 ± 1.81[a]	0.12 ± 1.34[a]
Sweets (servings)	-0.35 ± 1.31[a]	-0.54 ± 1.97[a]	-0.05 ± 2.12[a]
Oil (servings)	-0.36 ± 2.68[a]	0.38 ± 1.41[a]	0.19 ± 1.60[a]
Variety (items)	2.75 ± 3.30[a]	0.55 ± 4.52[a]	3.10 ± 11.10[a]
Healthy Eating Index score	5.25 ± 17.20[a]	4.68 ± 16.87[a]	1.32 ± 17.90[a]

Data expressed as mean ± standard deviation. Means followed by the same letter are not significantly different according to the Tukey's test at a significance level of 5%. G1 – group who lost more than 0.87 BMI units; G2 – group who lost 0 to 0.87 BMI units; and G3 – group who gained BMI. The median BMI loss of the study participants was -0.87 units.

Milk, for example, consists of two proteins with different absorption profiles: 80% is casein, absorbed slowly, and 20% is whey protein, absorbed rapidly[29]. Whey promotes great satiety since it increases the secretion of the hormones glucose-dependent insulinotropic polypeptide (GIP), peptide YY (PYY), leptin, cholecystokinin (CCK), and glucagon-like peptide-1 (GLP-1), possible mediators of satiety[50,51]. Although this effect is attributed to whey protein, it seems that synergic action of casein and whey protein seems to stimulate the secretion of these hormones more than their individual action[52]. When milk is compared with each of these proteins, milk seems to promote greater satiety[52], indicating that foods are more effective than their isolated proteins and/or nutrients. Faghih *et al*. (2011) compared the effects of low-fat cow's milk, calcium-fortified soy milk, and a calcium supplement in an intervention study and found that the group assigned cow's milk experienced a greater reduction of the study obesity parameters[28]

Furthermore, in the last decade, some studies reported the role of calcium on body weight regulation[13-15,18,19]. Higher calcium intake promotes lower influx of calcium into adipocytes, inhibiting lipogenesis and stimulating lipolysis, which could reduce adiposity and promote weight loss[10,11,14,19,40,53,54]. The action of calcium on the fecal excretion of fat is another factor that promotes weight and body fat loss, but only modestly[55,56]. Considering that, at present study, no changes in caloric intake was observed, the calcium hypothesis could be more logical than the effect of dairy protein in satiety in our data.

A recent meta-analysis showed that the increase in dairy intake results in a modest effect for weight loss in short-term and energy-restriction studies[17]. At present study, there was no change in energy intake but even so, we found weight loss in this population and dairy intake contributed for it. An important point is that although no caloric restriction were made, all individuals made part of exercise program, which contributes for negative energy balance in all groups. Furthermore, although

Table III
Forward stepwise multiple regression analysis of the dietary variable deltas (Δ = M1-M0) according to delta BMI

Variable	*DF*	*Parameter Estimate*	*Standard Error*	*t Value*	*p*
R^2 = 0.096					
Intercept	1	-0.32855	0.18179	-1.81	0.0751
Δ grains (servings)	1	0.01729	0.16907	0.10	0.9189
Δ fruits (servings)	1	0.01587	0.07667	0.21	0.8367
Δ non-starchy vegetables (servings)	1	-0.19600	0.14023	-1.40	0.1667
Δ legumes (servings)	1	0.08907	0.11868	0.75	0.4555
Δ dairy (servings)	1	-0.40382	0.16623	-2.43	0.0177
Δ meats (servings)	1	0.07922	0.15780	0.50	0.6172
Δ sweets (servings)	1	-0.00160	0.10505	-0.02	0.9879
Δ oil (servings)	1	0.00485	0.11253	0.04	0.9658
Δ total fats (%)	1	0.08031	0.11299	0.71	0.4796
Δ saturated fats (%)	1	0.08083	0.05991	1.35	0.1817
Δ monounsaturated fats (%)	1	0.07884	0.05036	1.57	0.1220
Δ polyunsaturated fats (%)	1	0.01781	0.06699	0.27	0.7911
Δ fibers (g)	1	-0.00418	0.01432	-0.29	0.7712
Δ variety (score)	1	-0.02491	0.04091	-0.61	0.5446
Δ Healthy Eating Index score	1	0.02189	0.01175	1.86	0.0668
Δ energy (kcal)	1	-0.00007708	0.00067729	-0.11	0.9097
Δ protein (%)	1	0.11388	0.10720	1.06	0.2918
Δ carbohydrates (%)	1	0.14145	0.10281	1.38	0.1733

dairy was the only food group associated statistically, all other foods groups ingested had a biological effect and could influence weight loss in our population, so it is not correct to affirm that we found an isolated effect of dairy group, but we can affirm that this group was the main dietary factor.

There are several study limitations, because dairy product intake were not evaluated according to dairy product fat content (low-fat or whole), so it was not possible to determine the effect of saturated fat came from these products for weight changes. Moreover, the administration of only one 24-hour recall at M0 and M1 could not show the dietary habit in 20 weeks of the study. It is also important to remember that the objective of our study was to observe the effect of dietary changes in body mass and exclusive interventions increasing dairy intake are necessary and should be tested in other populations.

Conclusion

An increase of dairy intake was the main nutritional factor related to weight reduction of overweight adults after lifestyle change program. Even though the increase in consumption of dairy products was small, it has contributed significantly to body fat decrease. Based on our results, the increase of dairy intake should be an important nutritional counselling for participants of lifestyle change program. More studies focusing in increases of dairy intake are necessary to confirm this association.

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Authors' contributions

EPO wrote the manuscript and was the mentor of the work; ACMD wrote the manuscript, KCPM corrected and revised the final manuscript. JEC made the statistical analysis and corrected the manuscript. RCB corrected, revised the final manuscript and was the mentor of the work. All authors read and approved the final manuscript.

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