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Prudent diet is associated with low sleepiness among short-haul truck drivers

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Objectives: The lifestyle of postindustrial society has undergone major shifts characterized by changes in demographic and epidemiologic profiles, eating habits, and job structures, with irregular working hours, particularly night shifts. The investigation of dietary patterns is of great importance for the discussion and devising of effective dietary strategies for shift and night workers in general, particularly in view of the increased sleepiness reported during night work.
Objective: We aimed to determine the association between dietary patterns of Brazilian truck drivers and sleepiness levels, according to work shift.
Methods: A cross-sectional study of 52 drivers (25 long haul and 27 short haul) at a freight company was carried out. This study entailed application of a structured questionnaire collecting sociodemographic, lifestyle, and nutritional status data. Assessment of dietary intake using a 24-h dietary recall and an evaluation of sleepiness by the Karolinska Sleepiness Scale were performed. The principal components of the diet were analyzed by factor analysis to derive dietary patterns. A linear mixed model was then applied to determine a model for sleepiness levels of the drivers as a function of dietary pattern, time of day, and work shift.
Results: Three intake patterns were derived: traditional, prudent, and Western. Associations of time of day ($F = 23.629$, $P < 0.01$) and shift type ($F = 42.218$, $P < 0.01$) on sleepiness were found. An association between diet and sleepiness was also evident, where the prudent pattern was associated with low sleepiness among short-haul truck drivers ($F = 3.865$, $P = 0.02$).
Conclusions: The results of the present study revealed an association between dietary patterns and short-haul driving, in which the healthy pattern produced low sleepiness during the day. The sleepiness curve of long-haul drivers appears to have a flattening pattern, probably because of irregular working times.

Introduction

Over the last 50 years, the lifestyle of postindustrial society has undergone major shifts, characterized by changes in demographic and epidemiologic profiles as well as in industrialization and urbanization. Some of the changes in job structures include irregular working hours, particularly involving night shifts [1].

Shiftwork, especially night shifts, is associated with fatigue, stress, lower performance in activities, greater risks of accidents, and early functional disability [2,3]. These characteristics are linked to poor working conditions and deregulation of biological rhythms as a result of the hours in which workers perform their activities [1,4].

In addition, changes in the lifestyle of the population over recent decades have also affected eating habits. Preference for processed food products over foods rich in fibers and vitamins, together with sedentarism promoted by changes in the structure of work and by advances in technology, represent the main etiologic factors of overweight and obesity among adults [5–8].

Night workers are no exception to this change in dietary intake; indeed, the more ready availability of processed foods has facilitated night-time snacking, a common practice in this population [9,10]. The dietary behavior of this group of workers is heavily influenced by the working times. The consumption of snacks with a high energetic value yet low nutritional value in terms of micronutrients and fiber during work time has led to increased rates of overweight and obesity among these individuals [11–13].

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Several studies report an association between sleep restriction and changes in dietary intake that lead to weight gain [14–16]. Markwald et al. [17] found an increased food intake during periods of reduced sleep duration and consequently weight gain among study volunteers. According to the authors, this response seems to be a physiological adaptation of the organism to supply the energy needed for the longer waking period. In addition, when the amount of sleep was restored, a reduction in energy consumption, especially carbohydrates and fats, was identified in the sample analyzed.

A study by Nehme [18] involving night security guards found an interaction between obese individuals and increased sleep duration after a 30% increase in carbohydrate content in the caloric value of nighttime meals, suggesting possible mediation by obesity of the effect of carbohydrate intake on sleep of night workers.

The effects of carbohydrate intake during night shifts have been studied since the 1980s. These studies suggest that carbohydrate consumption is a factor that changes body mass and influences psychophysiological variables, such as mood [19–22]. Dye et al. [23] affirmed that carbohydrate-rich meals reduced mental performance and promoted increased levels of sleepiness compared with meals rich in fats. According to Linder [24], the effect of carbohydrate intake in promoting sleepiness occurs as a result of serotonin production, potentialized by meals rich in this nutrient. One study found that greater consumption of carbohydrates compared with other macronutrients, such as lipids, was associated with greater sleepiness [10].

Evidence from the literature suggests that the ingestion of meals with high fat and sugar content may promote excessive daytime sleepiness. According to Panossian and Veasey [26], food-induced sleepiness might be due to the hormonal and neuroendocrine response triggered by this kind of nutrient, characterized by increased glucose, leptin, cholecystokinin, peptide YY, inflammatory cytokines, reduced norepinephrine, and decreased neuronal wake sign.

The main sleep problems reported by shift workers are related to complaints of excessive sleepiness [3]. According to Åkerstedt and Wright [27], the misalignment between the endogenous circadian rhythms and the work schedules established by night shift work lead to sleepiness and sleep disorders while also increasing the risk of accidents.

Several studies have investigated the effects of shift work on sleepiness levels. A study of truck drivers in Belgium found a high level of sleepiness in 18% of respondents [27]. Another study conducted with drivers in Finland showed that about 40% of long-haul drivers and 21% of short-haul drivers reported problems staying alert during the work period [28].

However, analysis of nutrient intake alone cannot identify certain, more specific, dietary-related associations and outcomes, such as the risk of diseases [29]. For this reason, we decided to investigate dietary patterns instead of concentrating on the effect of a single nutrient. Drivers, being shift workers, also tend to have a diet poor in nutrients and exhibit changes in eating behavior [13]. The studies carried out in this population highlight low fruit and vegetable consumption, low fiber intake, high consumption of processed foods and fried foods, and excessive salt in meals [30–32].

The investigation of dietary patterns is of great importance for the discussion and devising of effective dietary strategies for shift and night workers in general. The present study involved truck drivers, a group of workers exposed to long periods of night work and static activity, which can lead to irritability, insomnia, reduced alertness, sedentarism, intake of alcoholic beverages, overweight, obesity, and unhealthy eating habits [33–35]. Thus the hypothesis of this study is that the healthy eating pattern is associated with low sleepiness during the day. The premise behind this hypothesis is that healthy eating habits lead to good sleep quality, which in turn reduces diurnal sleepiness. Therefore the aim of this study was to determine the association between dietary patterns of Brazilian truck drivers and sleepiness levels, according to work shift.

Methods

Study sample and design

The present cross-sectional study was conducted in a freight company as part of an institutional program promoting health and quality of life. The company in question has been operating for 35 y and possesses branches in all the capital cities of Brazil. The company had 248 drivers (110 short haul and 138 long haul) on its staff at the time of data collection (May and September 2012). An initial total of 120 drivers were randomly selected (40 short-haul male drivers, 40 long-haul male drivers, 20 short-haul female drivers, and 20 long-haul female drivers), of whom only 71 individuals agreed to take part in of the study (29 long-haul drivers and 42 short-haul drivers).

Short-haul drivers worked a fixed daytime schedule of 09:00 h to 17:00 h, Monday to Friday, with Saturday and Sunday off. Depending on seasonal demands, overtime during the week and on Saturdays was common. Long-haul drivers worked irregular hours on predominantly long distance trips often made during the night (from 23:00 h) and early hours. Periods off were not systemically scheduled in advance.

The following exclusion criteria were applied: use of medications that cause changes in sleep (antiarrhythmics, beta blockers, selective serotonin inhibitors, sedating antihistamines, and sympathomimetic stimulants), presence of psychiatric, hormonal or sleep disturbances, and having a second job. After losses from the sample, the final number of participants who had sleepiness measured and had answered the 24-h dietary recall was 52 ($n = 27$ short haul and $n = 25$ long haul). The sampling power calculated a posteriori was 0.95 (95%), with an effect of 21.4% according to calculations performed using Stata statistical software.

Ethical aspects

The study was approved by the Research Ethics Committee of the School of Public Health of the University of São Paulo (COEP FSP/USP), under approval number 2313/2012. All drivers randomly selected were asked to take part in the study and agreed voluntarily after being explained the objectives of the study and signing the Free and Informed Consent Form, previously approved by the COEP of the FSP/USP stipulated in resolution 196/96, of the Ministry of Health National Board of Health [36].

Data collection and processing

This study was performed with the application of a structured questionnaire collecting data on sociodemographic (gender, age, educational level, marital status) and lifestyle habits (drinking, smoking). Data were also collected for self-reported body mass and height to assess study participants′ nutritional status. Studies suggest the use of self-report measurements as a rapid, economical, and reliable alternative for monitoring nutritional status of the population in situations when direct measurements are not feasible [37–40].

The 24-h dietary recall was conducted on 3 non-consecutive days, comprising 2 working days and 1 day off, to minimize the influence of intrapersonal variability on dietary intake of the sample studied. A photograph album illustrating serves of the most common foods in the Brazilian diet was employed as an aid during interviews [41].

The data collected by the 24-h dietary recall were previously checked for quality of the information. Standardized quantification of foods and beverages in grams, milligrams, and milliliters was performed. Data were keyed into the software Nutrition Data System for Research Version 2007 [42], whose main database is the Food Composition Table of the U.S. Department of Agriculture. Nutritional values of traditional Brazilian preparations and foods not included in the software program were input based on information from the Brazilian Food Composition Table [43].

More than 1000 food items were reported, grouped according to nutritional value and characteristics of Brazilian dietary culture [5,44]. Foods consumed by less than 10% of the sample were excluded from the analysis [45].

Foods were classified into 22 groups: fruit (fresh fruit, fruit salad, and dried fruit); vegetables (all vegetables and legumes); beans (carioca and black beans, peas, lentils, chickpeas); roots and tubers (potato, manioc, yam, taro); rice, bread, and cakes (white and whole rice, white and whole meal bread, and homemade sponges without icing); breakfast cereals (granola, oats, corn flakes); milk, milk derivatives, and eggs (whole and skimmed milk, cheese, cream cheese, yogurt, and boiled eggs or omelets); vegetable oils and olive oil; juices; processed meats; white meats; red meats; pastas and fast food (pizza, lasagna, spaghetti, hamburger, fritter); fried foods, animal fat, and emulsions (fried egg, fried potatoes, chicken savory, cheese bread, rissoles, kibbeh, pork scratchings, butter, lard, mayonnaise, and margarine); sugar and desserts (refined sugar, brown sugar, honey, jams, compotes, jelly, dulce de leche, peanut confectionary, soft chocolate bon bons, coconut confectionary, and iced cakes with filling); processed sweet products (boiled sweets, chewing gum, ice-cream, biscuit creams, and chocolates); coffee and teas; soft drinks, alcoholic beverages (lager, draft beer, and wine); snacks and savories (salted peanuts, savory "chips," packet sweet popcorn, and salted popcorn); soups and broths; and pâtés and sauces (mayonnaise-based pâtés and white sauce).

Sleepiness measurements were made using the Karolinska Sleepiness Scale (KSS). The KSS was completed by the drivers every 3 h after waking for 10 d. The KSS is self-rated and preceded by the question "How are you feeling right now?" with scores ranging from 1 to 9, classified as "extremely alert" = 1, "very alert" = 2, "alert" = 3, "rather alert" = 4, "neither alert nor sleepy" = 5, "some signs of sleepiness" = 6, "sleepy, but no difficulty remaining awake" = 7, "sleepy, some effort to keep alert" = 8, "extremely sleepy, fighting sleep, a lot of effort to remain awake" = 9 [46].

Statistical analysis

Normality was tested using the Shapiro-Wilk test. Pearson χ^2 test was applied to test the association between the categorical variables such as sex, age, marital status, nutritional status, and drinking and smoking habits. Dietary patterns were derived by conducting a factor analysis using principal component analysis, employing the 22 food groups as variables. The adequacy of the sample was determined using the Kaiser-Meyer-Olkin test as a reference, with values >0.50 defined as acceptable [25]. To determine the number of factors (patterns) to be retained for analysis, criteria of analysis of the scree test and eigenvalues >1.5 was adopted. Three factors were retained for subsequent analyses. These factors (patterns) were named according to the food groups and factor loading scores and based on the names used in the literature on dietary patterns. Food groups with factor loadings >|0.3| were considered significant.

A linear mixed model was applied to check for the existence of significant differences between the mean sleepiness scores of drivers according to dietary patterns, shift, day, and time of collection (time bands) and also the effects of interaction among these variables.

All statistical analyses were performed using SPSS version 19.0 and Stata Version 13 software packages. A 5% level of statistical significance was adopted for all tests.

Results

In terms of gender distribution, 76.9% (n = 52) of the drivers studied were men. In addition, the short-haul (day shift) group represented the majority of the drivers, at 51.9%. A large proportion of the drivers were in the 20 to 39 y age group (48.0%), and most were married or lived with a partner (78.8%).

The percentage of smokers was 15.3%, whereas 21.1% of the drivers interviewed reported having given up smoking. Regarding use of alcoholic beverages, 51.9% of the participants reported drinking on special occasions, and higher beverage intake was evident among the long-haul (irregular shift) group (68%). Notably, more than 60% of the drivers were in the obese and overweight category. No statistically significant differences were found among the variables analyzed on the Pearson χ^2 test (Table 1).

Three dietary patterns were derived, traditional, prudent, and Western, explaining 34.9% of the total variance of intake. The first pattern (traditional) consisted of foods featured in the Brazilian diet, including beans, rice, bread, coffee/tea, juices, white meats, processed meats, and low vegetable intake (significant negative loading). The second pattern (prudent) was characterized by consumption of root vegetables and tubers, milk and dairy, eggs, vegetable oils and olive oil, and breakfast cereals and by low intake of processed meat, fried foods and animal fat, processed sweet products, alcoholic beverages, and snacks/savories. The third pattern (Western) contained typical foods found in the modern Western diet, such as fast foods, soft drinks, pâtés and sauces, processed meat, and breakfast cereals and low consumption of vegetables and white meat (Table 2).

The average caloric intake of participants was 2698.5 kcal (standard deviation 917.5 kcal). Carbohydrate consumption, compared with recommendations for acceptable macronutrient distribution intervals, was adequate for 84% of the short-haul drivers. Regarding the long-haul group, 45.8% consumed less than the recommended amount of carbohydrates. Statistically significant differences were found between the groups (long and short haul) regarding the

Table 1
Sociodemographic and lifestyle characteristics of study participants (n = 52)

	Long-haul (irregular shift)		Short-haul (day shift)		P (χ^2
Variables	n	%	n	%	
Sex					
Female	6	24.00	6	22.22	0.87
Male	19	76.00	21	77.78	
Age					
20–39 y	10	40.00	15	55.60	
40-49 y	11	44.00	7	25.90	0.37*
≥50 y	4	16.00	5	18.50	
Marital status					
Single	5	20.00	6	22.22	0.84
Married/living with partner	20	80.00	21	77.78	
Educational level					
<9 y	9	36.00	6	22.22	
9–11 y	9	36.00	9	33.33	0.39
≥12 y	7	28.00	12	44.45	
Smoking					
No	14	56.00	19	70.40	
Former smoker	7	28.00	4	14.80	0.44*
Yes	4	16.00	4	14.80	
Alcohol use					
No	6	24.00	9	33.40	
Former drinker	2	8.00	8	29.60	0.05*
Yes	17	68.00	10	37.00	
Nutritional status					
Normal weight	9	36.00	8	30.80	0.69
Overweight/obese	16	64.00	18	69.20	

*Fisher exact test P < 0.05.

Table 2
Factor loadings for the three dietary patterns derived on factor analysis of drivers in second phase of study (n = 52)

Food group	Dietary pattern*		
	Traditional	Prudent	Western
Fruit			
Vegetables	−0.3131		−0.4124
Beans	0.7944		
Root vegetables and tubers		0.7038	
Rice, bread, and cakes	0.7787		
Breakfast cereals		0.3397	0.4727
Milk, dairy, and eggs		0.5847	
Vegetable oils and olive oil		0.4623	
Juices	0.5166		
Processed meats	0.5003	−0.3848	0.3689
White meat	0.4760		−0.3375
Red meat			
Pasta and fast food			0.7954
Fried foods, animal fat, and emulsions		−0.3811	
Sugar and desserts			
Processed sweet products		−0.3282	
Coffee and teas	0.6074		
Soft drinks			0.4349
Alcoholic beverages		−0.6099	
Snacks and savories		−0.4836	
Soups and broths			
Pâtés and sauces			0.6714
% Explained variance	0.1332	0.1081	0.0987

*Only values >|0.3| and >|−0.3| shown.

adequacy of carbohydrate intake (P = 0.02). Regarding fat consumption, 33.3% of long-haul drivers had higher than the recommended consumption. No statistically significant differences were found for adequacy of fat intake between the groups (P = 0.07). Protein consumption was considered adequate for all participants.

The linear mixed model analysis revealed a statistically significant difference in the levels of sleepiness between work shift types (F = 42.218, $P < 0.000$), with higher mean sleepiness scores among day workers (KSS short haul = 3.77, 95% confidence interval [CI] 3.65–3.87) relative to irregular shift workers (KSS long haul = 3.28, 95% CI 3.15–3.40).

Examination of the overall sample, without stratification by work shift, revealed a time- of-day influence on mean sleepiness scores ($P < 0.01$). The highest mean sleepiness scores were found for the early hours (00:00–02:59 h/03:00–05:59 h with KSS = 4.62, 95% CI 4.30–4.93, and KSS = 4.0, 95% CI 3.75–4.34, respectively), nighttime (21:00–23:59 h KSS = 4.05, 95% CI 3.84–4.25) and periods around lunchtime (12:00–14:59 h KSS = 3.31, 95% CI 3.11–3.51), characterizing a typical physiological pattern of variation in sleepiness over the 24-h period (Fig. 1A).

Drivers from the short-haul group (day workers) who adopted the Western diet had higher mean sleepiness scores compared with both individuals in the long-haul group (working night shifts) and drivers that had other dietary patterns who also worked during the day (short haul) (Fig. 1B). For drivers working irregular shifts (long haul), mean sleepiness scores were similar across all three dietary patterns (KSS = 3.08 for Traditional; KSS = 3.45 for Prudent, and KSS = 3.32 for Western). A significant interaction was found between dietary pattern and work shift type (P = 0.02) (Fig. 1B).

Significant interactions were found among dietary pattern, shift type, and time of day for workers with the prudent pattern ($P <$ 0.01). The sleepiness scores showed expected variation during the 24-h period (U-shaped curve, with greater sleepiness at night) for both the traditional and Western dietary patterns. However, analysis of the sleepiness curve for the prudent pattern revealed a delay in the peak compared with the other patterns, with the highest mean scores occurring between 03:00 and 05:59 h as opposed to around midnight (Fig. 2A). There were no major variations in mean sleepiness scores during working hours among the three dietary patterns for drivers working irregular shifts (Fig. 2B).

Discussion

Three different dietary patterns were found among the drivers assessed in the present study. The first pattern (traditional) was characterized by beans, rice, bread, coffee, tea, juices, white meat, and processed meats and inverse correlation with vegetable intake. The second pattern (prudent) was characterized by root vegetables and tubers, milk and dairy, eggs, and vegetable oils and olive oil, and the third pattern (Western) included fast foods, soft drinks, pâtés and sauces, and processed meats. Moreover, the present results indicated an interaction among dietary pattern, work shift type, and time of day. In other words, besides the expected result in which sleepiness varies with shift type and time of day, an association was also detected between diet and sleepiness, with the prudent pattern differing slightly to the others. Also noteworthy is the flattening of the sleepiness curve, irrespective of diet, identified among the drivers from the long-haul group. This likely is due to the fact that, associated with these changes in dietary intake, the sleep deprivation common in night workers can exacerbate metabolic disturbances, such as glucose intolerance, insulin resistance, and dyslipidemia [14]. On top of this, there is also circadian disruption manifested by changes in the sleep–wake cycle [47].

In this case, although the increased homeostatic pressure of sleep during wake state is expected to promote greater sleepiness during work shifts, the opposite occurs. By contrast, an increase in circadian pressure negatively influences sleep onset, despite homeostatic pressure as a result of sleep debt. Consequently, drivers remain alert during work and also have problems getting to sleep during time off, with a greater pressure for wake state than for sleep.

Human beings are naturally diurnal individuals and should be fasting at night, with endogenous mobilization of glucose into the bloodstream. This explains why night workers generally have lower appetite, indigestion, and gastrointestinal diseases, because many metabolic functions follow a pattern of circadian rhythm, including digestion, absorption, and storage of nutrients [48,49]. Irregular shift work (including work at night) is also associated with a number of different health problems caused by changes in the endogenous timing system, particularly cardiovascular diseases [50]. In addition to these aspects, irregular shift workers have no set routine, hampering the maintenance of regular habits of physical activity and eating meals at the proper time [51–54]. These factors lead to a high prevalence of overweight and obesity, a phenomenon also identified among the drivers assessed in the present study.

Furthermore, the literature reports negative lifestyle habits associated with this group of workers, such as alcohol use and smoking. In conjunction, these variables are major causes underlying the development of chronic diseases such as obesity, diabetes, cancer, and circulatory diseases [55,56].

Regarding dietary intake and night work, the literature indicates the adoption of unhealthy diets in terms of nutritional value, based on the consumption of fast foods, caffeine-rich drinks, soft drinks, and chocolates and lower intake of fish and fruit by this group of workers [57,58]. This behavior is evidenced in the results of the present study by a Western dietary pattern characterized by the consumption of fast foods, processed meats, and soft drinks. Another aspect typically found in the diet of individuals working

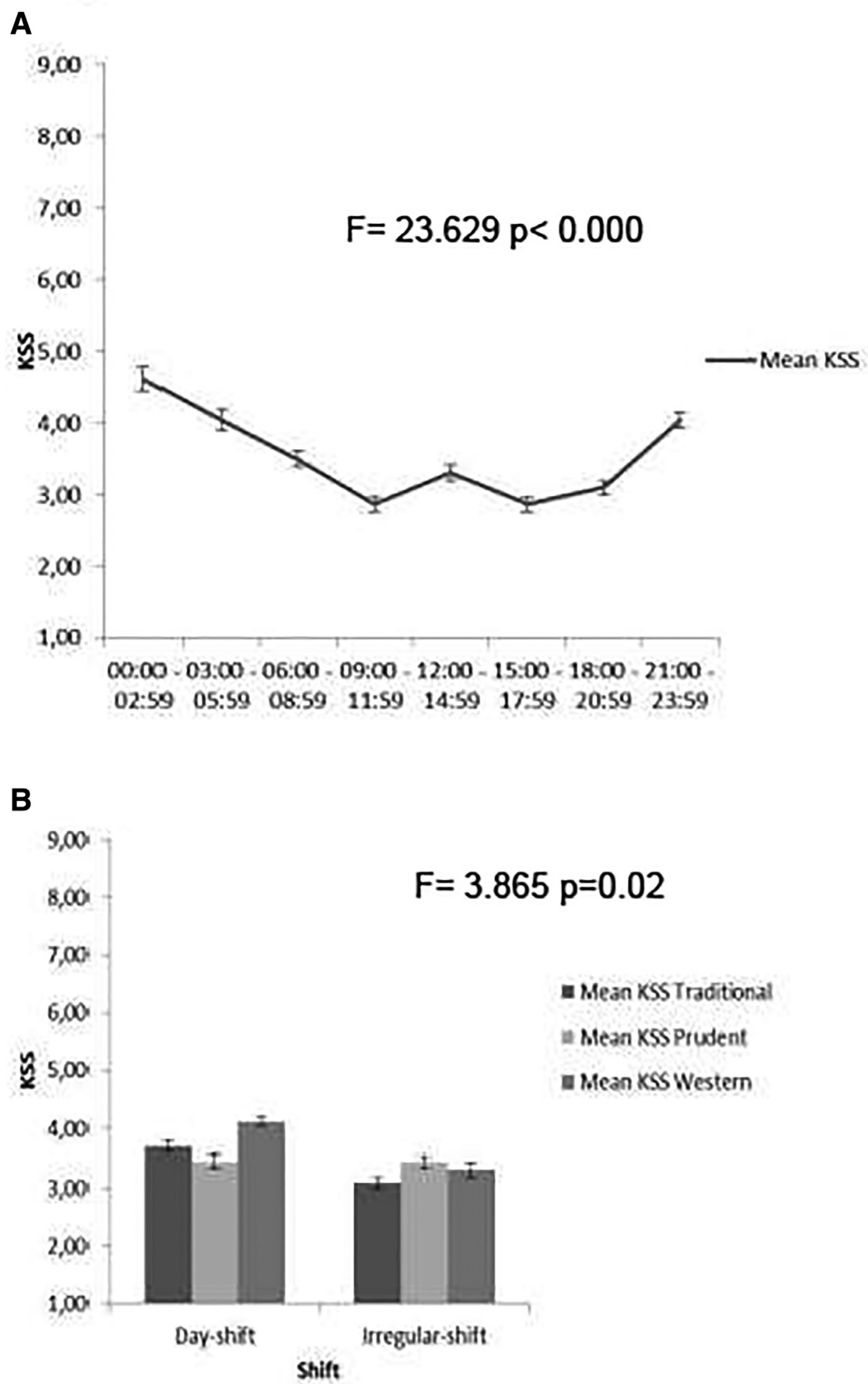

Fig. 1. Mean sleepiness score over 24-h period (A) and according to food pattern and work shift type (B) among truck drivers ($n = 52$).

irregular shifts, especially night shifts, is a diet with a nutritional composition that is carbohydrate rich, promoted by high intake of sweet products, bread, and foods derived from grains. In a previous study, Nishiura et al. [59] reported that the preference for foods rich in fats, the habit of skipping the first meal of the day, and eating outside the home increased with shorter sleep duration among workers. According to Gallant et al. [60], individuals who practiced night eating tended to choose tastier foods with a high glycemic index and rich in fats. Intake of these types of foods has a negative impact on postprandial glucose metabolism, with possible disruption of the peripheral circadian system, such as internal desynchronization.

The patterns found in this study have been previously described in the national and international literature [61–64]. The Western pattern has been associated with the parameters abdominal obesity, arterial hypertension, and changes in metabolism of lipids and glucose, as well as with coronary heart diseases and metabolic syndrome [65–70]. The prudent pattern, considered the closest to a

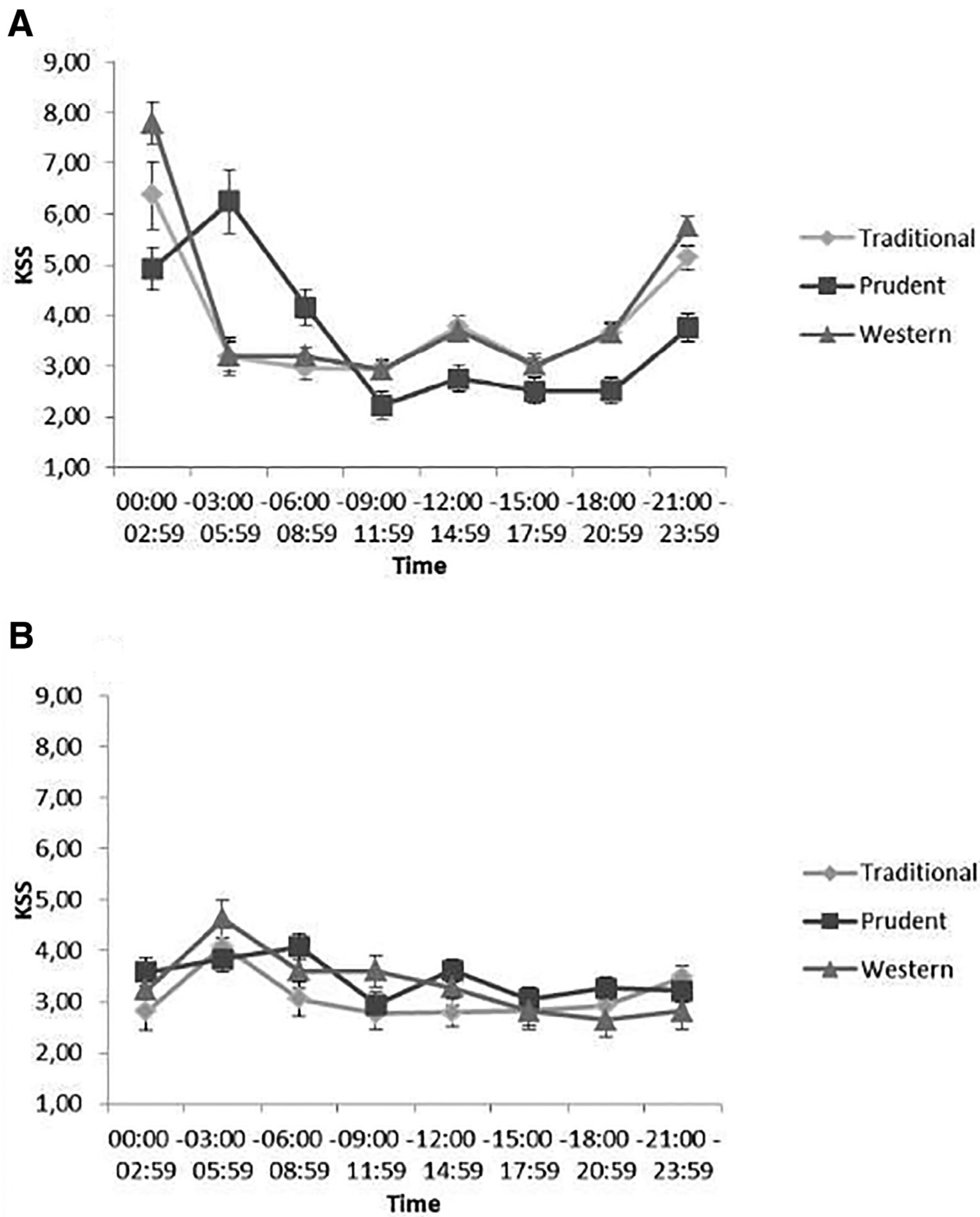

Fig. 2. Mean sleepiness in day-shift (A) and irregular-shift (B) drivers according to dietary patterns: traditional, prudent, and Western ($n = 52$). Significant differences among shifts: $F = 42.218$, $P < 0.00$; time: $F = 23.629$, $P < 0.00$. Interactions: eating pattern and shift: $F = 3.865$, $P < 0.02$; eating pattern and time: $F = 3.662$, $P < 0.00$; shift and time: $F = 16.823$, $P < 0.00$; eating pattern, shift, and time: $F = 4.876$, $P < 0.01$. KSS, Karolinska Sleepiness Scale.

healthy pattern in the present sample and comprising foods considered beneficial for health, has been associated with lower prevalence of hypertension and lower levels of markers for cardiovascular diseases [71]. The traditional pattern comprising rice and beans is considered healthy by the Ministry of Health [5] and has been associated with lower triglyceride values and waist-to-hip ratio [72].

The relationship among food intake, sleepiness, and performance has not yet been clearly elucidated in the literature. In general, studies affirm a reduction in state of alertness after food intake [73–75]. Landström et al. [76], however, highlighted that the effects of macronutrients on sleep and performance are relatively small and weak compared with the light–dark cycle, for instance.

Studies investigating this line of research have reported that carbohydrates and timing of meals have a strong effect on metabolism and internal rhythms [77,78]. A study by Nehme [18] in security guards found an association between sleepiness levels and carbohydrate intake among obese individuals. The study suggested that obesity mediated the effect of carbohydrates on sleepiness and sleep duration in the workers studied. Similarly, a time-of-day influence on sleepiness was also found in the present study. Given this scenario, the methodology employed in dietary pattern analysis allows the investigation of plausible relationships between dietary variables and a number of health conditions. The advantages of this method lie in the fact that global assessment of the usual diet, as opposed to specific assessment of nutrients, has a greater ability to predict risk of diseases as a result of several aspects such as lower chances of error caused by erroneous associations and reduced confounding effects of lifestyle-related variables and by encompassing complex interactions and correlations among nutrients that can alter their bioavailability action with the organism [79–82]. Nevertheless, a few limiting factors in the method of dietary pattern analysis should be mentioned. These factors include the subjective nature of factor analysis affecting the consolidation of food items and composition of food groups; the number of factors to be retained, along with their classification [83]; and the impossibility of drawing isolated causal inferences because these are based on the existence of correlations among variables [84,85]. It is also important to highlight the limitations of the cross-sectional study design, especially regarding the impossibility of establishing a cause-and-effect relationship between the variables analyzed [86]. The initial findings in the present study suggest an association of diet with sleepiness, particularly for the prudent pattern. This relationship warrants further investigations by future studies to describe this relationship more fully.

Although the association between sleep and food intake was first studied in the 1980s and 1990s, as mentioned in a review by Dashti et al. [16], only a few studies have investigated dietary patterns and sleep problems. A study on dietary patterns was conducted in Japan, concluding that a healthy pattern was inversely associated with sleep disturbances [87]. In China the traditional northern and modern dietary patterns were associated with lower levels of insomnia [88]. Nevertheless, given that the relationship between sleep quality and dietary pattern has not yet been fully elucidated, recommendations and dietary guidelines for irregular-shift workers should be made with caution. We suggest that food intake recommendations be defined to improve workers' quality of life in the workplace and reduce the risk of non-communicable diseases.

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