Nutr Hosp. 2016; 33(1):123-130 ISSN 0212-1611 - CODEN NUHOEQ S.V.R. 318

Nutrición Hospitalaria

Trabajo Original

Otros

Effects of oat bran and nutrition counseling on the lipid and glucose profile and anthropometric parameters of hypercholesterolemia patients

Efectos del salvado de avena y del asesoramiento nutricional en el perfil de lípidos y glucosa y en los parámetros antropométricos de los pacientes con hipercolesterolemia

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Abstract

Background: In order to prevent chronic, non communicable disease, it is essential that lifestyle is modified to include a diet high in fiber.

Aim: To assess the effect oat bran (OB) in conjunction with nutrition counseling (NC) have on lipid and glucose profile, anthropometric parameters, quality of diet, and ingestion of ultraprocessed foods (UPF) and additives in hypercholesterolemia sufferers.

Method: This was a 90-day, double-blind, placebo-controlled, block-randomized trial undertaken on 132 men and women with LDL-c ≥ 130 mg/dL. The participants were sorted into two groups: OB Group (OBG) and Placebo Group (PLG), and were given NC and 40g of either OB or rice flour, respectively. Lipid and glucose profile were assessed, as were the anthropometric data, quality of diet (Diet Quality Index revised for the Brazilian population - DQI-R) and whether or not UPF or additives were consumed.

Results: Both groups showed a significant decrease in anthropometric parameters and blood pressure, as well as a significant reduction in total and LDL cholesterol. There was also an improvement in DQI-R in both groups and a decrease in consumption of UPF. Blood sugar, HOMA-IR and QUICKI values were found to be significantly lower only in the OBG.

Conclusion: Our findings in lipid profile and anthropometric parameters signify that NC has a beneficial effect, which is attributable to the improved quality of diet and reduced consumption of UPF. Daily consumption of 40 g of OB was found to be of additional benefit, in decreasing insulin-resistance parameters.

Key words:

Oat bran. Beta-glucan. Nutrition counseling. Hypercholesterolemia. Dyslipidemia. Chronic. Non communicable diseases.

Resumen

Antecedentes: con el fin de prevenir la enfermedad crónica, no transmisible, es esencial que el estilo de vida se modifique para incluir una dieta alta en fibra.

Objetivo: evaluar el efecto de la harina de avena (DE) en conjunto con consejos de nutrición (NC) sobre el perfil lipídico y glucémico, los parámetros antropométricos, la calidad de la dieta, y la ingestión de alimentos ultraprocesadas (UPF) y aditivos en los enfermos de hipercolesterolemia.

Método: se realizó un ensayo de 90 días, doble ciego, controlado con placebo, aleatorizado realizado en 132 hombres y mujeres con c-LDL ≥ 130 mg / dl. Los participantes fueron clasificados en dos grupos: DE Group (OBG) y el grupo placebo (PLG), y se les dio NC y 40 g de DE o de harina de arroz, respectivamente. Se evaluó el perfil lipídico y la glucemia, así como los datos antropométricos, la calidad de la dieta (Índice de Calidad de la dieta revisada para la población brasileña ICD-R) y si se consumieron UPF o aditivos.

Resultados: ambos grupos mostraron una disminución significativa en los parámetros antropométricos y la presión arterial, así como una reducción significativa en el colesterol total y LDL. También hubo una mejora en la ICD-R en ambos grupos y una disminución en el consumo de la UPF. La glucemia, HOMA-IR, y QUICKI fueron significativas en inferiores sólo en el grupo que consumió salvado de avena.

Conclusión: nuestros hallazgos sobre las modificaciones en el perfil lipídico y en los parámetros antropométricos significan que los consejos nutricionales tienen un efecto beneficioso, que es atribuible a la mejoría en la calidad de la dieta y al menor consumo de alimentos ultraprocesados. El consumo diario de 40 g de salvado de avena proporciona un beneficio adicional, al disminuir los parámetros de resistencia insulínica.

Palabras clave:

Harina de avena. Beta-glucano. Asesoramiento nutricional. Hipercolesterolemia. Dislipidemia. Enfermedades crónicas no transmisibles.

Received: 27/10/15
Accepted: 12/11/15

de Souza SR, de Oliveira GMM, Luiz RR, Rosa G. Effects of oat bran and nutrition counseling on the lipid and glucose profile and anthropometric parameters of hypercholesterolemia patients. Nutr Hosp 2016;33:123-130

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INTRODUCTION

High serum cholesterol levels have been shown to cause approximately 4.4 million deaths per year worldwide (1). There are numerous studies demonstrating a strong relationship between dyslipidemia and atherosclerotic vascular disease (2-6). Research into both primary as well as secondary prevention sustains this link to increased cardiovascular risk, highlighting the essential role that lifestyle change plays in non-pharmacological treatment of atherosclerotic disease, especially in the long term (2-6).

In the prevention of chronic, non communicable disease, it is vital to create an environment conducive to health and healthful choices (2). Research in primary and secondary prevention shows that in dyslipidemia sufferers nutrition counseling inhibits the modulation of mechanisms that regulate lipid and glucose metabolism (7,8).

Oat (*Avena sativa L.*) contains beta-glucans, soluble fibers that may act to inhibit the absorption of fats and carbohydrates. Although the Food and Drug Administration (FDA) and ANVISA (Brazil's health watchdog) consider a daily intake of 3 g of beta-glucans to be sufficient to curtail cholesterol absorption, clinical trials have provided controversial results (11-13), which compels further investigation.

The main objective of our study is to assess the effect oat flour consumption coupled with nutrition counseling have on the lipid and glucose profile, anthropometric parameters, quality of diet and the ingestion of processed foods and additives in hypercholesterolemia sufferers.

MATERIAL AND METHODS

This study was approved by the Research Ethics Committee monitoring studies involving human beings at the Aloysio de Castro State Cardiology Institute (IECAC) –ruling no. 47305. All the participants that agreed to take part in the research signed a free and informed consent form (FICF).

The sample calculation was based on a pilot study involving 44 individuals (14 men, 30 women), using Openepi software version 3.0 (Open Source Epidemiological Statistics for Public Health, available at www.openepi.com), with a 95% (α) confidence interval, the power of 80%, and a 1:1 size ratio between the sample groups. We took into account differences between mean (intervention *vs.* placebo) decrease in LDL-c, of 30 mg/dl x 15 mg/dL (absolute values), with variability (SD) of 30. The resulting number was 63 individuals for each group.

We performed a 90-day, double-blind, placebo-controlled block-randomized trial on men and women over 20 years of age whom we found at the Aloysio de Castro State Cardiology Institute. Criteria for inclusion: LDL-c $\geq$ 130 mg/dL, either taking or not taking lipid-lowering medication. Criteria for exclusion: water restrictions, use of dietary-fiber supplements, or pregnancy or lactation. We selected 227 individuals of whom 134 met the inclusion criteria. The screening and inclusion phase took place between October 2012 and January 2014.

The included individuals were sorted into two groups: Oat Bran Group (OBG) and Placebo Group (PLG). The nutrition counseling they were given was based on *Dez Passos para uma Alimentação Saudável do Ministério da Saúde* (14) (Ten Steps to a Healthy Diet published by the Ministry of Health). During each appointment individuals were given a box containing 30 daily portions of a morning mixture, comprising either fat-free powdered milk, sucralose-based artificial coloring and 40 g of oat bran (OBG) containing the equivalent of 3 g of beta-glucans, or 40 g of corn starch and rice flour (PLG), with instructions to consume the preparation as porridge in the morning. Each participant was monitored for 90 days through monthly visits.

The anthropometric data gathered: body mass (BM) and height, body mass index (BMI), waist circumference (WC) (15) and neck perimeter (NP) (16), blood pressure (BP) (17), food frequency questionnaire (FFQ), and 24-hour recall (24HR). A 12-hour fast preceded testing for total cholesterol (TC), triglycerides (TG) (18), high-density lipoprotein (HDL-c) and low-density lipoprotein (LDL-c) (20), fasting blood sugar (FBS) (21), fasting insulin (FIN) and insulin resistance (HOMA-IR) (22), with insulin resistance defined as being a HOMA value > 2.71 (23), insulin-sensitivity index (QUICKI) (24).

Quality of diet was assessed through the 24HR throughout the entire intervention by using the Food Processor® software version 7.2 (25), the Nutritional Composition Table for Foods Consumed in Brazil (26), the Table for Assessing Dietary Intake in Home Food Proportions (27), and Dietary Reference Intakes (28). We applied the Diet Quality Index revised for the Brazilian population (DQI-R) (29), with a cutoff point of 75 percentile (75 p), taking as the baseline the points the DQI-R attributed to all the 24HRs at basal time (t0). DQI-R values greater than or equal to 75 p were deemed "adequate standard diet", while under 75 p was an "inadequate standard diet".

The assessment of ultraprocessed foods and additives was performed by way of 24HR, with the consumption of such foods as chocolate, margarine, cookies, whole milk, foods with fillings, soft drinks, candies, added sugar, instant noodles, vegetable oil, sodium and processed juices quantified before and after the nutritional intervention.

Exploratory analysis of the data was done by calculating the measures of central tendency and amplitude (median and interquartile range). We assessed the normality of the variables using the Komolgorov Smirnoff method. As most of the variables were not of normal distribution, we adopted the non-parametric Mann-Whitney and Wilcoxon tests. We used the SPSS software package (Statistical Package for the Social Sciences) version 20.0. The level of statistical significance we adopted was 5% ($p < 0.05$).

RESULTS

One hundred and thirty-two participants completed the study, 66 in each group. Their overall characteristics are presented in table I. We found that there was no difference between the groups, testament to the effectiveness of the randomization. Around half

the patients had at least one risk factor and around a fifth had suffered some sort of cardiovascular event. Around 40% used medication to treat high blood pressure, and 15% of the OBG and 17% of the PLG were taking hypolipidemic medication, without properly controlling LDL-c.

Table II presents the variation in anthropometric parameters and blood pressure over the course of the study. We found that both groups underwent a significant decrease in these variables by the end of 90 days of nutrition counseling.

Table III presents the variation between laboratory parameters over the course of the study. Both groups showed a significant decrease in total cholesterol and LDL-c. The HOMA-IR and QUICKI glucose values showed a significant decrease only in the group that was given the oat flour intervention.

Table IV presents the nutritional data over the course of the study and it shows that both groups reduced their carbohydrate consumption and achieved a normal distribution of macronutrients. However, only the OBG saw a significant increase in dietary fiber consumption.

In our diet-quality analysis, classified by DQI-R, we found the value 80.57 in 75 p. At t0 27% of the OBG participants were found to have adequate eating habits, with a score ≥ 80.57. In the PLG, 23% practiced an adequate diet. By the end of the study, the percentages increased significantly to 88% and 89% in the OBG and PLG, respectively.

Table V presents anthropometric, biochemical and blood pressure data from the pre- and post-intervention periods, as related to quality of diet. The OBG and PLG were subdivided into DQI-R < p75 *versus* DQI-R ≥ p75 categories. We found that even the individuals who began the study with adequate eating habits improved their score. By the end of the study both subgroups achieved practically the same DQI-R. OBG and PLG participants were found to eat a low quantity of processed food at t0, which lowered even more once both the OBG and PLG had undergone 90 days of nutritional intervention.

Table I. General and clinical characteristics of the study group

Characteristics	OBG	PLG
Number of participants (n)	66 (50%)	66 (50%)
Age (years)	55.42 ± 10.15	56.09 ± 11.10
Women (n)	40 (30%)	48 (36%)
Below 60 years (n)	42 (32%)	41 (31%)
Years os schooling		
Less than eight years (n)	22 (17%)	17 (13%)
Between eight and eleven (n)	38 (29%)	32 (24%)
Older than eleven (n)	06 (5%)	17 (13%)
Alcohol consumption		
Does not consume (n)	47 (36%)	46 (35%)
Daily consumption (n)	03 (2%)	0 (0%)
Weekly consumption (n)	09 (6%)	10 (7%)
Casual consumption (n)	07 (5%)	10 (7%)
Smoking		
No smoking (n)	38 (29%)	45 (34%)
Smoker (n)	05 (4%)	0 (0%)
Former smoker (n)	23 (18%)	21 (16%)
Medical history		
Hypertensive (n)	53 (40%)	54 (41%)
Diabetics (n)	13 (10%)	09 (7%)
In use of lipid-lowering (n)	20 (15%)	23 (17%)
Post AMI (n)	23 (17%)	29 (22%)
Post-angioplasty (n)	14 (11%)	20 (15%)
Post-revascularization (n)	25 (19%)	21 (16%)
Stable angina (n)	11 (8%)	14 (11%)

OBG: Oat bran group; PLG: Placebo group; AMI: Acute myocardial infarction. Results expressed as frequency (n) and percentage out of the total number of study participants, except for age which is expressed as mean ± standard deviation.

DISCUSSION

Our findings from the lipid profile and anthropometric parameters show that nutrition counseling has a beneficial effect that can be attributed to the improvement in diet quality and the decreased consumption of ultraprocessed foods in our study. Nutrition intervention at a population level is shown to be beneficial over time, especially when the lifestyle changes proposed are followed, both in primary and secondary prevention (30). These measures seem to have a greater effect in developing nations where large segments of the population are low-income. However, it is necessary to involve society and health care professionals in order to see that the strategies being proposed are carried out step by step (31).

Karmally et al. (32) compared the effects of oat flour consumption (3 g of beta-glucans) with corn-based cereal lacking in soluble fiber in 152 individuals with hypercholesterolemia for six weeks. They noted a drop in TC and LDL-c of 4.5% and 5.3%, with no decrease in BM. Chen et al. (33) assessed 102 individuals with hypercholesterolemia taking 8g of beta-glucans over 90 days, with no significant results in BM, WC, TC or LDL-C. Maki et al. (11) conducted a study on 144 overweight or obese adults with LDL-c ≥ 130 mg/dL and taking 3 g beta-glucans and undergoing a BM-loss program over a period of 12 weeks. They found a significant decrease in TC, LDL-c and not in HDL-c in the intervention group, with minor decreases in BM.

Table II. Anthropometric data and blood pressure during the study

	t0		t30		t60		t90	
	Median	*Interquartile range*	*Median*	*Interquartile range*	*Median*	*Interquartile range*	*Median*	*Interquartile range*
BM (kg)								
OBG	76.5	(66.8-88.5)	74.5*	(65.5-86.5)	74*	(66.3-87.3)	73*	(64.8-87.3)
PLG	74	(66.5-85)	74	(65-84)	72*	(65-84)	72*	(64-84.5)
BMI (kg/m²)								
OBG	28.5	(25.8-32.9)	27.8*	(25.8-32.2)	27.3*	(25.4-31.7)	27.2*	(24.9-31.8)
PLG	29.4	(27-33.4)	28.7*	(26.5-33)	28.6*	(26-32.7)	28.2*	(25.6-32.3)
WP (cm)								
OBG	97.5	(88-108)	96*	(86.8-105.3)	94*	(86-104.3)	93*	(86-103)
PLG	97	(89.5-106)	94*#	(87-103)	92*#	(86-101)	92*	(83-101)
NP (cm)								
OBG	38	(36-40)	37*	(34.8-40)	36.5*	(34.8-40)	36*	(34-39.3)
PLG	38	(34-39)	36*	(34-38)	36*	(34-38)	36*	(34-38)
SBP (mmHg)								
OBG	120	(110-130)	110*	(110-120)	110*	(110-120)	110*	(100-120)
PLG	120	(115-130)	120	(110-120)	110*	(105-120)	110*	(100-120)
DBP (mmHg)								
OBG	80	(70-90)	80	(70-80)	70*	(70-80)	70*	(70-80)
PLG	80	(80-85)	80	(70-80)	80	(70-80)	70*	(70-80)

OBG: Oat bran group; PLG: Placebo group; t0: Start of the study; t30: First consultation; t60: Second consultation; t90: Third consultation; t: End of the study; BM: Body mass; BMI: Body mass index; WC: Waist circumference; NP: Neck perimeter; SBP: Systolic blood pressure; DBP: Diastolic blood pressure. Results are expressed as median and interquartile range;: Statistically significant reduction within each group relative to t0 ($p < 0.05$) by Wilcoxon test; #: Statistically significant difference ($p < 0.05$) when comparing the reductions achieved between groups, the Mann-Whitney test (U).*

Charlton et al. (34) assessed the added effects that 1.5 g or 3 g of beta-glucans has on nutrition counseling in 87 adults with hypercholesterolemia over six weeks. They noted a significant drop in TC, LDL-c, BM and BP in both groups, with no difference between them, corroborating the results of this study. Zhang et al. (35) assessed the effect 3.6 g of beta-glucans coupled with nutrition counseling had on 166 adult hypercholesterolemia sufferers. They noted a significant decrease in TC, LDL-c and WC only in the beta-glucan group, a significant decrease in HDL-c in the control group and no significant changes in the other experimental parameters, BP or BM. The results from this study diverge from those of Charlton et al. (34) and Zhang et al. (35).

A recent systematic revision of the use of beta-glucans for lowering blood sugar and lipids in diabetic patients showed benefits stemming both from low and high doses over prolonged periods of use. The authors stress that there is a dearth of longitudinal studies where the beneficial effects can be better evaluated (36). A possible mechanism to explain this effect could be that the gelatinous layer created by the beta-glucans prevents the enterocytes from absorbing glucose (37). There are also reports of a decrease in insulin resistance in obese women who ingest high doses of beta-glucans (38). These results are similar to the results of this study, which present a significant drop in serum glucose, HOMA-IR and QUICKI, suggesting a decrease in insulin resistance in dyslipidemia sufferers. However, these findings were obtained through much higher doses than the ones previously described (38).

The inclusion of patients both in primary and secondary prevention may have masked the effect OF had on lipid profile due to 20% of the sample using of hypolipidemic medication. However, all the patients involved had LDL-c ≥ 130 mg/dL, suggesting a

Table III. Biochemical data during the study

	t0		t30		t60		t90	
	Median	*Interquartile range*	*Median*	*Interquartile range*	*Median*	*Interquartile range*	*Median*	*Interquartile range*
CT (mg/dL)								
OBG	238	(214-262)	202*	(184-246)	216*	(191-248)	221*	(200-249)
PLG	233	(219-250)	205*	(173-231)	210*	(185-236)	224*	(192-237)
LDL-c (mg/dL)								
OBG	155	(138-174)	133*	(113-154)	137*	(119-160)	143*	(121-161)
PLG	152	(138-169)	131*	(108-151)	134*	(116-151)	140*	(116-157)
HDL-c (mg/dL)								
OBG	47	(38-57)	46.5	(37-50.3)	46	(38-54.3)	46.5	(40.8-55.5)
PLG	48	(42-57)	45*	(39-52.5)	47	(40-55.5)	48	(41-56)
No HDL (mg/dL)								
OBG	191	(166-219)	160*	(142-195)	167*	(144-198)	172*	(151-191)
PLG	179	(164-202)	158*	(131-183)	158*	(136-189)	165*	(141-193)
TG (mg/dL)								
OBG	147	(106-232)	121*#	(93-178)	136.5	(95-194)	138.5	(100-198)
PLG	126	(98.5-166.5)	130	(87-170)	118	(88.5-160.5)	127	(99-183)
GLI (mg/dL)								
OBG	99.5	(92-112)	95*	(89-107)	93.5*	(90-110)	95*	(90-107)
PLG	95	(88-103)	94	(87-102.5)	94	(85.5-103)	92	(88-103.5)
INS (µU/dL)								
OBG	7	(4.8-11.3)	5.5*	(4-9)	6	(4-10.3)	6	(4-9)
PLG	7	(5-10.5)	6	(4-9.5)	6	(4-9)	6	(4-10)
HOMA-IR								
OBG	1.95	(1.1-3.27)	1.27*#	(0.94-2.5)	1.45*	(0.9-2.7)	1.42*	(0.9-2.6)
PLG	1.7	(1.17-2.37)	1.38	(0.92-2.6)	1.43	(1.06-2.23)	1.46	(0.94-2.5)
QUICKI								
OBG	0.34	(0.32-0.38)	0.37*	(0.33-0.39)	0.36*	(0.33-0.39)	0.36*	(0.33-0.39)
PLG	0.35	(0.34-0.37)	0.36	(0.33-0.39)	0.36	(0.34-0.38)	0.36	(0.33-0.39)

OBG: Oat bran group; PLG: Placebo group; t0: Start of the study; t30: First consultation; t60: Second consultation; t90: Third consultation-end of the study; TC: Total cholesterol; LDL-c: Cholesterol bound to low density lipoprotein; HDL-c: Cholesterol attached to high-density lipoprotein; Non-HDL: Lipoprotein sum except HDL-c; TG: Triglycerides; GLI: Fasting plasma glucose; INS: Fasting insulin; HOMA-IR: Homeostasis model assessment-insulin resistance; QUICKI: Checking quantitative index of insulin sensitivity. Results are expressed as median and interquartile range;: Statistically significant reduction within each group relative to t0 ($p < 0.05$) by Wilcoxon test; #: Statistically significant difference ($p < 0.05$) when comparing the reductions achieved between groups, the Mann-Whitney test (U).*

lack of control, even while employing pharmacological measures. The same reasoning applies to 10% of the diabetic patients taking oral hypoglycemic agents. When patients taking hypolipidemic and hypoglycemic drugs were excluded from the sample group, results were not affected.

CONCLUSION

The findings pertaining to lipid profile and anthropometric parameters show that NC has a beneficial effect attributable to the improved quality of diet and decreased consumption of UPF.

Table IV. Consumption of nutrients, dietary fibers, caffeine and micronutrients during the study

	T0		t30		t60		t90	
	Median	*Interquartile range*	*Median*	*Interquartile range*	*Median*	*Interquartile range*	*Median*	*Interquartile range*
VET t (kcal)								
OBG	1,973	(1,758-2,365)	1,958	(1,746-2,352)	1,961	(1,739-2,356)	1,959	(1,741-2,338)
PLG	1,877	(1,731-2,158)	1,872	(1,720-2,142)	1,865	(1,707-2,088)	1,879	(1,702-2,115)
VET c (kcal)								
OBG	2,026	(1,748-2,538)	1,700*	(1,414-2,009)	1,795*	(1,534-2,101)	1,890*	(1,539-2,261)
PLG	2,152	(1,796-2,659)	1,706*	(1,348-1,935)	1,738*	(1,318-2,249)	1,695*	(1,434-2,036)
PTN (kcal)								
OBG	445	(339-599)	407*	(302-521)	419	(319-603)	453	(368-579)
PLG	446	(344-537)	428	(277-532)	389	(295-581)	383*#	(299-481)
CHO (kcal)								
OBG	1,135	(970-1,331)	909*	(749-1,146)	993*	(752-1,220)	980*	(868-1,320)
PLG	1,193	(947-1,404)	899*	(734-1,057)	909*	(702-1,155)	962*	(779-1,094)
LIP (kcal)								
OBG	446	(341-745)	308*	(207-489)	297*	(226-472)	329*	(228-469)
PLG	475	(308-773)	298*	(187-477)	288*	(191-492)	312*	(200-519)
Total fibers (g)								
OBG	22.3	(13.3-30.5)	29.7*#	(23.3-36.7)	31.2*#	(27.2-43)	34.1*#	(29.1-43)
PLG	21.7	(13.9-29)	19.9	(14.7-28.6)	22	(16.9-29.5)	22.3	(15.9-30.7)
Soluble fibers (g)								
OBG	4.8	(2.47-8)	10.1*#	(8.9-12.5)	11.9*#	(8.9-15)	11.4*#	(9.2-14.5)
PLG	4.5	(2.5-6.6)	5.2	(3.3-7.3)	5.3	(3.7-7.1)	5.1	(3.8-7.2)
Insoluble fibers (g)								
OBG	12.2	(7.1-18.6)	12.9	(10.3-18.5)	15.7*#	(10.9-21.3)	15.6*#	(11.2-22.1)
PLG	11.8	(7.1-16.1)	11.3	(6.6-16.4)	10.3	(7.2-13)	11.9	(7.2-16.8)
Riboflavin (mg)								
OBG	1.64	(1.13-2.1)	1.57	(1.31-1.88)	1.65	(1.4-2.1)	1.67	(1.3-2.1)
PLG	1.61	(1.17-2.29)	1.43*#	(1.24-1.81)	1.47*#	(1.21-1.84)	1.58	(1.25-1.85)
Niacin (mg)								
OBG	26.9	(18.1-35.2)	18.2*#	(13-31.7)	21.9*#	(12.9-33)	21.3*#	(14-34)
PLG	25.8	(20.6-32)	24.4	(16.7-28.4)	29.9*	(17.1-48.9)	22	(15.1-37.8)
Calcium (mg)								
OBG	592	(306-713)	677*	(568-886)	753*	(597-937)	697*	(587-958)
PLG	478	(279-603)	783*	(625-960)	723*	(604-997)	902*#	(673-1091)
Magnesium (mg)								
OBG	301	(210-393)	334*#	(295-426)	377*#	(310-481)	383*#	(309-476)
PLG	265	(226-360)	262	(215-343)	270	(206-349)	250	(210-347)
Potassium (mg)								
OBG	2,503	(1,930-3,343)	3,110*	(2,526-3,636)	3,387*	(2,893-4,087)	3,408*	(2,926-4,294)
PLG	2,479	(1,880-3,170)	2,940*	(2,414-3,401)	3,052*	(2,604-4,010)	2,951*	(2478-3,761)
Sodium (mg)								
OBG	1,776	(1,291-2,647)	1,146*	(729-1,496)	1,155*	(912-1,573)	1,101*	(738-1,816)
PLG	1,747	(1,137-2,510)	1,186*	(843-1,632)	1,032*	(744-1,440)	1,173*	(783-1,692)
Caffeine (mg)								
OBG	64.7	(58.1-123.17)	24.1*	(0-58.1)	23.2*	(0-58.1)	11.6*	(0-58.1)
PLG	103.5	(55.6-144.5)	29.1*	(0-58.1)	11.62*	(0-58.1)	29.05*	(0-58.1)

OBG: Oat bran group; PLG: Placebo group; t0: First consultation-baseline; t30: First return visit; t60: Second return visit; t90: Third return visit-study end; TEV t: Theoretic total energy value; VET c: Total energy consumed; Ptn: Protein; Cho: Carbohydrates; Lip: Lipids; kcal: kilocalories. Results are expressed as median and interquartile range;: Statistically significant reduction within each group relative to t0 ($p < 0.05$) by Wilcoxon test; #: Statistically significant difference in comparing the parameters observed between the groups, the Mann-Whitney test (U).*

Table V. Anthropometric, biochemical and blood pressure data in study groups at the beginning and end of the intervention according to the quality of the diet

	t0				t90			
	DQI-R < p75		*DQI-R ≥ p75*		*DQI-R < p75*		*DQI-R ≥ p75*	
	Median	*Interquartile range*	*Median*	*Interquartile range*	*Median*	*Interquartile range*	*Median*	*Interquartile range*
DQI-R								
OBG	70.9	(63.84-75.71)	84.7	(83.3-87.5)	89.8*	(89.9-92.9)	89.8*	(88.4-95.5)
PLG	71.9	(67.55-76.07)	83.4	(81.95-83.92)	88.7*	(84.18-91.2)	89.6*	(87.74-94.4)
MC (kg)								
OBG	77	(68-94.5)	76	(63.5-85)	73*	(66-90)	74*	(60.5-83.5)
PLG	77	(67-93)	71	(65-78)	75*	(65-86)	69*	(60-77)
IMC (kg/m²)								
OBG	29.6	(26.3-33.4)	27.3	(24.6-30.9)	28.8*	(25.4-32.7)	26.1*	(24.03-30.2)
PLG	30.2	(27.8-35)	27.8	(24.8-30.6)	28.7*	(26.4-32.9)	25.8*	(24.6-30.1)
WC (cm)								
OBG	98	(89.5-110)	94	(86-103)	93*	(87-104)	92*	(83.5-98.5)
PLG	98	(90-110)	93	(84-101)	93*	(85-105)	88*	(81-94)
NP (cm)								
OBG	38	(36-40.5)	38	(35-40)	36*	(34-39.5)	37*	(33.5-39.5)
PLG	38	(35-42)	38	(33-39)	36*	(34-40)	36*	(33-38)
SBP (mmHg)								
OBG	120	(115-130)	120	(110-125)	110*	(100-120)	110*	(105-115)
PLG	120	(120-130)	120	(110-120)	110*	(100-120)	110*	(100-110)
DBP (mmHg)								
OBG	80	(75-90)	80	(70-85)	70*	(70-80)	70*	(70-80)
PLG	80	(80-90)	80	(80-80)	70*	(70-80)	70*	(70-80)
CT (mg/dL)								
OBG	235	(212-264)	241	(216-262)	224*	(196-250)	215*	(201-230)
PLG	233	(218-249)	231	(219-256)	215*	(185-238)	229	(197-236)
LDL-c (mg/dL)								
OBG	155	(137-185)	155	(142-165)	146*	(124.5-165.5)	136*	(120-157)
PLG	152	(139-169)	147	(137-181)	140*	(112-156)	140	(125-164)
HDL-c (mg/dL)								
OBG	47	(38-57)	47	(43-55)	45	(37-58)	47	(41-52.5)
PLG	46	(42-56)	51	(48-62)	47	(40-54)	53	(44-63)
Non HDL (mg/dL)								
OBG	188	(166-220)	191	(164-216)	173*	(151-199)	166*	(151-184)
PLG	180	(166-201)	169	(161-207)	164*	(137-193)	167	(150-195)
TG (mg/dL)								
OBG	151	(112-211)	142	(98-237)	150	(104-201)	122*#	(92-175)
PLG	130	(107-166)	112	(91-186)	133	(98-183)	126	(103-183)
GLI (mg/dL)								
OBG	100	(92-113)	96	(91-113)	96*	(91-107)	92*	(98-102)
PLG	95	(88-103)	94	(82-103)	92	(88-104)	92	(83-103)
INS (µU/dL)								
OBG	8	(5-12)	5	(4-10.5)	7	(4-9.5)	4	(3-7.5)
PLG	7	(5-11)	7	(5-13)	6	(4-10)	8	(4-10)
HOMA-IR								
OBG	2.22	(1.11-3.3)	1.27	(0.92-3.67)	1.56*#	(0.96-2.62)	1.03*	(0.71-2.42)
PLG	1.76	(1.17-2.4)	1.7	(1.18-3.1)	1.42*#	(0.93-2.77)	1.7	(1-2.24)
QUICKI								
OBG	0.34	(0.32-0.38)	0.37	(0.32-0.39)	0.36*	(0.33-0.39)	0.38*	(0.34-0.41)
PLG	0.35	(0.33-0.37)	0.35	(0.32-0.37)	0.36	(0.33-0.39)	0.35	(0.34-0.38)

DQI-R < p75: Group who started the study with the Diet Quality Index (Revised) below the 75th percentile; IQD-R ≥ p75: Group who started the study with the Diet Quality Index (Revised) at or above the 75th percentile; t0: Start of the study; t90: End of the study; MC: Body mass; BMI: Body mass index; WC: Waist circumference; NP: Neck perimeter; SBP: Systolic blood pressure; DBP: Diastolic blood pressure; CT: Total cholesterol; C LDL: Cholesterol bound to low density lipoprotein; HDL-C: Cholesterol attached to high-density lipoprotein; Non-HDL: Lipoprotein sum except HDL-c; TG: Triglycerides; GLI: Fasting plasma glucose; INS: Fasting insulin; HOMA-IR: Homeostasis model assessment-insulin resistance; QUICKI: Checking quantitative index of insulin sensitivity. Results are expressed as median and interquartile range;: Statistically significant reduction within each group relative to t0 ($p < 0.05$) by Wilcoxon test; #: Statistically significant difference ($p < 0.05$) when comparing the reductions achieved between groups, the Mann-Whitney test.*

Daily consumption of 40 g of OF was shown to be of added benefit in lowering the parameters relating to insulin resistance.

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