Short Communication

Impact of Shift Work on the Eating Pattern, Physical Activity and Daytime Sleepiness Among Chilean Healthcare Workers

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ABSTRACT

We evaluated the eating pattern, physical activity, and daytime sleepiness level in Chilean shift workers. Fifty, middle-aged adult health workers from a public hospital in Santiago, Chile, were included: a group undergoing shift work (shift workers, including at least one “night shift” and one “long day”; n = 33), and day workers under traditional schedule (from 8:00 to 17:00h, n = 17). Body composition, physical activity, and daytime sleepiness level, and diet characteristics (diet composition, meals’ timing, and diet quality) were assessed. Despite similar total energy intake, shift worker showed lower carbohydrate (% of energy) and higher protein intake (both P < 0.01), decreased diet quality, an irregular eating pattern, and delayed meal timing (all P < 0.05). Physical activity and daytime sleepiness levels did not differ between groups. Findings from this first Chilean study in healthcare shift workers support the fact that meal timing and diet quality appear as critical factors for upcoming intervention studies in this group.

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1. Introduction

Shift work (SW) is commonplace in Westernized societies representing a high proportion of the working force worldwide [1]. Evidence in humans has shown the adverse health effects of SW, disturbing the circadian rhythms and the sleep–wake cycle, and increasing the risk for chronic noncommunicable diseases [2]. An altered diet structure has been reported in shift workers [2–4], and SW is positively associated with obesity risk [1,5]. In Chile, around 25% of health and private companies include shift working [6], but the relevance of SW on health-related behaviors is unknown. We evaluated the diet, physical activity, and daytime sleepiness level in Chilean healthcare shift workers and day workers.

1.1. Subjects and design

This was an exploratory, cross-sectional study. We included fifty adult healthcare workers, between aged 18–65 years, having a traditional or rotating work schedule, all belonging to the Dr. Exequiel González Cortés Hospital, Santiago, Chile. Exclusion criteria were decompensated chronic disease (uncontrolled thyroid disease, genetic dyslipidaemias, severe hypertriglyceridemia and hypercholesterolemia, morbid obesity), eating disorders, psychiatric disorders, and participants who have had a dietary regimen during the last 30 days.

Shift workers’ group (n = 33) included health workers following rotating SW with a weekly schedule of at least one ‘night shift’, one 12-hour (or ‘long day’) shift, and two consecutive days off. Every health worker performing SW followed this workload continuously. Therefore, shift workers performed night shift two days a week. Day workers’ group (n = 17) included health workers working Monday to Friday, from 8:00 to 17:00h.

The study protocol was evaluated by the Institutional Review Board of the Faculty of Medicine, University of Chile, Santiago, Chile (040-2014), according to the Declaration of Helsinki. The Committee for People Responsibility of Dr. Exequiel Gonzalez Cortés Hospital approved the study aims and design. All participants were informed about the aims and characteristics of the study and their right to refuse to participate at any time, through an initial assembly with the entire Hospital Community. Therefore, it was considered that the participants, who responded to the invitation and attended the evaluations, consented to their participation.
1.2. Evaluations

A physician conducted a clinical evaluation focused on anamnesis and evaluation of overall health status. Nutritional evaluation included the assessment of body composition (by electrical bioimpedance, Inbody 510, Inbody Co., Ltd Inbody Bldg. Seoul, Korea) and anthropometry (weight and height, Seca 700, Seca®, Hamburg, Germany; waist, hip, and neck circumferences were also assessed. Physical activity level was estimated by the International Physical Activity Questionnaire [7]. Daytime sleepiness was estimated using the Epworth Sleepiness Scale [8], an internationally validated instrument assessing daytime sleepiness under everyday life situations. A total sleepiness score is obtained, and sleepiness was categorized as moderate (total score ≥ 10) or severe (total score ≥ 15).

A 24-hour recall (24hR) and a food history record evaluated dietary characteristics. Individual information about the clock time and type of each meal, details on foods/beverages, the number of serving portions, and foods’ commercial labels was obtained. Diet's nutritional composition was analyzed using the software Food Processor SQL® (ESHA Research, Salem, OR, USA).

Diet quality was assessed using an adapted version of the Healthy Eating Index (HEI) proposed for the United States of America population, adapted to the Chilean healthy dietary guidelines for adults [9]. This adapted diet quality index evaluated the compliance with daily recommended consumption of food groups (portions/day) of cereals, vegetables, fruits, dairy products, and meats as components of a healthy diet for the Chilean population. The intake of total fat (% of total energy), saturated fat (% of total energy), sugars (% of total energy), sodium (g/day), and the diversity of the diet (based on compliance above or below 25% of the recommended portions of the five analyzed food groups) are also components of the index. A score from 0 to 10 points is calculated for each component based on the achievement of recommended food portions/day or nutrients intake/day (as % of total energy). For each component, a score of 10 points means better compliance with healthy diet recommendations. Finally, the overall quality index score was calculated as the sum of the individual components’ scores [9].

1.3. Statistical analysis

Data are shown as mean ± SEM or median (interquartile range) in accordance with the distribution of variables, as assessed by the Shapiro Wilk test. To compare differences in categorical variables distribution between both groups, the Chi-square or Fisher’s exact test was used. Based on the analysis of variables’ distribution, differences between groups regarding background characteristics and diet assessment were assessed using student t test (for parametrically distributed variables) or Wilcoxon rank sum test (for nonparametrically distributed variables). The significance level was set at an α-level of 5%. STATA® v.13.1 (Stata Corporation, College Station, TX) was used for analyses and GraphPad Prism 6.0 (GraphPad Prism Software, Inc. San Diego, CA) for figure processing.

1.4. Results

No differences regarding age, gender, BMI, percentage of body fat, and anthropometrical parameters were observed between groups (Table 1). In addition, the time allocated to perform physical activities of different intensities did not differ, with only a trend to reduced time spent walking in shift workers (P = 0.085). Daytime sleepiness level score, as well as the proportion of participants having moderate or severe daytime sleepiness, was also similar (Table 1).

Total energy intake did not differ between both groups (Table 2). Likewise, absolute protein and fat intake was similar, but absolute carbohydrate intake was lower in shift workers. A higher proportion of energy coming from proteins and fats and a lower proportion of energy coming from carbohydrates were found in shift workers (all P < 0.05, Fig. 1a). However, micronutrient/vitamins intake showed poor adequacy against daily recommendations for the whole sample, without group differences (see Supplementary Table S1).

Overall diet’s quality index and quality scores for vegetable, total fat, and saturated fat intake were diminished in shift workers (all P < 0.05, Fig. 1b). Shift workers showed lower meal frequency (P < 0.006), greater skipping of main meals (Fig. 1c and d), and food intake in the early morning hours (from midnight to 6 am P < 0.05, Table 2).

Table 1
General characteristics

| Variable                        | All (n = 50) | Day workers (n = 17) | Shift workers (n = 33) | P value* |
|---------------------------------|-------------|---------------------|-----------------------|---------|
| Age, years                      | 37.1 ± 1.8  | 38.8 ± 3.4          | 36.2 ± 2.2            | 0.52    |
| Gender, M/F                     | 3/50        | 1/16                | 2/31                  | 0.99    |
| Weight, kg                      | 72.7 ± 2.2  | 76.4 ± 5.3          | 71.1 ± 2.3            | 0.38    |
| BMI, kg/m²                      | 29.5 ± 1.0  | 30.7 ± 2.3          | 29.0 ± 1.1            | 0.49    |
| Overweight, n (%)               | 35 (70)     | 11 (64.7)           | 24 (72.7)             | 0.99    |
| Obesity, n (%)                  | 16 (32)     | 5 (29.4)            | 11 (33.3)             | 0.74    |
| Waist circumference, cm         | 90.5 ± 2.2  | 93.4 ± 5.1          | 89.2 ± 2.3            | 0.46    |
| WHR                             | 0.85 ± 0.01 | 0.86 ± 0.02         | 0.85 ± 0.01           | 0.60    |
| Neck circumference, cm          | 34.7 ± 0.5  | 35.4 ± 1.0          | 34.4 ± 0.6            | 0.39    |
| Body fat, %                     | 40.8 ± 1.1  | 39.8 ± 1.9          | 41.3 ± 1.2            | 0.54    |
| Physical activity, intense (min/sem) | 0 (0-360) | 0 (0-0)             | 0 (0-420)             | 0.463   |
| Physical activity, moderate (min/sem) | 0 (0-240) | 0 (0-240)           | 0 (0-120)             | 0.399   |
| Physical activity, low-intensity (min/sem) | 214.5 (49.5-792) | 231.0 (99-990) | 214.5 (247.792) | 0.692   |
| Walking, min/sem                | 120 (60-150) | 120.0 (120-180)    | 120.0 (60-120)        | 0.085   |
| Sleepiness score, points        | 10.0 ± 0.7  | 10.6 ± 1.2          | 9.5 ± 0.8             | 0.554   |
| Moderate daytime sleepiness, n (%) | 25 (50)   | 9 (18)              | 16 (32)               | 0.845   |
| Severe daytime sleepiness, n (%) | 9 (18)     | 4 (8)               | 5 (10)                | 0.496   |

Data as mean ± SEM or as a percentage (%), unless otherwise indicated.

* Between groups comparison using student t test or Wilcoxon rank sum test, unless otherwise indicated.

† Comparison between groups using Fisher’s exact test. M: masculine; F: female; BMI, body mass index: kg/m²; WHR: waist-to-hip ratio.
The higher proportion of energy from proteins and fats in shift workers compared with that of day workers suggests that the diet in this group is more likely to be inadequate regarding dietary pattern, characterized by increased energy intake, with high total fat and saturated fat intake.

The aforementioned dietary changes can also be expected to be found in shift workers. As this is the first study conducted assessing dietary patterns in Chilean health workers, findings suggest that further diet characteristics could be impaired in this group. Our findings of delayed timing of late afternoon meals, frequent meals skipping, snacking behavior, and nighttime eating are in line with others [3,4,11]. Given that meal timing plays a role as or more important than the total calorie count for metabolic consequences [16], further interventions modulating eating patterns could be highly relevant to improve the metabolic health of shift workers [4].

Our findings also agree with a recent report showing an irregular eating pattern in shift workers when working the night shift, with frequent snacking behavior compared with that in day shifts or days off, interrupting the normal nighttime fasting period [4].

Our findings of similar physical activity and daytime sleepiness levels between groups suggest that other factors may similarly influence both behaviors. A similar total physical activity with higher sedentariness has been reported in shift workers [17]. The fact that 86.7% of Chilean adults are sedentary [15] and the high prevalence of obesity (close 30% in our sample) closely associated with poor population’s dietary habits [15] could relate to the absence of differences we found.

As limitations of our study, we would like to point out that we studied a small sample of healthcare workers and coming from only one hospital belonging to the Chilean public health system. Diet was studied a small sample of healthcare workers and coming from only one hospital belonging to the Chilean public health system. As for strengths, we would like to mention that dietary patterns, diet quality, and meal timing were well characterized. Further intervention studies are urgently needed aiming at strategic health preventive actions in Chilean shift workers. Our current results will be useful for strategies modulating meal timing, physical activity, and sleep patterns aimed to improve metabolic and circadian health in this population group.

In summary, the eating pattern is disturbed in this sample of Chilean healthcare shift workers. Those changes may contribute to

### Table 2: Nutritional composition of diet

| Dietary intake                      | Day workers (n = 17) | Shift workers (n = 33) | P Value |
|-------------------------------------|----------------------|------------------------|---------|
| Energy intake, kcal                 | 2494.6 ± 270.7       | 2041.7 ± 111.2         | 0.142   |
| Foods/beverages intake, g           | 2351.5 ± 264.3       | 2151.1 ± 119.1         | 0.498   |
| Energy density, kcal/g              | 1.0 ± 0.1            | 0.9 ± 0.03             | 0.391   |
| Protein, g                          | 75.5 ± 7.1           | 78.5 ± 4.6             | 0.689   |
| Carbohydrate, g                     | 372.3 ± 48.1         | 263.9 ± 15.9           | 0.050   |
| Fat, g                              | 78.3 ± 9.7           | 74.6 ± 6.4             | 0.754   |
| Dietary fiber, g                    | 23.2 ± 2.5           | 21.9 ± 1.9             | 0.677   |
| Saturated fat, g                    | 3.4 (14.6)           | 4.4 (20.7)             | 0.709   |
| Monounsaturated fat, g              | 0.2 (45.6)           | 0.9 (48.8)             | 0.439   |
| Polyunsaturated fat, g              | 0.06 (20.9)          | 1.0 (36.2)             | 0.908   |
| Cholesterol, mg                     | 209.4 (155.7)        | 219.5 (139.7)          | 0.841   |
| Trans fatty acids, g                | 1.3 (1.3)            | 0.3 (0.9)              | 0.141   |
| Omega 3 fatty acids, g              | 0.4 (0.7)            | 0.4 (0.4)              | 0.975   |
| Omega 6 fatty acids, g              | 3.5 (3.3)            | 2.6 (2.4)              | 0.243   |
| Omega6/omega 3, ratio               | 6.6 (5.1)            | 5.2 (5.6)              | 0.147   |
| Caffeine, mg                        | 175.2 (131.6)        | 164.8 (156.0)          | 0.785   |

Data as mean ± SEM or. Bold P values depict significant differences for comparison between Day workers and Shift workers.

In summary, the eating pattern is disturbed in this sample of Chilean healthcare shift workers. Those changes may contribute to the absence of differences we found.

As limitations of our study, we would like to point out that we studied a small sample of healthcare workers and coming from only one hospital belonging to the Chilean public health system. Diet was studied a small sample of healthcare workers and coming from only one hospital belonging to the Chilean public health system. As for strengths, we would like to mention that dietary patterns, diet quality, and meal timing were well characterized. Further intervention studies are urgently needed aiming at strategic health preventive actions in Chilean shift workers. Our current results will be useful for strategies modulating meal timing, physical activity, and sleep patterns aimed to improve metabolic and circadian health in this population group.

In summary, the eating pattern is disturbed in this sample of Chilean healthcare shift workers. Those changes may contribute to
circadian and metabolic dysregulation in this group. As this is the first study evaluating these outcomes in this group, results highlight an urgent need for interventions modulating meal timing and diet quality in Chilean healthcare shift workers.

Disclaimers

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Conflicts of interest

All authors have no conflicts of interest to declare.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.shaw.2020.07.002.

References

[1] Costa G. Shift work and health: current problems and preventive actions. Saf Health Work 2010;1(2):112–23.
[2] Ramin C, Devore EE, Wang W, Pierre-Paul J, Wegrzyn LR, Schernhammer ES. Night shift work at specific age ranges and chronic disease risk factors. Occup Environ Med 2015;72(2):100–7.
[3] Lowden A, Moreno C, Holmback U, Lennernas M, Tucker P. Eating and shift work - effects on habits, metabolism, and performance. Scand J Work Environ Health 2010;36(2):150–62.
[4] Shaw E, Dorrian J, Coates AM, Leung GKW, Davis R, Rosbotham E, Warnock R, Huggins CE, Bonham MP. Temporal pattern of eating in night shift workers. Chronobiol Int 2019 Dec 2;36(12):1613–25.
[5] Antunes LC, Levandovski R, Dantas G, Caumo W, Hidalgo MP. Obesity and shift work: chronobiological aspects. Nutr Res Rev 2010;23(1):155–68.
[6] WorkAdministration. Work survey. Executive summary. Santiago, Chile: Chilean Government; 2014.
[7] Craig CL, Marshall AL, Sjostrom M, Bauman AE, Booth ML, Ainsworth BE, Pratt M, Ekelund U, Yowye A, Sallis JF, Oja P. International physical activity questionnaire: 12-country reliability and validity. Med Sci Sports Exerc 2003;35(8):1381–95. 2003/08/06.
[8] Johns MW. A new method for measuring daytime sleepiness: the Epworth sleepiness scale. Sleep 1991;14(6):540–5.
[9] Pinheiro A, Atalah E. Proposal of a method to assess global quality of diet. Rev Med Chile 2005;133:175–82.
[10] Bonham MP, Bonnell EK, Huggins CE. Energy intake of shift workers compared to fixed day workers: a systematic review and meta-analysis. Chronobiol Int 2016 Sep 13;33(8):1086–100.
[11] Nakamura M, Miura A, Nagahata T, Toki A, Shibata Y, Okada E, Ojima T. Dietary intake and dinner timing among shift workers in Japan. J Occup Health 2018 [advpub].
[12] Souza RV, Sarmento RA, de Almeida JC, Canuto R. The effect of shift work on eating habits: a systematic review. Scand J Work Environ Health 2018.
[13] Food and Nutrition Board, Institute of Medicine of the National Academies. Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids (macronutrients). In: A report of the panel on macronutrients, subcommittees on upper reference levels of nutrients and interpretation and uses of dietary reference intakes, and the standing committee on the scientific evaluation of dietary reference intakes. Washington, D.C.: The National Academies Press; 2005. 1357 p.
[14] Cain SW, Filtness AJ, Phillips CL, Anderson C. Enhanced preference for high-fat foods following a simulated night shift. Scand J Work Environ Health 2015;41(3):288–93.
[15] Ministry of Health & National Institute of Statistics. National health survey (ENS) 2016-2017; 2018. Santiago, Chile.
[16] Mattson MP, Allison DB, Fontana L, Harvie M, Longo VM, Malaise WJ, Mosley M, Notterpek L, Ravussin E, Scheer FJL, Seyfried TN, Varady KA, Panda S. Meal frequency and timing in health and disease. Proc Natl Acad Sci 2014;111(47):16647–53.
[17] Flahr H, Brown WJ, Rolbe-Alexander TL. A systematic review of physical activity-based interventions in shift workers. Prev Med Rep 2018;10:323–31.