DOI: 10.1590/1413-812320152012.01772015

Effectiveness of a home-based exercise program on anthropometric and metabolic changes among school cooks

Efetividade de um programa de exercícios físicos domiciliares sobre as modificações antropométricas e metabólicas em merendeiras

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Abstract *The scope of this study was to evaluate the anthropometric and metabolic changes after low intensity home-based exercise. In the school year of 2007, 95 school cooks in the city of Niteroi (State of Rio de Janeiro, Brazil) were randomly assigned to one of the following groups: home-based exercise (n = 47) or control group (n = 48). The home-based exercise program was performed three times a week, during 40 minutes at moderate intensity. Anthropometric variables were collected at the baseline and after 4 and 8 months, whereas biochemical and individual food intake were measured at the baseline and after 8 months. Energy expenditure was evaluated only at the baseline. The home-based exercise group exhibited a greater weight loss (-0.9 vs. -0.2; p = 0.05) in comparison with controls during the follow-up and the same pattern was found for BMI (-0.1 vs. +0.1; p = 0.07), although without statistical significance. Exercise showed no effects on waist circumference, lipid profile and glucose. In conclusion, greater weight loss was observed in the group that performed low intensity home-based exercise and this strategy can assist in body weight control even without alterations in terms of lipids and glucose.*

Key words *Obesity, Prevention, Workers, School cooks*

Resumo *O presente estudo teve como objetivo avaliar as alterações metabólicas e antropométricas após a realização de programa de exercício físico domiciliar de baixo volume. No ano escolar de 2007, 95 merendeiras escolares do município de Niterói (Rio de Janeiro/Brasil) foram alocadas aleatoriamente nos seguintes grupos: exercício físico domiciliar (n = 47) e controle (n = 48). O programa de exercício físico domiciliar consistiu na realização exercícios de moderada intensidade, três vezes na semana, 40 minutos. Variáveis antropométricas foram coletadas na linha de base, aos 4 e 8 meses, sendo as variáveis bioquímicas e o consumo de alimentos obtidos na linha de base e aos 8 meses. O grupo de exercícios demonstrou uma maior redução do peso corporal (-0,9 vs. -0,2; p = 0,05), tendo o mesmo padrão sido observado para o IMC (-0,1 vs. + 0,1; p = 0,07), embora sem significância estatística. Não foram observados efeitos do exercício para a circunferência de cintura, perfil lipídico e glicose. Concluindo, uma maior perda de peso foi observada no grupo que realizou o programa de exercícios domiciliares de baixo volume podendo essa estratégia auxiliar no controle do peso corporal, mesmo sem alterações para lipídeos e glicose.*

Palavras-chave *Obesidade, Prevenção, Trabalhadores, Merendeiras*

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Introduction

Obesity is one of the most serious public health problems in the world, and it is recognized as an important risk factor for many chronic conditions[1,2]. The dramatic increase in the prevalence of obesity is mainly explained by environmental factors that encourage increased food consumption and decreased energy expenditure[3-5].

The work environment is an important factor that could influence the lifestyle and behavior of people, thereby contributing to weight gain and obesity[6]. Individuals who are engaged in physically strenuous jobs are significantly less likely to engage in physical activity during their leisure time, decreasing their total daily energy expenditure and thus contributing to a positive energy balance. Therefore, they are more prone to gain weight over time[7,8].

School cooks are an important occupational group in Brazil not only because they are directly responsible to prepare and serve all meals offered at schools but also because they can have an influence in the schools' health eating process, being a reference for students in their behaviors related to food consumption[9].

A cook's work involves great physical effort as results of frequent shifts, carrying heavy loads and extended periods of standing performing activities such as cutting vegetables, stirring pans and washing the dishes[10]. However, school cooks are exposed to food cues most of the time during their work's activities and it could increases the desire to eat, leading this group of workers to an increased risk of a high food intake[11,12].

When conducting another randomized trial focusing on reducing the beverage intake of students, we realized that many school cooks are overweight or obese and they added a lot of sugar to juices served in schools[13]. Given that physical activity has been advocated as an important strategy to reduce overweight and obesity[14], we designed the present study aiming to investigate the effectiveness of a home-based exercise program on weight, lipid profile and glucose changes among school cooks. We hypothesized that even a small-volume home-based exercise could facilitate weight loss in this group of workers.

Materials and methods

A randomized clinical trial was conducted during the school year of 2007 (March to December 2007) among public schools in the in the city of Niteroi, Rio de Janeiro, Brazil. Out of 36 public schools located in this city, we selected 20 schools from three different areas with similar demographic and socio-economic profiles. One of the three areas was randomly selected to receive intervention (seven schools) and another to be the control (seven schools), aiming thus to reduce contamination between the groups. Of the seven schools in the third area, three were randomly allocated to the intervention group and three to the control group (one school was undergoing building work). This area was the most distant from the center of Niteroi and had a lower population density, meaning that schools were not close together and there was less chance of contamination.

Because of the small number of male cooks (n = 5), we included only women who were neither pregnant nor breastfeeding. Cooks on sick leave or those working in other functions were excluded. A total of 101 cooks were eligible, and six refused to participate in the study.

All participants received information about the goals of the study and signed an informed consent. The study was approved by the institutional review board of the State University of Rio de Janeiro.

School cooks enrolled in the present study were public servants who worked in periods of eight hours, five days per week, in three different shifts (morning, afternoon and night). They eat at least one meal at school and they are responsible to prepare all meals as well as to wash all dishes used to serve and prepare the meals at school. Schools do not have dishwasher to help the school cooks to perform their tasks.

Intervention

The home-based exercise intervention group received a booklet on physical exercises, consisted of stretching and aerobic exercises that could be practiced at home (the booklet is available at www.ims.uerj.br). The exercise sessions were divided into three parts: 1) A warm-up routine consisting of gentle body movement and stretching exercises (5 minutes); 2) An aerobic cycle performed in a circuit with continuous movements involving large arm and leg muscles, as well as exercises using a ball, ropes, stair climbing, and standing up from a chair (balls and ropes were given to the participants) (30 minutes); and 3) a cool-down period, in which the same initial stretching exercises were performed (5 minutes). The participants were asked to practice the exer-

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cises contained in the booklet at least three times a week, 40 minutes per session, during the eight months. In the first week, women were advised to perform only a 20-minute session, increasing gradually (10 minutes per session per week) up to 40 minutes per session. They were asked to maintain an exercise intensity at which, if necessary, they could talk with any person next to them without breathlessness, which features a low-to-moderate intensity[15]. Additionally, they were advised to reduce the exercise intensity if they felt any discomfort (e.g., if they were experiencing breathlessness or muscle aches). Each session comprised activities with balls, ropes, stairs and chair. School cooks allocated to intervention group were monthly followed in order to be stimulated to the practice of home-based exercise. The control group was also monthly followed; however, they did not receive the booklet and only received general information about the health benefits of physical activity.

All school cooks, from both the control and exercise group, participated in three discussion sessions about healthy eating, as described previously[16].

Measurements

The anthropometric variables were collected at three different times (baseline, 4 and 8 months), while fasting blood samples and individual food intake, based on a previously validated semi-quantitative food frequency questionnaire[17], were collected at baseline and after 8 months. This food frequency questionnaire (FFQ) contains 81 items with 8 different options for frequency (two or more times per day to never) and 3 different options for size (large, medium and small) for most of the items except for items difficult to identify portion size such as onions and other spices, butter, etc.

Height was measured to the nearest 0.5 cm with a wall-mounted stadiometer, and body weight was measured using the same calibrated digital scale (Tanita, BC 533 Inner Scan) for all participants. Circumference measurements were taken at the largest girth of the hip and smallest girth of the waist. All anthropometric measurements were performed according to standard techniques[18].

Blood samples were collected in the morning after at least 10 hours of fasting. Plasma lipids and glucose were measured using GoldAnalisa kits. The LDL and VLDL cholesterol concentrations were calculated according to the Friedewald equation[19] based on the triacylglycerol measurements.

Physical activity energy expenditure at baseline was evaluated in a random sub-sample of 30 participants using an accelerometer (Actical® physical activity monitor, Mini Mitter, Bend, OR, USA). The accelerometer was programmed according to the manufacturer's instructions by entering the height, weight, age and sex of each subject. The subjects were instructed to place the accelerometers at their waists and wear them continuously for two consecutive days, except during activities in which contact with water could occur (e.g., during a bath).

Data analysis

The descriptive statistical analysis comprised means (standard deviation) or percentages. Comparisons between groups at baseline were performed by using Student's t-test or chi-squared test. Shapiro-Wilk test demonstrated a skewed distribution for body weight, BMI, waist circumference and waist-to-hip ratio, and all these variables underwent a logarithmic transformation. The effects of home-based exercise on anthropometric variables were evaluated through linear mixed models (LMM) analysis taking into consideration the cluster effects for the schools (PROC MIXED procedure in SAS version 9.1; SAS Institute Inc, Cary, NC). The LMM is an intention-to-treat analysis because it includes all observations of each one of the subjects regardless of loss to follow-up or compliance with instructions. The term of interest was treatment X time interaction, which estimates the rate of change in the outcomes over time. Residual plots of all models were examined, and their distribution did not show major deviations from regression assumptions. Changes in plasma lipids and glucose (samples of which were taken twice) between the groups were determined by Student's t-test.

Results

School cooks enrolled in the study had a mean age of 45.8 (± 9.5) years. The prevalence of overweight was 39% and the prevalence of obesity was 26%, totalizing 65% of the subjects with excess of weight at baseline. Seventy six percent of the school cooks had 8-12 years of schooling, and only 4% had more than twelve years of schooling. The percentage of energy consumed as car-

bohydrate was 60.1% and as fat was 27.6%. Mean energy intake and physical activity energy expenditure at baseline were high, as shown in Table 1.

No differences were found between groups for any variable at baseline (Table 1). Losses to follow-up during the 8-month period were 8.5% for the control group and 14.9% for the exercise group, and none of the losses was related to the exercise protocol (4 quit the job, 2 retired, 2 got pregnant, 2 stayed on sick leave, 1 was on sabbatical). No differences between those who completed the study and those who losses to follow-up were found for any baseline characteristics ($p > 0.30$).

The effects of home-based exercise are shown in tables 2 and 3. The exercise group exhibited greater weight loss at the end of study (-0.9 vs. -0.2; $p = 0.05$) and the same pattern was found for BMI, although without statistical significance (-0.1 vs. + 0.1; $p = 0.07$). Total energy intake decreased with no significant differences between groups at the end of follow-up (-1150 + 2364 kcal for control and -1037 + 2888 kcal for exercise group; p= 0.85). No effects of exercise were found for circumference, lipid profile or glucose (Tables 2 and 3).

Discussion

In Brazil, meals are offered free of charge to all students of public schools, which makes the school cooks an important occupational group in Brazil since they are responsible to prepare and serve all meals offered at school. Also, they can have an influence in the schools' health eating process and, therefore, they have a primary importance on promotion of healthy eating and prevention of childhood obesity[20,21].

In a previous randomized controlled trial focusing on reducing the beverage intake of stu-

Table 1. Baseline characteristics of school cooks by exercise group.

Variable	Control (n = 48)	Exercise (n = 47)	p-value[a]
Age (years)	46.2 (9.5)	45.5 (9.6)	0.73
Per capita income (reais)	587.1 (349.3)	604.0 (424.6)	0.84
Body weight (kg)	69.5 (15.7)	68.3 (12.4)	0.69
Height (m)	157.6 (8.4)	159.5 (6.4)	0.22
Waist circumference (cm)	85.0 (13.6)	81.8 (11.0)	0.21
Hip circumference (cm)	106.1 (16.3)	104.8 (9.6)	0.48
Body mass index (kg/m2)	28.1 (6.7)	26.9 (5.0)	0.34
Waist-to-hip ratio	0.80 (0.08)	0.78 (0.07)	0.23
Total cholesterol (mg/dl)	200.9 (38.2)*	198.5 (41.4)*	0.78
HDL cholesterol (mg/dl)	44.3 (8.8)*	44.0 (10.1)*	0.91
LDL cholesterol (mg/dl)	134.2 (28.6)*	133.7 (35.3)*	0.95
VLDL cholesterol (mg/dl)	22.5 (17.2)*	20.7 (11.9)*	0.59
Triacylglycerol (mg/dl)	112.5 (85.8)*	103.6 (59.5)*	0.59
Glucose (mg/dl)	96.6 (49.8)*	85.6 (22.0)*	0.20
Energy intake (kcal)	4067 (2323)	3590 (2438)	0.35
Physical activity energy expenditure (kcal)	894 (241)†	805 (299)‡	0.44
Nutritional status (BMI)			
Eutrophic (18.5 - 24.9 kg/m2)	33.3	36.2	0.27
Overweight (25.0 - 29.9 m2)	33.3	44.7	
Obese (> 30 kg/m2)	33.3	19.1	
Schooling (%)			
Primary	35.4	21.3	0.11
Secondary	64.6	70.2	
Further education	0	8.5	
Skin color (%)			
White	47.9	63.8	0.30
Mulatto	35.4	25.5	
Black	16.7	10.7	

Data are expressed as means (standard deviation). [a] P-value was obtained by using Student's t test for continuous and chi-squared test for categorical variables. * n = 40; † n = 14; ‡ n = 16.

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Table 2. Crude means (standard deviation) and adjusted changes from baseline (Δ) for anthropometric characteristics during the follow-up by exercise group.

	4 months (Control = 45 Exercise = 42)		8 months (Control = 44 Exercise = 40)		
	Mean (sd)	Δ[a]	Mean (sd)	Δ[a]	p-value[a]
Body Weight (kg)					0.05
Control	68.4 (15.3)	- 0.5	68.9 (14.5)	- 0.2	
Exercise	68.8 (12.8)	+ 0.2	67.3 (13.1)	- 0.9	
Body Mass Index (kg/m^2)					0.07
Control	27.6 (6.5)	- 0.2	28.1 (6.1)	+ 0.1	
Exercise	27.1 (4.9)	+ 0.2	26.8 (5.1)	- 0.1	
Waist Circumference (cm)					0.40
Control	83.2 (12.0)	- 0.8	83.7 (11.3)	- 0.8	
Exercise	82.8 (10.5)	+ 0.2	80.9 (10.3)	- 0.9	
Waist–to–hip ratio					0.64
Control	0.82 (0.11)	+ 0.01	0.80 (0.06)	+ 0.01	
Exercise	0.81 (0.13)	0.00	0.79 (0.07)	+ 0.01	

[a] Linear mixed model (PROC MIXED in SAS) based on repeated measures include time, treatment and time x treatment interaction adjusted for baseline values and cluster effect;

Table 3. Means (standard deviation) and changes from baseline of lipid profile and glucose during the final follow-up by exercise group.

	8 months	Changes from baseline (Control = 20 Exercise = 20)	p-value[a]
Total cholesterol (mg/dl)			0.42
Control	208.4 (36.1)	3.9 (35.1)	
Exercise	200.7 (40.8)	- 3.8 (24.0)	
HDL cholesterol (mg/dl)			0.31
Control	52.9 (13.6)	9.1(11.6)	
Exercise	59.9 (15.5)	12.8 (11.6)	
LDL cholesterol (mg/dl)			0.17
Control	129.2(25.7)	- 4.0 (30.2)	
Exercise	116.3(31.3)	- 17.8 (32.3)	
VLDL cholesterol (mg/dl)			0.56
Control	26.2 (14.3)	-1.2 (16.7)	
Exercise	24.5 (11.5)	1.2 (6.6)	
Triacylglycerol (mg/dl)			0.56
Control	131.2 (71.6)	- 6.1(86.6)	
Exercise	122.5 (57.7)	5.8 (32.8)	
Glucose (mg/dl)			0.72
Control	105.2 (50.1)	4.6 (23.3)	
Exercise	93.5 (42.8)	7.1 (20.9)	

[a] Student's t test.

dents[13], we realized that many cooks were obese and, to our knowledge, no study have been conducted to investigate intervention strategies to control body weight in this group of workers. Strategies to prevent weight gain targeted at this group of workers should be investigated, because excess body weight is associated with loss of productivity, absenteeism, sick leave, disability, injuries and health-care claims[22-24]. In addition, the control of body weight and prevention of obesity

is an important issue among workers, not only to prevent obesity-related diseases but also to improve work performance and quality of life[8].

Small-changes approaches to prevent weight gain[1] could be a part of this strategy, although others have questioned this approach[25], and the role of exercise on body weight maintenance is considered important[26]. However, the effects of different amounts of exercise training on body weight remains a controversial issue. Slentz et al.[27] examined the effects of different amounts of exercise on body weight in 120 overweight sedentary subjects during eight months, with no changes in diet. They found that even a modest amount of exercise (30 min/d) was positively associated with weight maintenance and blunted the weight gain observed in the control group. These results highlight the importance of physical activity for weight control, creating an energy imbalance and increasing the metabolism of adipose tissue[28].

The current study demonstrated a positive effect on weight change from a small-volume home-based exercise program with the exercise group exhibiting a four times greater reduction for weight (-0.9 vs. -0.2; $p = 0.05$) in comparison with controls. Although without statistical significance, changes on BMI demonstrated the same pattern (-0.1 vs. + 0.1; $p = 0.07$). This indicates that the small-volume of home-based exercise proposed in the present study could facilitate weight loss in this specific group of workers, which shows a high prevalence of overweight and obesity (about 65%).

The high caloric intake observed in our sample of school cooks could explain the high prevalence of overweight and obesity found in our sample, greater than the 50% prevalence for Brazilian women in the same age range in a recent Brazilian National Survey[29]. On the other hand, the high daily energy expenditure observed among school cooks in the present study, almost 900 kcal per day, appeared to be insufficient to counteract the effects of high caloric consumption on energy balance.

Although we did not propose any specific recommendation to decrease energy intake, except for reduction of sugar and sweetened beverages in both exercises and controls, the school cooks showed a significant reduction in energy intake in all groups, nearly 1000 kcal of the 4000 kcal reported at baseline, that may have contributed to the weight loss, but with a difference of almost 1 kg between the exercise and control groups. This indicates that even the small-volume of home-based exercise proposed in the present study contributed to the achievement of a negative energy imbalance and then could facilitate weight loss in this group of workers with a high prevalence of overweight.

Numerous studies have documented the favorable effects of physical activity on metabolic parameters, such as lipid profile and insulin sensitivity[30,31]. We did not find any statistically significant effects of exercise on blood lipids or glucose after 8 months; these results may have been affected by the fact that 50% of the participants did not allow the blood test at the end of the study. Moreover, most women in the present study had baseline levels of lipids and glucose within the normal range, making it difficult to obtain significant changes for these parameters.

The major limitation of this study is the small sample size, which makes the extrapolation of our results difficult. It happened because school cooks are a small group of workers. Notwithstanding, we included all school cooks from 20 schools in three different areas. Another limitations were the high percentage of subjects that refused blood drawing at the end of the study (about of 50%), a lack of an objective measurement of compliance to exercise protocol and a lack of measurement to evaluate body composition. All these factors may have contributed to shifting our findings towards the null hypothesis; however, favorable changes in body weight suggest that small-volume home-based exercise is a good strategy for weight control. Also, the instrument used to evaluate energy consumption in the present study (food frequency questionnaire) usually overestimate energy intake[17]. Conversely, when this instrument was used among other female groups in Brazil a lower energy intake had been observed[32], indicating that school cooks included in the present study really ingests an elevated amount of energy. To our knowledge, this study is the first to evaluate the effect of an intervention based on small changes approach on weight control among school cooks, highlighting its originality.

In conclusion, a greater weight loss from a small-volume of home-based exercise was achieved in this group of school cooks and this strategy could facilitate weight control even though no differences were observed for lipids and glucose. However, more studies are necessary to investigate different strategies to prevent weight gain and improve metabolic profile among this specific group of workers.

Collaborations

MFF Mediano, RAG Souza and R Sichieri designed the study, performed the statistical analysis and participated in the interpretation of the results. MFF Mediano wrote the first draft of the manuscript. AM Souza helped in the statistical analysis. MFF Mediano, RAG Souza AM Souza performed the data collection and interviews. All authors were responsible for the critical review of the article. All authors read and approved the final version of the manuscript.

Acknowledgements

This study was funded by grant from the Brazilian National Research Council – CNPq.

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Artigo apresentado em 17/09/2014
Aprovado em 15/04/2015
Versão final apresentada em 17/04/2015