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Original/*Deporte y ejercicio*

Association between work shift and the practice of physical activity among workers of a poultry processing plant in Southern Brazil

Anderson da Silva Garcez[1], Raquel Canuto[2], Vera Maria Vieira Paniz[1], Beatriz Anselmo Olinto[3], Jamile Macagnan[1], Ruth Liane Henn[1], Marcos Pascoal Pattussi[1] and Maria Teresa Anselmo Olinto[1,4]

[1]Post-Graduate Program in Collective Health, University of Vale do Rio dos Sinos, São Leopoldo. [2]Department of Nutrition, Federal University of Rio Grande do Sul State, Porto Alegre. [3]Post-Graduate Program in History, Unicentro, Paraná. [4]Department of Nutrition, Federal University of Health Science of Porto Alegre, Porto Alegre. Brazil.

Abstract

Introduction: **The regular practice of physical activity (PA) has been associated with better health. In addition, job characteristics may determine the PA behaviours of employees, including the work shift. However, relatively few studies have examined the PA behaviour among shift workers.**

Objective: **This study aimed to investigate the association between work shift and the practice of PA among workers of a poultry processing plant in Southern Brazil.**

Methods: **A cross-sectional study was conducted with 1206 workers (786 females), ages 18 to 50, working in shifts on a production line that operates 24 hours/day. Workers who engaged in more than 150 minutes/week of PA were considered active. Multivariate analyses were conducted using Poisson regression and all analyses were stratified by gender.**

Results: **Of the total participants studied, 36% (95%CI: 33-39) were considered active and the sociodemographic characteristics associated with PA differed among males and females. Regarding work shift, night shift workers had higher prevalence of PA. However, increased PA was significantly associated with work shift particularly among females. After controlling for potential confounders, women who worked during the night shift were approximately 30% more active than those who worked during the day (PR[prevalence ratio]=1.32;95%CI: 1.07-1.62;p=0.010).**

Conclusions: **This study found a low prevalence of PA among the workers and indicated a significantly association between work shift and PA. Working at night was positively associated with regular PA, particularly among females. These results contribute for initiatives that aim**

Correspondence: Maria Teresa Anselmo Olinto.
Post-Graduate Program in Collective Health.
University of Vale do Rio dos Sinos.
Av. Unisinos 950, C.P. 275, São Leopoldo.
RS, 93022-000, Brazil.
E-mail: mtolinto@gmail.com

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ASOCIACIÓN ENTRE TURNO DE TRABAJO Y LA PRÁCTICA DE LA ACTIVIDAD FÍSICA ENTRE LOS TRABAJADORES DE UNA PLANTA DE PROCESAMIENTO DE AVES EN EL SUR DE BRASIL

Resumen

Introducción: **La práctica regular de actividad física (AF) se ha asociado con una mejor salud. Además, las características del trabajo se pueden determinar las conductas de la AF de los trabajadores, incluyendo el turno de trabajo. Sin embargo, relativamente pocos estudios han examinado el comportamiento AF entre los trabajadores por turnos.**

Objetivo: **Este estudio tuvo como objetivo investigar la asociación entre turno de trabajo y la práctica de la AF entre los trabajadores de una planta de procesamiento de aves en el sur de Brasil.**

Métodos: **Un estudio transversal se llevó a cabo con 1.206 trabajadores (786 mujeres), con edades entre 18 a 50 años, trabajando en turnos de una línea de producción que funciona las 24 horas/día. Los trabajadores que han participado en más de 150 minutos/semana de AF se consideraron activos. Se realizó un análisis multivariante mediante regresión de Poisson y todos los análisis se estratificó por sexo.**

Resultados: **De los participantes en el estudio, el 36% (IC del 95%: 33-39) se consideraron activas y las características sociodemográficas asociadas con AF difirieron entre machos y hembras. En cuanto a los turnos de trabajo, los trabajadores del turno de noche tenían mayor prevalencia de la AF. Sin embargo, el aumento de la AF se asoció significativamente con el trabajo por turnos sobre todo entre las mujeres. Después de ajustar por factores de confusión, las mujeres que trabajaban en el turno de la noche fueron aproximadamente un 30% más activos que los que han trabajado durante el día (PR[razón de prevalencia]=1,32;IC del 95%: 1,07-1,62;p=0,010).**

Conclusiones: **Este estudio encontró una baja prevalencia de PA entre los trabajadores e indicó una asociación significativa entre el trabajo por turnos y AF. Trabajar de noche se asoció positivamente con la AF regular, especialmente entre las mujeres. Estos resultados contribuyen a las iniciativas para aumentar la AF entre los tra-**

to increase PA among the workers, take into account the job characteristics and gender differences.

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bajadores, teniendo en cuenta las características de las diferencias laborales y de género.

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Palabras clave: *Actividad física. Trabajo por turnos.*

Introduction

The regular practice of physical activity is a modifiable behaviour that has been associated with better health and prevention of morbidity and mortality[1, 2]. Given its importance, the increase of the physical activity level is recommended by the World Health Organization[3]. Furthermore, epidemiological studies have shown that different sociodemographic variables (such as gender, age and education status) are associated with different levels of physical activity[4, 5]. In addition to the sociodemographic factors, job characteristics may determine the physical activity behaviours of employees[6]. For example, an important characteristic is shift work, a work schedule in which workers replace each other to perform similar tasks at different times, which allows for 24 hours per day of production[7].

Shift work can interfere with many aspects of the health and well-being of workers. Shift work may alter the workers' biological rhythms, sleep patterns, behavioural habits and social life.[8, 9] In addition, recent studies found a possible association between shift work and the risk of health problems like metabolic syndrome, increased body weight and cardiovascular diseases[10-14]. Estimates indicate that approximately 20% of the economically active population worldwide engage in shift work[15]. In Brazil, approximately 10% of the population is engaged to this type of work. This percentage may be even higher, considering that in the last decade has been a significant increase in the service sector and in industrial systems of production[16].

There are relatively few studies about the association between shift work or work shift and physical activity[17, 18]. However, the exposure to the shift work may restrict the opportunities for participation in physical activities due to the settings, schedules and shifts imposed by the working[19], i.e., the exposure to the shift work may be an important barrier to a regular practice of physical activity, which could contribute to a better tolerance to shift work and reduce the fatigue that work may cause[20, 21]. Thus, the aim of this study was to investigate the association between work shift and the practice of physical activity among workers of a poultry processing plant in Southern Brazil.

Methods

A cross-sectional study was conducted on production line workers, ages 18 to 50, at a large poultry processing plant in Southern Brazil. Eligible participants had worked fixed shifts for at least six months. This company, which operated continuously 24 hours/day, employed approximately 2600 workers who had a work schedule of 44 hours per week in three major sectors (cutting, evisceration and thermo processing).

The sample size was calculated using EpiInfo 6.0 software and based on a finite population equation derived from the following parameters and estimates: 31% expected prevalence, referring to the physical activity level in the Brazilian population[22]; sampling error of three percentage points; 95% confidence level; 80% statistical power; a 10% increase due to missing data; and a 15% increase due to confounding factors. The estimated necessary sample size was 1141 employees. The company has employees who live in several municipalities; for logistical reasons, the sample was limited to all employees living in the municipality where the company was headquartered (n = 1043) as well as those living in the two closest municipalities (n = 235). Pregnant women and employees who had not worked for 10 or more days in the last month for any reason were excluded. All employees were interviewed individually in their homes between January and May 2010.

Physical activity and demographic, socioeconomic and occupational characteristics were obtained using a standardised questionnaire pre-tested through a previous pilot study. The questionnaire assessed the participants' regular physical activity through the previous month, identifying both the frequency (number of days) and duration of physical activities. The questionnaire distinguished between two domain-specific measures of physical activity – leisure-time (such as recreational activity) and transportation (such as displacement walking or cycling to work or the market). This instrument was based on the International Physical Activity Questionnaire (IPAQ), considering the domains of leisure-time and transportation, which have been shown a better reliability and validity, as recommended in a recent study[23]. The outcome was expressed by the average time spent on physical activities in minutes per week. Workers who engaged in more than 150 minutes per week of physical activity were considered "active"[3, 24].

The demographic variables investigated were age (collected as a continuous variable in complete years and categorised in quartiles), marital status (classified as with or without partner) and skin colour (self-reported by the interviewees and categorised as white or other). The socioeconomic variables assessed were education status (categorised as 1 to 4 years of elemen-

tary school, 5 to 8 years of elementary school, some high school and completed high school or more) and total family income in minimum wages (gathered as continuous data and categorised into quartiles). Occupational variables were evaluated by the following characteristics: working sector (classified according to the level of fatiguing activities between the three sectors of the production line; more fatiguing included the cutting sector and less fatiguing included the evisceration and thermo processing sectors) and work shift (categorised as day shift and night shift, where the day shift involved work schedules between 6:00AM and 2:00PM and the night shift involved work schedules between 6:00PM and 5:00AM, in which workers experienced 90% of their work schedule during the hours of darkness).

Data analysis was performed using Stata version 12.0 (StataCorp, College Station, TX, USA). To investigate the association between exposure (work shift) and the outcome (physical activity), an unadjusted and adjusted prevalence ratios with 95% confidence intervals were calculated by Poisson regression with robust variance using three models[25]. Model I was unadjusted, and the other two models were multivariable. Model II was adjusted for demographic characteristics, Model III was adjusted for Model II more socioeconomic characteristics, and Model IV was adjusted for Model III more working sector. Only the characteristics associated with the outcome (physical activity) that showed a p-value lower than 0.20 were considered confounding factors and were included in the multivariable analysis. All analyses were stratified by gender due to the differences in socioeconomic characteristics and a gender interaction effect between exposure and outcome observed in preliminary analysis.

This study was submitted to and approved by the Research Ethics Committee of the University of Vale do Rio dos Sinos, RS, Brazil. All workers signed an informed consent form to participate in the study.

Results

Of the 1278 workers initially selected for study, 25 (2%) were pregnant at the time of the interview and 47 (4%) could not participate because they had been dismissed or had moved to a municipality not included in the study. In all, 1206 workers were interviewed, and there were no dropouts. Females accounted for 65% of the sample (n = 786), and the mean age of the interviewees was 30.5 (standard deviation [SD]: 8.7 years). The employees had worked in the company for an average of 5.5 years (SD: 4.2 years), and the mean time of work on the same shift was 3.5 years (SD: 3.5 years) for the day shift workers and 3.6 years (SD: 3.2 years) for the night shift workers. Other sample characteristics are displayed in Table I. The age, education status and family income differed between the genders ($p<0.05$).

Of the total participants studied, 36% (95% CI: 33 to 39) were considered active and this prevalence among males was 37% (95% CI: 33 to 42) and 36% (95% CI: 32 to 39) among females. There was no statistical difference between males and females. In addition, the average time spent on physical activities in minutes per week among the total workers was 128.7 min (SD: 143.5 min), with no significant difference between males and females: 133.3 min (SD: 145.7 min) and 126.3 min (SD: 142.4 min), respectively.

The distribution of the prevalence of physical activity and the respectively factors associated with the practice of physical activity according to the demographic, socioeconomic and occupational characteristics for the total workers and stratified by gender are displayed in Table II. In total workers, the characteristics associated with physical activity were marital status ($p=0.006$), skin colour ($p=0.010$), education status ($p<0.001$), working sector ($p<0.001$) and work shift ($p=0.006$). The factors associated with physical activity differed between males and females. Among males, physical activity was statistically associated with age ($p<0.001$), marital status ($p=0.002$), education status ($p<0.001$) and working sector ($p<0.001$); among women, physical activity was statistically associated with skin colour ($p=0.037$), working sector ($p<0.001$) and work shift ($p=0.015$).

Regarding the association between work shift and physical activity, overall, night shift workers had higher prevalence of physical activity (39.0% vs. 30.8%; $p=0.006$) compared to the day shift workers (Table II). However, increased physical activity was significantly associated with work shift particularly among females (Table III). After controlling for potential confounders, women who worked during the night shift were approximately 30% more active than those who worked during the day (Prevalence Ratio=1.32; 95%CI: 1.07, 1.62; $p=0.010$).

Discussion

Our study identified a low prevalence of regular physical activity among shift workers and there were differences between males and females regarding the sociodemographic factors associated with physical activity. In addition, work shift showed an independent effect for the practice of physical activity, particularly among females. Women who worked during the night shift were more active than those who worked during the day.

There has been little discussion or agreement about the association between the practice of physical activity and work shift. Some studies have reported lower levels of physical activity among evening workers than those who work during the day[18, 26, 27]. Other studies comparing alternate shift workers with daytime workers have found no association between the practice of leisure physical activity and work schedule[28-31]. Howe-

Table I
Demographic, socioeconomic and occupational characteristics, at total sample and stratified by gender, among shift workers in Southern Brazil. (n = 1206)

Characteristics	*Total (n = 1206) n (%)*	*Males (n = 420) n (%)*	*Females (n = 786) n (%)*	*p-value*[a]
Demographic				
Age (quartiles)				0.015
18 to 23 years	321 (26.6)	92 (21.9)	229 (29.1)	
24 to 29 years	329 (27.3)	132 (31.4)	197 (25.1)	
30 to 37 years	265 (22.0)	88 (21.0)	177 (22.5)	
38 to 50 years	291 (24.1)	108 (25.7)	183 (23.3)	
Marital status				0.167
With partner	809 (67.1)	271 (64.5)	538 (68.4)	
Without partner	397 (32.9)	149 (35.5)	248 (31.6)	
Skin colour (n=1203)				0.176
White	1008 (83.8)	342 (81.8)	666 (84.8)	
Other	195 (16.2)	76 (18.2)	119 (15.2)	
Socioeconomic				
Education status (n=1205)				0.029
1 to 4 years elementary school	212 (17.6)	88 (21.0)	124 (15.8)	
5 to 8 years elementary school	311 (25.8)	101 (24.0)	210 (26.8)	
High school incomplete	104 (8.6)	44 (10.5)	60 (7.6)	
High school completed	578 (48.0)	187 (44.5)	391 (49.8)	
Family income (quartiles) (n=1192)				0.005
I (lower)	295 (24.8)	119 (28.7)	176 (22.7)	
II	299 (25.1)	117 (28.2)	182 (23.4)	
III	303 (25.4)	90 (21.7)	213 (27.4)	
IV (higher)	295 (24.7)	89 (21.4)	206 (26.5)	
Occupational				
Working sector				0.101
More fatiguing	837 (69.4)	279 (66.4)	558 (71.0)	
Less fatiguing	369 (30.6)	141 (33.6)	228 (29.0)	
Work shift				0.184
Day shift	406 (33.7)	131 (31.2)	275 (35.0)	
Night shift	800 (66.3)	289 (68.8)	511 (65.0)	

[a] *p*-values of Chi-square test for differences between the genders.

ver, a recent study found that irregular-shift workers were more physically active than day-shift workers[17]. It must be pointed out that studies have made use of different criteria for assessing both physical activity and shift work. In addition, gender differences have not been explored in the studies, and physical activity is often included as a confounding factor rather than a primary outcome.

The low prevalence of physical activity observed in this population of workers was a result that has been found in other studies[5, 22]. However, the rate of physical activity among the workers was slightly higher than the rates found in broader population surveillance data of Brazil[22]. In addition, previous studies have also suggested that males trend to be more active than females[4, 5, 32].

The sociodemographic characteristics associated with the practice of physical activity differed among genders in this study. We found a negative association between age and the practice of physical activity only among men, an important gender difference that has been reported elsewhere[4]. In addition, the fact that men not living with a partner were more active is consistent with other studies[29, 33]. Our findings also suggested that workers with higher education levels are more likely to engage in physical activity, particularly among women. This socioeconomic factor has been associated to high level of physical activity practice[33]. Furthermore,

Table II

Prevalence of physical activity (PA) and their prevalence ratios (PR) according to demographic, socioeconomic and occupational characteristics, at total sample and stratified by gender, among shift workers in Southern Brazil. (n = 1206)

Characteristics	Total (n = 1206)			Males (n = 420)			Females (n = 786)		
	PA (%)[a]	PR (95% CI)	p-value[b]	PA (%)[a]	PR (95% CI)	p-value[b]	PA (%)[a]	PR (95% CI)	p-value[b]
Demographic									
Age (quartiles)			0.052			<0.001			0.687
18 to 23 years	39.9	1.20 (0.97, 1.48)		53.3	2.05 (1.42, 2.98)		34.5	0.91 (0.71, 1.18)	
24 to 29 years	37.7	1.13 (0.91, 1.40)		38.6	1.49 (1.01, 2.19)		37.1	0.98 (0.76, 1.28)	
30 to 37 years	33.2	1.00 (0.79, 1.26)		33.0	1.27 (0.82, 1.97)		33.3	0.88 (0.67, 1.17)	
38 to 50 years	33.3	1.00		25.9	1.00		37.7	1.00	
Marital status			0.006			0.002			0.282
With partner	33.6	1.00		32.1	1.00		34.4	1.00	
Without partner	41.6	1.24 (1.06, 1.44)		47.0	1.46 (1.15, 1.87)		38.3	1.11 (0.92, 1.36)	
Skin colour (n=1203)			0.010			0.137			0.037
White	34.8	1.00		36.0	1.00		34.2	1.00	
Other	44.1	1.27 (1.06, 1.52)		44.7	1.24 (0.93, 1.66)		43.7	1.28 (1.01, 1.61)	
Socioeconomic									
Education status (n=1205)			<0.001			<0.001			0.091
1 to 4 years elementary school	24.1	1.00		15.9	1.00		29.8	1.00	
5 to 8 years elementary school	34.4	1.43 (1.08, 1.90)		36.6	2.30 (1.33, 3.97)		33.3	1.12 (0.80, 1.56)	
High school incomplete	44.2	1.84 (1.33, 2.54)		45.5	2.86 (1.60, 5.10)		43.3	1.45 (0.98, 2.16)	
High school completed	40.3	1.68 (1.29, 2.17)		46.0	2.89 (1.74, 4.80)		37.6	1.26 (0.93, 1.70)	
Family income (quartiles) (n=1192)			0.843			0.273			0.517
I (lower)	42.0	1.08 (0.89, 1.31)		46.2	1.18 (0.85, 1.62)		39.2	1.01 (0.78, 1.30)	
II	29.4	0.75 (0.60, 0.95)		32.5	0.83 (0.57, 1.19)		27.5	0.71 (0.53, 0.95)	
III	36.0	0.92 (0.75, 1.14)		32.2	0.82 (0.55, 1.22)		37.6	0.97 (0.76, 1.23)	
IV (higher)	39.0	1.00		39.3	1.00		38.3	1.00	
Occupational									
Working sector			<0.001			<0.001			<0.001
More fatiguing	31.1	1.00		29.0	1.00		32.1	1.00	
Less fatiguing	48.0	1.54 (1.33, 1.79)		53.9	1.86 (1.46, 2.36)		44.3	1.38 (1.14, 1.67)	
Work shift			0.006			0.205			0.015
Day shift	30.8	1.00		32.8	1.00		29.8	1.00	
Night shift	39.0	1.27 (1.07, 1.50)		39.5	1.20 (0.90, 1.60)		38.8	1.30 (1.05, 1.61)	

[a] Workers who performed ≥ 150 min of physical activities per week were considered to be active.
[b] *p*-values of Wald test for heterogeneity of proportions (categorical variables) and for linear trend (ordinal variables).

family income was not associated with physical activity among the workers, possibly due to the relatively homogenous social status of the population. Finally, the variable skin colour was not consistent in this study. We believe that this inconsistence might be due to our population group was composed almost exclusively of Caucasians.

The scientific literature on work and gender roles in the first decade of the 21st century shows that the widespread entry of women into the workforce did not create significant changes in domestic gender roles. One study indicated that the invisibility of domestic work and the "naturalisation" of the feminine nature of this work persist despite the increasing participation

of women in the workforce[34]. In this direction, this is an important characteristic that may explain the differences between males and females regarding the sociodemographic factors associated with physical activity.

Gender differences in physical activity and work shift may be related to the cultural roles of men and women in society. Women have reportedly chosen to work the night shift in order to care for their children during the day[34]. This suggests that women who choose to work the night shift have more time for physical activity than women who work day shifts. Another possible hypothesis is that females are more likely to engage in transportation related physical activity due to the professional and domestic demands imposed by the daily lives of females.

A combination of professional and domestic tasks could have affected the health of females entering the workforce[35, 36]. In addition, a study has suggested that even though female shift workers manage to maintain relatively healthy lifestyles compared to males, female night shift workers have more difficulty maintaining healthy behaviours than female daytime workers[37]. Our study did not reinforce those findings which may indicate that the knowledge of the deleterious health effects of night work encourages the female workers to adopt healthier lifestyles or behaviours.

The type of work performed by employees had an important and significant influence on physical activity. Generally, in the plant's three sectors, workers perform predominantly manual tasks without displacement, and they only switch (relay) between the sitting and standing position. In the plant employing this study's respondents, workers in the cutting sector perform more fatiguing activities, which may explain why physical activity was lower in this sector than the other two. Previous studies have suggested that workplace factors, such as strenuous labour and job stress, are associated with a decrease in physical activity[29, 38].

Limitations of our study include the use of self-reported physical activity data, which may be imprecise. In addition, the intensity, the hour of the practice of the physical activities (if before or after the shift work), and occupational physical activity were not examined. Furthermore, due to the physical activity levels in the present study sample were higher than in the general Brazilian population, a healthy worker effect may be present in this study, thus inference of these findings should be done carefully[39]. Finally, it is possible an absence of power to detect a statistical difference between work shift and physical activity among males because the analyses were stratified by gender.

To the best of our knowledge, this is one of the first studies to use a sample of shift workers from a large plant in a developing South American country. We included only employees who had been working in fixed shifts for at least six months and who were already adapted to the routine of shift work. Furthermore, we used cut-off points for physical activity that have been recommended by major health agencies and included two domain-specific measures of physical activity (leisure-time and transportation) that are recommended for categorising levels of physical activity and for guiding public health programs and have a better reliability and validity than occupational and housework domains[23]. In addition, our multivariable analysis taking into account important confounding and explanatory factors related to the outcome.

Table III

Unadjusted and adjusted prevalence ratios (PR) for the association between work shift and physical activity, at total sample and stratified by gender, among shift workers in Southern Brazil. (n = 1206)

Work shift	*Model I*[a] *PR (95% CI)*	*Model II*[b] *PR (95% CI)*	*Model III*[c] *PR (95% CI)*	*Model IV*[d] *PR (95% CI)*
Total (n = 1206)				
Day shift	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Night shift	1.27 (1.07, 1.50)	1.26 (1.06, 1.49)	1.25 (1.06, 1.48)	1.29 (1.09, 1.52)
p-value	0.006	0.008	0.009	0.003
Males (n = 420)				
Day shift	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Night shift	1.20 (0.90, 1.60)	1.19 (0.90, 1.57)	1.22 (0.92, 1.61)	1.23 (0.94, 1.63)
p-value	0.205	0.230	0.165	0.133
Females (n = 786)				
Day shift	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Night shift	1.30 (1.05, 1.61)	1.29 (1.05, 1.60)	1.28 (1.04, 1.58)	1.32 (1.07, 1.62)
p-value	0.015	0.018	0.022	0.010

[a]Model I = unadjusted prevalence ratio; [b]Model II = adjusted for demographic characteristics; [c]Model III = adjusted for model II and socioeconomic characteristics; [d]Model IV = adjusted for model III and working sector. *P*-values: Wald test for heterogeneity of proportions.

This study found a low prevalence of the practice of physical activity among the workers and indicated a significantly association between work shift and physical activity. Working at night was positively associated with regular physical activity, particularly among females. These results contribute to initiatives that improve worksites and help inform employees and motivate them to increase physical activity and decrease sedentary behaviours, take into account the job characteristics and gender differences. In addition, the present study has important implications for elucidating the association between work shift characteristic and physical activity behaviour among a sample of shift workers. However, future longitudinal researches are necessary to explore these associations and clarify the role of work-related factors on physical activity behaviour among shift workers.

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Conflicts of interest

The authors declare that there are no conflicts of interest.

References

1. Lee IM, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *Lancet* 2012; 380: 219-229.
2. WHO. World Health Organization. Global health risks: mortality and burden of disease attributable to selected major risks. Geneva; 2009.
3. WHO. World Health Organization. Global Recommendations on Physical Activity for Health. Geneva; 2010.
4. Azevedo MR, Araujo CL, Reichert FF, Siqueira FV, da Silva MC, Hallal PC. Gender differences in leisure-time physical activity. *Int J Public Health* 2007; 52: 8-15.
5. Florindo AA, Guimaraes VV, Cesar CL, Barros MB, Alves MC, Goldbaum M. Epidemiology of leisure, transportation, occupational, and household physical activity: prevalence and associated factors. *J Phys Act Health* 2009; 6: 625-632.
6. Trost SG, Owen N, Bauman AE, Sallis JF, Brown W. Correlates of adults' participation in physical activity: review and update. *Med Sci Sports Exerc* 2002; 34: 1996-2001.
7. ILO. International Labour Organization. Shift work: conditions of work and employment programme. Information Sheet No. WT-8. Geneva; 2004.
8. Scott AJ. Shift work and health. *Prim Care* 2000; 27: 1057-1079.
9. Tepas DI, Barnes-Farrell JL, Bobko N, Fischer FM, Iskra-Golec I, Kaliterna L. The impact of night work on subjective reports of well-being: an exploratory study of health care workers from five nations. *Rev Saude Publica* 2004; 38 Suppl: 26-31.
10. Macagnan J, Pattussi MP, Canuto R, Henn RL, Fassa AG, Olinto MT. Impact of nightshift work on overweight and abdominal obesity among workers of a poultry processing plant in southern Brazil. *Chronobiol Int* 2012; 29: 336-343.
11. Wang XS, Armstrong ME, Cairns BJ, Key TJ, Travis RC. Shift work and chronic disease: the epidemiological evidence. *Occup Med (Lond)* 2011; 61: 78-89.
12. Canuto R, Garcez AS, Olinto MT. Metabolic syndrome and shift work: a systematic review. *Sleep Med Rev* 2013; 17: 425-431.
13. Barbadoro P, Santarelli L, Croce N, Bracci M, Vincitorio D, Prospero E et al. Rotating shift-work as an independent risk factor for overweight Italian workers: a cross-sectional study. *PLoS One* 2013; 8: e63289.
14. Garaulet M, Gomez-Abellan P. Chronobiology and obesity. *Nutr Hosp* 2013; 28 Suppl 5: 114-120.
15. Rajaratnam SM, Arendt J. Health in a 24-h society. *Lancet* 2001; 358: 999-1005.
16. Moreno CRC, Fischer FM, Rotenberg L. Workers' health in society 24 hours. *Sao Paulo Perspec* 2003; 17: 34-46.
17. Marqueze EC, Ulhoa MA, Castro Moreno CR. Leisure-time physical activity does not fully explain the higher body mass index in irregular-shift workers. *Int Arch Occup Environ Health* 2014; 87: 229-239.
18. Ma CC, Burchfiel CM, Fekedulegn D, Andrew ME, Charles LE, Gu JK et al. Association of shift work with physical activity among police officers: the Buffalo cardio-metabolic occupational police stress study. *J Occup Environ Med* 2011; 53: 1030-1036.
19. Atkinson G, Fullick S, Grindey C, Maclaren D. Exercise, energy balance and the shift worker. *Sports Med* 2008; 38: 671-685.
20. Atkinson G, Edwards B, Reilly T, Waterhouse J. Exercise as a synchroniser of human circadian rhythms: an update and discussion of the methodological problems. *Eur J Appl Physiol* 2007; 99: 331-341.
21. Harrington JM. Health effects of shift work and extended hours of work. *Occup Environ Med* 2001; 58: 68-72.
22. Brazil. Ministry of Health. Vigitel Brasil 2010: surveillance of risk factors for chronic diseases and protection for telephone survey. Brasília; 2011.
23. Hallal PC, Gomez LF, Parra DC, Lobelo F, Mosquera J, Florindo AA et al. Lessons learned after 10 years of IPAQ use in Brazil and Colombia. *J Phys Act Health* 2010; 7 Suppl 2: S259-264.
24. Pate RR, Pratt M, Blair SN, Haskell WL, Macera CA, Bouchard C et al. Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA* 1995; 273: 402-407.
25. Barros AJ, Hirakata VN. Alternatives for logistic regression in cross-sectional studies: an empirical comparison of models that directly estimate the prevalence ratio. *BMC Med Res Methodol* 2003; 3: 21.
26. Lin YC, Hsiao TJ, Chen PC. Persistent rotating shift-work exposure accelerates development of metabolic syndrome among middle-aged female employees: a five-year follow-up. *Chronobiol Int* 2009; 26: 740-755.
27. Metzner RJ, Fischer FM. Fatigue and workability in twelve-hour fixed shifts. *Rev Saude Publica* 2001; 35: 548-553.
28. Pietroiusti A, Neri A, Somma G, Coppeta L, Iavicoli I, Bergamaschi A et al. Incidence of metabolic syndrome among night-shift healthcare workers. *Occup Environ Med* 2010; 67: 54-57.
29. Schneider S, Becker S. Prevalence of physical activity among the working population and correlation with work-related factors: results from the first German National Health Survey. *J Occup Health* 2005; 47: 414-423.

30. Li Y, Sato Y, Yamaguchi N. Shift work and the risk of metabolic syndrome: a nested case-control study. *Int J Occup Environ Health* 2011; 17: 154-160.
31. Barros MV, Nahas MV. Health risk behaviors, health status self-assessment and stress perception among industrial workers. *Rev Saude Publica* 2001; 35: 554-563.
32. Salles-Costa R, Heilborn ML, Werneck GL, Faerstein E, Lopes CS. Gender and leisure-time physical activity. *Cad Saude Publica* 2003; 19 Suppl 2: S325-333.
33. Varo JJ, Martínez-González MA, De Irala-Estévez J, Kearney J, Gibney M, Martínez JA. Distribution and determinants of sedentary lifestyles in the European Union. *Int J Epidemiol* 2003; 32: 138-146.
34. Marcondes WB, Rotenberg L, Portela LF, Moreno CRdC. The weight of work leads women to healthcare. *Sao Paulo Perspec* 2003; 17: 91-101.
35. Artazcoz L, Borrell C, Benach J. Gender inequalities in health among workers: the relation with family demands. *J Epidemiol Community Health* 2001; 55: 639-647.
36. Rotenberg L, Portela LF, Marcondes WB, Moreno C, Nascimento CP. Gender and night work: sleep, daily life and the experiences of night shift workers. *Cad Saude Publica* 2001; 17: 639-649.
37. Kaneko SY, Maeda T, Sasaki A, Sato A, Tanaka K, Kobayashi T et al. Changes in health habits of female shift workers. *J Occup Health* 2004; 46: 192-198.
38. Kouvonen A, Vahtera J, Oksanen T, Pentti J, Vaananen AK, Heponiemi T et al. Chronic workplace stress and insufficient physical activity: a cohort study. *Occup Environ Med* 2013; 70: 3-8.
39. Pearce N, Checkoway H, Kriebel D. Bias in occupational epidemiology studies. *Occup Environ Med* 2007; 64: 562-568.