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The impact of shift work on Portuguese Air Transport ground worker's diet

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Abstract: Introduction: "Early to bed, early to rise" is built on the assumption that sleeping is inevitable at night and waking up should take place with sunrise. When we counteract this with shift work, worker's eating behavior may be affected. The aim of this study was to analyze the influence that shift work has on the diet of shift workers (SW). Methods: A semi-quantitative food frequency questionnaire was delivered to 190 ground SW and to a control group of 40 ground workers who didn't do shifts. Results: We observed significantly differences between SW and control group. Our data confirmed that SW present a hypercaloric and hyperlipidic diet, with high values of saturated fat, dietary cholesterol, trans fat and sugar. Conclusion: According to our research it can be established that shift work have impact in worker's dietary intake, reflecting the need to develop specific nutritional strategies for this working class.

Keywords: Shift work, Diet, Dietary intake, Nutritional intake, Food consumption frequency.

O impacto do trabalho por turnos na dieta dos trabalhadores de terra da Transportadora Área Portuguesa

Resumo: Introdução: A expressão "Deitar cedo e cedo erguer" é construída sobre o pressuposto de que dormir é inevitável durante a noite e acordar deveria ocorrer com nascer do sol. Quando contrariamos isto com o trabalho por turnos, o comportamento alimentar do trabalhador pode ser afetado. O objetivo deste estudo foi analisar a influência que o trabalho por turnos tem na dieta dos trabalhadores por turnos (SW). Métodos: Um questionário semi-quantitativo de frequência alimentar foi entregue a 190 trabalhadores por turnos e a 40 trabalhadores de horário regular. Resultados: Observamos diferenças significativas entre SW e grupo controlo. Os nossos dados confirmaram que SW apresentam uma dieta hipercalórica e hiperlipídica, com valores elevados de gordura saturada, colesterol alimentar, gordura trans e açúcar. Conclusão: De acordo com este estudo, o trabalho por turnos têm impacto no consumo alimentar do trabalhador, o que reflete a necessidade de desenvolver estratégias nutricionais específicas para trabalhadores por turnos.

Palavras-chave: Trabalho por turnos, dieta, ingestão alimentar, ingestão nutricional, frequência do consumo de alimentar.

1. Introduction

Shift work involves irregular or unusual hours, compared to those of a normal daytime work schedule (Wang et al. 2011). For many years, shift work has been required to provide vital services and emergency cover at 24 hours a day, as well as for maintaining long-term industrial processes (Atkinson et al., 2008). According to recent European and American surveys, between 15-30% of the adult population is involved in some type of shift work, with 19% of the European population reportedly working at least 2 hours between 22 pm and 5 am (Boudreau et al., 2013). According to 2010 economic report also 10% of the Portuguese employed population does shift work (Relatório de Conjuntura 2010). Benjamin Franklin's dictum "*early to bed, early to rise*" is built on the supposition that sleep is inevitable at night and waking should correspond to sunrise. When we counteract this with, shift work, night work, reduction in normal sleep, all of which are common in modern societies, a sleep-wake cycle and circadian rhythms disruption will be create (Bass, 2012). In most individuals, the circadian rhythm does not rapidly adapt to phase shifts, and this state of chronic circadian misalignment can lead to sleep and performance complaints but also contributes to the association between night work and adverse health outcomes, such as elevated cardiovascular diseases risk, metabolic syndrome, diabetes, specific cancer types and weight gain when compared to general population (Boudreau et al., 2013). Several studies in the past also showed that food and regular meal patterns have synchronizing effects on the circadian system. Vice versa, the primary control level of the circadian system, the master clock, which is located in the suprachiasmatic *nuclei*, regulates food intake by especially adapting the human body to the light/dark cycle (Ekmekcioglu & Touitou, 2011). Eating behaviour might be altered by working shifts, especially when night shift is involved, due to a diverse range of biological, social and cultural factors. Work shift appears to affect the amount ingested, the quality of dietary intake and daily energy distribution. Dietary intake tends to be more irregular during the night (Lowden et al., 2010). The aim of this study was to analyze the influence that shift work has on the diet of TAP ground workers.

2. State of the art

Most studies do not find differences between shift workers and regular day workers regarding to total macronutrient and energy intake, but has been reported changes in eating habits (Antunes et al., 2010). Often shift workers choose meals that are quick and easy to prepare since they haven't energy to cook (Persson & Martensson, 2006). In the workplace, these workers tend to choose cold meals in the evening, although hot food can also be available. The craving for carbohydrates, in particular sugar is very common. Food consumption in the workplace is also influenced by the quality of food available and conditions for workers carrying out the meals. The lack of variety of food options is a factor that influences food consumption (Lowden et al., 2010). In night shifts, workers tend to consume food with more energy density than other shifts and consume more food from vending machines (Atkinson et al., 2008). Pasqua and Moreno (2004) demonstrated that the seasons also appear to have an important role in eating habits of workers. Meals in winter tend to contain higher energy density and a high glucose and lipid content. The season will influence not only the type of food consumed as well as the quantity (Idem).

Apparently there is no big difference between day and night workers in food intake, regarding to the night shift, but younger workers have a lower food intake than older workers (Lowden et al., 2010). Ekmekcioglu and Touitou (2011) concluded that the energy distribution by a greater number of meals is more advantageous than a lower number of meals and more satiating breakfast appears to have a favourable effect on weight regulation in these workers. In shift workers is often observed high consumption of small snacks during night shifts (Assis et al., 2003).

The consequences of food intake restriction (skipping meals, incomplete meals, diets and malnutrition) in shift workers have been observed. In the short term has been reported an energy deficit and long-term deficits of various nutrients (minerals, vitamins, fatty acids and essential amino acids) (Lowden et al., 2010). Knutson et al. (1990) have shown that fiber intake decreased after 6 months of shift work and it was concluded that it could be due to the reduced consumption of green vegetables and increased consumption of sugary drinks. Linseisen and Wolfram (1994) concluded that consumption of dietary fiber, zinc, vitamin A and D is lower in night workers.

One study showed that the diet of shift workers was rich in meat, starches, soft drinks and sweets (Assis et al., 2003). In Debry et al. (1967), shift worker's diet were rich in protein and animal fat, however it has been shown that the daily energy intake was not different from regular workers. The same was found in Reinberg et al. (1979), although in this case there is an increased of the intake of carbohydrate during the night shift (Lowden et al., 2010).

The majority of evidence shows that the daily energy intake between shifts does not vary. However, working shift appears to affect the amount ingested, the quality of dietary intake and daily energy distribution. The food intake tends to be uneven during the night period (Lowden et al., 2010).

Regarding to symptomatology the night shift is associated with a reduction of sleep (4-7 hours), symptoms of insomnia and sleepiness (Boudreau et al., 2013). The sleep deprivation leads to an increase in energy consumption from foods with a high content of glucose and may thus contribute to the ponderal gain (Lowden et al., 2010). Sleep deprivation or an altered sleep may be associated with obesity and cardiovascular diseases (Ekmekcioglu & Touitou, 2011).

The prevalence of sleepiness and/or insomnia is 32% in permanent night workers, 26% of shift workers and 18% in regular workers (Milia et al., 2013). Studies also show that there is a relation between fatigue and shift work (Eldevik et al., 2013).

One of the biggest complaints among shift workers are also gastrointestinal disorders. The most common are appetite disorders, irregular bowel movements, constipation, dyspepsia, abdominal pain and flatulence (Atkinson et al., 2008). Marinaccio et al. (2013) have shown that one of the most susceptible groups to stress are also the shift workers.

3. METHODS

Workplace characteristics

TAP Portugal – Portuguese Air Transport is an international airline that operates from its operational base in Lisbon. The TAP shift workers (SW) can work on shift's schedules with amplitude of sixteen hours (H16), twenty-four hours (H24) or shift's with an amplitude above sixteen hours and below twenty-four hours. This study is restricted to H16 and H24 shifts since these are the most frequent shifts on TAP. The H16 includes a morning shift (from 6am to 2pm) and an afternoon shift (from 2pm to 10pm). The shift workers work in the morning shift at least 3 weeks in a row and switch after to the afternoon shift also with a frequency of at least 3 weeks, and then they repeat the process. The H24 includes a morning shift (from 8am to 4pm), an afternoon shift (from 4pm to midnight) and a night shift (midnight to 8am). The shift workers work in the morning shift at least 4 weeks in a row, then switch after to the afternoon shift also with a frequency of at least 4 weeks, and finally switch to the night shift for at least 4 weeks. After de night shift they repeat the process (morning shift, to afternoon shift, to night shift)[8]. Every aspect of this study was approved by TAP institutional review board.

3.1 Sample

We studied 190 ground SW (25 females and 165 males) and a control group of 40 ground workers who didn't do shifts (35 females and 5 males). In the SW sample, 125 worked on H16 shifts and 65 worked on H24 shifts. Our sample was also divided in blue collars and white collars, according to labour characteristics: Blue collar is a working class person who performs manual labour as opposed to white collar worker who performs non-manual labour. The professions gathered in "Blue collars" included technicians of repair and treatment of airplane's material, technicians of precision's machines, technicians of aircraft's maintenance and technicians of support to maintenance. The professions gathered in "White collars" were sales management, administration, informatics and telecommunications technicians, physicians and nurses. Workers with less than 12 months of shift work, less than 18 years old or older than 65 years were not considered in this study. The disparity in the gender and age of the sample could lead to bias. To reduce the bias we analyzed a randomly sample collected from the SW sample (25 females and 15 males) and the same control group (35 females and 5 males). Despite our best efforts we cannot eliminate the difference in ages between samples. The participants in the study were recruited by the administrative assistants, doctors and nurses of the medical centre of TAP.

3.2 Measures

It was delivered individually to the TAP ground workers a printed questionnaire in the medical centre of TAP, which included information about age, gender, weight, height, changes in biochemical parameters, symptomatology, profession details (blue collars and white collars), type of shift (H16 and H24 shifts), meals pattern (number of meals per day, time for meals and if meals were made alone or with colleagues), water intake, and finally physical activity pattern. Participants only had to fill their personal information (age, gender, last weight and height, type of shift and type of profession) and mark with an "x" if they had some of the symptomatology (insomnia, sleepiness, fatigue, stress, constipation and diarrhea) or which biochemical parameter was changed in the last blood sample (c-total, c-HDL, c-LDL, blood glucose and triglycerides). The workers were also evaluated regarding to physical activity and nutritional intake with the closed questions about frequency/duration/type of exercise, meals pattern and water intake. We also delivered individually a printed semi quantitative food frequency questionnaire developed by the Department of Hygiene and Epidemiology of the Medical School of the University of Porto. The frequency reported for each item was multiplied by the respective standard middle portion, in grams (g), and by a factor of seasonal variation, which was considered the average seasonality of three months (0,25). The conversion of food to nutrients was performed using the program Plus Food Processor (ESHA Research, Salem, Oregon) with nutritional information from food composition of the US Department of Agriculture adapted to Portuguese food. Since the latest Portuguese National Food Survey collection reports to 1980, and the Portuguese population have notably changed dietary pattern, we decided to compare our results with data about food availability, collected by National Institute of Statistics. Our results were also compared to Dietary Reference Intakes.

3.3 Statistical analysis

The statistical analyses were performed using statistical software SPSS version 22. Our data doesn't follow normal distribution, so we analyzed the variables with non-parametric tests. The continuous variables were tested with Mann-Whitney U test and the dichotomous variables with Pearson's chi-squared test and Fisher's exact test. We used 95% confidence intervals with a level of significance of $p<0.05$.

4. Results

The Table 1 shows the sample characteristics. The average age of SW was 37 years old and presented a BMI mean of 25.5 kg/m^2 while the control group presented 45 years old and also 25.5 kg/m^2. No significant differences were found, comparing the BMI between gender, profession and shift type on SW sample. Regarding changes on biochemical parameters, we only found significantly differences concerning to c-total which 13% of SW referred altered values by opposite of 30% of control group ($p<0.05$). We didn't find significant differences on this variable depending on profession and shift type.

According to symptomatology, no significantly differences were observed between groups, except for constipation which was observed in 6% of the SW and 33% of control group ($p<0.05$). According to profession details we found significant differences on symptomatology: white collars presented significantly more sleepiness than blue collars ($p<0.05$). Also H24 SW presented more insomnia and constipation compared to H16 SW ($p<0.05$). According to meals pattern, the SW and the control group did nearly 4 meals per day and in both groups less than 10% did those meals alone ($p>0.05$). The average time consumed for lunches and dinners was approximately 25 minutes and 10 minutes for breakfasts, snacks and suppers ($p>0.05$).

The water intake was between 1.2-1.5 litres/day in both groups ($p>0.05$). On the SW sample, blue collars and males drank significantly more water than white collars and females ($p<0.05$). Both groups presented very similar behaviors in cook techniques (boil, grill, roast, stew and braise). Only a significantly higher intake of fried meals was observed in SW ($p<0.05$). Comparing SW with control group, 86% of SW and 83% of control group do physical exercise ($p>0.05$). The SW who did exercise, made per session an average of 60 minutes compared to 45 minutes of the control group ($p<0.05$).

Table 1: Sample characteristics

	Categories	SW (n=190)	Control Group (n=40)	p value
Age	Age (years)	37	45	<0.05
BMI	BMI (kg/m^2)	25.47	25.51	ns
Gender	Female	13% (25)	88% (35)	<0.05
	Male	87% (165)	12% (5)	
Shift	H16	66% (125)	-	-
	H24	34% (65)	-	
Profession	Blue collar	72% (137)	5% (2)	<0.05
	White collar	28% (53)	95% (38)	
Altered biochemical Parameters	C-total	13% (25)	30% (12)	0.008
	C-LDL	3% (6)	3% (1)	ns
	C-HDL	4% (7)	3% (1)	ns
	Blood glucose	3% (6)	5% (2)	ns
	Triglycerides	4% (7)	3% (1)	ns
Symptomatology	Sleepiness	24% (45)	13% (5)	ns
	Insomnia	29% (55)	25% (10)	ns
	Stress	40% (75)	33% (13)	ns
	Fatigue	50% (94)	48% (19)	ns
	Diarrhea	6% (11)	3% (1)	ns
	Constipation	6% (12)	33% (13)	<0.05
Meals pattern	Number of meals per day	4	4	ns
	Water per day (liters)	1.5	1.2	ns
	Time for main meals (minutes)	26	24	ns
	Time for intermediate meals (minutes)	11	10	ns
	Meals alone	9% (17)	5% (2)	ns
	Meals accompanied	91% (173)	95% (38)	
Cook techniques per week	Boil	3	2	ns
	Grill	3	3	ns
	Fry	2	1	0.002
	Roast	2	2	ns
	Stew	1	1	ns
	Braise	1	1	ns
Physical exercise	Workers who do physical exercise	86% (163)	83% (33)	ns
	Duration per session (minutes)	60	45	0.005
	Number of sessions per week	4	3	ns
Type of exercise	Walking	17% (32)	30% (n=12)	0.004
	Swimming	3% (5)	3% (n=1)	
	Jogging	20% (38)	3% (n=1)	
	Gym	17% (33)	35% (n=14)	
	Others	25% (47)	10% (n=4)	

Table 2 shows food consumption pattern. When comparing to average of Portuguese population, our sample consumed higher amount of fruits, beans, fish and beverages with caffeine ($p<0.05$) and by opposite a lower amount of vegetables, meat and entrails, cereals, potatoes and alcoholic beverages ($p<0.05$). Workers who had H24 shifts presented higher intake of fish and coffee ($p<0.05$).

Table 2: Comparison of food consumption/day with the average consumption/day of the Portuguese population

Food groups	Portuguese population [a] (g)	Control Group		SW	
		Mean (g)	p value	Mean (g)	p value
Fruits	213	303	0.023	309	<0.05
Dairy	346	296	ns	357	ns
Vegetables	265	195	0.005	200	<0.05
Beans	10	29	<0.05	51	<0.05
Fish	58	105	0.001	95	<0.05
Meat and entrails	191	153	0.004	161	<0.05
Cereals and rice	347	164	<0.05	212	<0.05
Potato	201	60	<0.05	72	<0.05
Chocolate and cocoa	12	11	ns	8	<0.05
Beverages with caffeine	12	287	<0.05	306	<0.05
Sodas	204	120	<0.05	214	ns
Alcoholic beverages	261	39	<0.05	144	<0.05

Legends: [a] National Institute of Statistics;
*Note: *We only found significant differences between SW and control group regarding alcoholic beverages and cereals, which SW showed a higher intake (p<0.05).*

The table 3 shows the nutrient intake. Comparing to Dietary Reference Intakes (DRI), the SW sample presented an higher intake of several nutrients, as protein, fat, saturated fat, cholesterol, sugar, vitamins B, vitamin C, iron, phosphorus, sodium and zinc, and lower values of carbohydrates, fiber, trans fat, alcohol, caffeine, vitamin A, E, and K, magnesium and potassium ($p<0.05$). On SW sample, we didn't verify differences in gender, regarding to nutritional intake with the exception of alcohol which females presented lower levels ($p<0.05$). H16 SW presented higher level of alcohol intake compared to H24 SW ($p<0.05$). SW showed a higher intake of alcoholic beverages and cereals compared to controls ($p<0.05$). Regarding to nutrients SW consumed more trans fat, cholesterol, alcohol, riboflavin, folate and iron ($p<0.05$) than controls. No significant differences in the other nutrients were found ($p>0.05$). The randomly sample collected from the control group and SW was composed by 40 SW with an average age of 34 years old, and a control group of 40 non SW with an average age of 45 years old. SW presented higher levels of iron, had less constipation and more sleepiness than control group ($p<0.05$).

Table 3: Nutritional Intake

Nutrient	Mean and reference values [a]	Control Group		SW	
		Mean	P value	Mean	P value
Energy (Kcal)	Harris-Benedict equation: [b] Control Group: 1707 vs SW: 2096	2105	0.006	2365	<0.05
Protein (g)	10-35%: Control Group: 68 vs SW: 78	109	<0.05	116	<0.05
Carbohydrates (g)	45-65%: Control Group: 230 vs SW: 289	223	ns	265	<0.05
Fat (g)	20-35%: Control Group: 57 vs SW: 70	89	<0.05	92	<0.05
Saturated Fat (g)	<10%: Control Group: 19 vs SW: 23	26	0.006	28	<0.05
Trans Fat (g)	<1%: Control Group: 1.9 vs SW: 2.3	0.95	<0.05	1.1	<0.05
Cholesterol (mg)	300[c]	368	0.043	438	<0.05
Dietary Fiber (g)	14g/1000kcal: Control Group: 24 vs SW: 29	22	ns	24	<0.05
Sugars (g)	50[d]	103	<0.05	121	<0.05
Alcohol (g)	<10 ♀ - 20 ♂ [c]	2	<0.05	8	<0.05
Caffeine (mg)	100-200[e]	85	<0.05	77	<0.05
Vitamin A (RE)	2333 ♀ - 3000 ♂	1878	0.044	2427	0.001
Thiamin (mg)	1.1 ♀ - 1.2 ♂	1.55	<0.05	1.80	<0.05
Riboflavin (mg)	1.1 ♀ - 1.3 ♂	1.94	<0.05	2.43	<0.05
Niacin (mg)	14 ♀ - 16 ♂	25	<0.05	28	<0.05
Vitamin B6 (mg)	1.3	2.24	<0.05	2.52	<0.05
Vitamin B12 (mcg)	2.4	12.16	<0.05	16.36	<0.05
Folate (mcg)	400	296	<0.05	397	ns
Vitamin C (mg)	75 ♀ - 90 ♂	133	<0.05	152	<0.05
Vitamin D (mcg)	5	5.31	ns	5.24	ns
Vitamin E (mg)	15	11	<0.05	11	<0.05
Vitamin K (mcg)	90 ♀ - 120 ♂	14	<0.05	17	<0.05
Calcium (mg)	1000	899	ns	998	ns
Iron (mg)	18 ♀ - 8 ♂	15	0.048	18	<0.05
Magnesium (mg)	320 ♀ - 420 ♂	342	ns	377	0.020
Phosphorus (mg)	700	1482	<0.05	1647	<0.05
Potassium (mg)	4700	3518	<0.05	3804	<0.05
Sodium (mg)	1500	2223	0.003	2356	<0.05
Zinc (mg)	8 ♀ - 11 ♂	13	<0.05	14	<0.05

Legends: [a] Dietary Reference Intakes; [b] Harris-Benedict equation; [c] European Society of Cardiology; [d] World Health Organization; [e] The Food and Drug Administration
*Note: * We only found significant differences between SW and control group regarding trans fat, cholesterol, alcohol, riboflavin, folate and iron, which SW showed a higher intake (p<0.05).*

5. Discussion

Although it has been noticed changes in eating behaviour between SW and day workers, the majority of studies didn't find differences concerning to total energy and macronutrient intake (Antunes, 2010). In this study, our sample of 190 SW presented a BMI of 25.5 kg/m^2, which means, according to World Health Organization (WHO), they were in a pre-obesity situation. Other studies like the one developed by Thomas and Power found higher BMI value (27.8 kg/m^2) (Thomas & Power, 2010; Di Lorenzo et al., 2003) One of the reason for this important difference may be the fact that our SW have more alluring conditions for the practice of physical exercise, such as, a gymnasium in their workplace and also access to an all-night cafeteria with healthy options: both mechanisms which can contribute to a healthier way of life. However, given the disparity of age and knowing that older shift workers have a higher food intake than younger workers, these results may not correspond to reality because the SW sample has a significantly lower age mean than the control group. The higher food intake could lead to a higher BMI. According to profession details, as Rachiotis et al. who also performed a study with blue and white collars, no differences concerning to BMI were found between groups. Related to shift type, contrary to results obtained by Marqueze et al. (2012), our H24 SW who do night work didn't present a higher BMI. However, we cannot forget that in Marqueze et al. (2012) study, nurses could work 6, 8 or 12 hours/day and our sample only work 8 hours, and it is well known that a higher risk of pre-obesity and obesity is related to a higher number of work hours (Kim et al., 2013).

On the study of Smith et al. (2013) only a small elevation in BMI was seen in SW who did night work. Like other authors we didn't find significant differences between SW and control group concerning BMI (Geliebter et al., 2000) Regarding to biochemical parameters, a small percentage of our sample showed changes in their values. Contrary to Ghiasvand et al. (2006), we found higher values of c-total in regular day workers when compared to SW. In that study they observed the same percentage of changed values of blood glucose, in both groups, but much more SW presented altered values of c-total, c-LDL, c-HDL and triglycerides. This could be due the fact of the biochemical parameters in our study were self-reported, without an absolute value, which may lead to an enormous bias. We may have also to consider the fact that SW of TAP have a frequency of 3 weeks in H16 shifts and 4 weeks in H24 shifts, in the same schedule, which benefits the workers since in general it is required 2 weeks to 1 month for the adjustment of circadian rhythm (Rathore et al., 2012). This period of time could be beneficial for the adjustments biochemical values and decrease the risk of several pathologies (Ekmekcioglu & Touitou, 2011). Also Hublin et al. (2010) didn't find results which support the association between shift work and cardiovascular diseases.

Regarding to symptomatology, SW presented insomnia and sleepiness in the same frequency as already observed by Milia et al. (2013) (26%) and Boivin et al. (2007) (32%). In the randomly sample collected, we also conclude that SW presented more sleepiness and less constipation than controls ($p<0.05$). The H24 SW appear to be more affected by sleep and gastrointestinal disorders than the H16 SW ($p<0.05$). Such results were also found by Costa (1996) who observed that night workers had more complaints of gastrointestinal symptoms than other shifts. Our results supports this, and since in H24 shift contained a night period and in H16 the later shift ends at 10 pm, the disruption of circadian rhythm in night workers could contribute to the gastrointestinal disorders. We verified that SW usually did 4 meals per day, which was more than what was found by Tagaki (1972). The fact of cafeteria be open at night may be the reason for this higher number of meals. We found significant difference regarding the number of fried meals, which were high in SW. Also significant differences were found regarding to the daily water intake between gender and type of profession, where males and blue collars drank more water ($p<0.05$). This could be attributing to the fact that the majority of blue collars are males, and a manual labour usually causes more thirst than a non-manual labour. Regarding physical activity duration, SW and blue collars presented a higher average duration of physical activity than control group and white collars ($p<0.05$).

These results are going against the results found in an Australian study which showed that people who have to be sitting most of working hours are more active in free time than workers who do heavy labour jobs with many work hours standing (Chau et al., 2012). Atkinson et al. (2008) also verified that jogging were the most practiced sports among SW. We also found significant differences between SW and control group concerning the type of exercise preferred, but this can be explain by the disparity of gender between the two groups, which control group prefer go to gymnasium (mostly females) and SW prefer jogging (mostly males). An unexpected high number of workers usually go to the gymnasium, but we have to take in consideration that TAP has a gymnasium for the workers in their installations.

Regarding to food consumption, it's important to refer that the Portuguese population has a potentially unhealthy diet with predominance of animal protein, excess of fat and foods high in sugar and in the latest years the consumption of red meat, fish, dairy and fruits declined and the consumption of refined cereals, vegetables, chocolate and coffee increased (Balança Alimentar Portuguesa, 2008-2012, INE, 2014). Comparing SW to the Portuguese population, our sample presented a higher intake of fruits, beans, fish and beverages with caffeine. However the control group obtained these same results, this could be derivative of the fact that both groups go to TAP's cafeteria which can result in similar meals, concerning the fish, beans, vegetables, meat and entrails, cereals, potatoes and fruit. Also the cafeteria serves suppers for the night workers which can influence diet quality since the workers don't have to use vending machines during the night, which are known to contain a large offer of sweets and others higher-energy dense foods.

Comparing the SW with control group, the SW consumed more alcoholic beverages than control group despite both groups are far below the average of the Portuguese population. However gender difference between two groups may influence the alcoholic intake. Regarding to shift type, H24 SW presented a high coffee intake. This fact was expected from a shift that has a night schedule. Like the majority of studies, we didn't find significant differences between SW and control group concerning energy intake, despite SW and control group both have a hypercaloric diet (Lowden et al., 2010). Their diet also presented high levels of lipids, as verified in Assis et al., protein and saturated fat as found in Di Lorenzo et al. (2003). We also found high levels of simple carbohydrates and such results were also found in Persson and Martensson (2006) study, which should be due to high consume of sodas and fruits. The diet of these workers presented a deficit in fiber, potassium, vitamin A and K that could be justified by the low intake of vegetables. Similar results were also found in Linseisen and Wolfram (1994). Their diet also presents high levels of sodium, as observed by Assis et al. The SW presented a higher intake of refined cereals, rice and alcoholic beverages than control group, as also higher values of trans fat, cholesterol, alcohol, riboflavin, folate and iron ($p<0.05$). H16 SW presented higher level of alcohol ($p<0.05$), a situation also reported by Smith et al. (2013). This could be related to the fact that night shifts compromised the workers social life which could influence the alcohol intake (Ghiasvand et al., 2006). Comparing the intake of both groups with DRIs, we can infer that control group had a better diet than SW ($p<0.05$). We can also infer that in the sample of SW, the blue collars have worst eating habits since distance more from DRI's of fiber and iron. Such results were also found in Leslie et al. (2013) ($p<0.05$). Also H24 shifts have worst eating habits than H16 shifts ($p<0.05$).

Therefore we can highlight that:

- Working shifts doesn't seem to increase the BMI or the cardiovascular risk, however the age difference between de samples could lead to bias in the conclusions of BMI results.
- SW present more sleepiness and less constipation; and shifts with a night schedule are more affected by sleep and gastrointestinal disorders.
- SW consumed more alcoholic beverages, mainly shifts without a night schedule and shifts with a night schedule present a higher intake of coffee.

- SW diet present deficit of fiber, potassium, vitamin A and K and high levels of calories, lipids, saturated fat, dietary cholesterol, trans fat and sugar.
- Both control group, white collars and H16 SW seem to present better eating habits.

6. Conclusion

We encountered some differences in the dietary intake between SW and the control group. Our data confirmed that SW have a hypercaloric and hyperlipidic diet, with high values of saturated fat, dietary cholesterol, trans fat and sugar. However, our study has the limitation of age difference between the samples, which can lead to bias.

There are few studies analyzing dietary intake of SW [7], but according to our results we can say that shift work seems to affect the worker's dietary intake, reflecting the need to develop specific nutritional strategies for this working class.

In order to minimize the health consequences, companies should provide dietary and lifestyle advice, in order to promote healthy habits (Antunes et al., 2010). Should also adopt health promotion programs in the workplace; provide a wide variety of healthy food choices and an area where workers can eat their meals (Lowden et al., 2010).

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