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Research Report

Food intake and circadian rhythms in shift workers with a high workload

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Abstract

Shift work is associated with nutritional and health problems. In the present study, the food intake of garbage collectors of the city of Florianópolis (Brazil) was investigated using a dietary survey method based on meal recording during 24 h and adapted for the Brazilian food context. Three different shifts (morning, afternoon, and night) were compared ($n = 22$ per shift). Age, body weight and body mass index (BMI) were similar for all groups. Daily energy expenditure was high in all three shifts, especially in morning shift workers. No difference in daily energy intake was found, in spite of differences in food choices and circadian ingestion rhythms. Energy intake was high and close to levels previously reported in athletes. Several factors not associated with shifts had significant impact on ingestion: hour of the day, time since the last meal, age, and BMI. Ingested foods were analyzed in groups based on nutrient content. Shifts significantly influenced intake of starches, alcoholic drinks, and sweets. In different periods of the day, food and nutrient intake were considerably affected by shifts. The analysis of circadian distribution of food choices and nutrient intake is important in shift workers, because total daily intake may not reveal shift-associated differences.

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Introduction

In European countries and in the United States, shift work has increased during the last 50 years and at the present time, about 20% of the work force in industrialized countries do shift work (Niedhammer, Lert, & Marne, 1996a). In Brazil, there are no comparative data for the total population but some research performed in the area of metropolitan São Paulo suggest that 11% of the working population does shift work (Fisher, Costa, Taira, & Watanabe, 1995).

Shift work in modern industrialized societies is necessary but it is associated with numerous health and lifestyle problems in workers. As a result of night and/or shift works, workers have to organize their food intake in meals and snacks taken at inhabitual hours (particularly at night) and

that can be more irregular than eating events on holidays or those that occur during day shift. Most night shift workers sleep at times when day workers eat at least one of their habitual meals (Niedhammer, Lert, & Marne, 1996b).

It has been established that more work accidents occur during certain day or night shifts (Fischer et al., 1993). In addition, night work or shift work could facilitate the development of certain pathologies such as cardiovascular or gastrointestinal diseases, perhaps as a result of the resynchronization of biological clocks, which impairs amount and quality of sleep, makes food intake irregular, or interferes with normal functions of the organism (Lennernäs, Akersted, & Hambræus, 1994b; Rutenfranz, Knauth, & Fisher, 1989; Waterhouse, Minors, Atkinson, & Benton, 1997).

Most studies indicate that food intake is different in the night shift. There are no studies, however showing the influence of shift on food intake in worker with very high levels of energy expenditure.

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The garbage collectors of the city of Florianopolis in the South of Brazil (350,000 inhabitants) are shift workers with a moderate to high workload. According to the formulas proposed by Frings-Dresen et al. (1995) for evaluating the work load of garbage collectors, considering the aerobic capacity estimated on the basis of the maximum oxygen consumption ($VO_2\text{max}$), the work load of these workers can be considered heavy (Duarte, 1998).

In the present study, we investigated the energy and nutrient intake of the garbage collectors of Florianopolis based on meal recording during 24 h. Garbage collection occurred in three different shifts (morning, afternoon and night). Following training in the use of food measurement units, the workers answered questionnaires about their eating behavior. Various factors influencing energy and macronutrient intake were studied using multiple regression analysis. Food choices were examined in terms of the food categories proposed by Sachs (1997) for describing nutrient intake in Brazil. Body adiposity was evaluated using the Body Mass Index (BMI) and compared in different shifts. Circadian rhythms of food intake were compared in workers of the three shifts.

Methods

Subjects

Garbage collectors of the city of Florianopolis participated in the study that took place during March and April 1999. The volunteers had been working for at least six months in the same permanent daily shift. Three work shifts were considered: morning (07:00–13:00 h), afternoon (15:00–21:00 h), and night (21:00–03:00 h). The work activities were the same for the three shifts and included walking and running on plane, rising or declining surfaces, lifting and carrying various weights of trash conditioned in plastic bags or in wheeled containers.

All of 132 garbage collectors (42 morning, 56 afternoon, 34 night) were invited to an introductory lecture on the research at the worksite. The lecture explained the objectives of the study and invited them to take part in the study. No financial reward was offered or given. The participants were offered group nutrition education based on the results of the study. The participants signed an informed consent form explaining the aims and methodology, as well as the intention to publish the results, before the beginning of the study.

The volunteers were selected according to the following criteria: (1) working in the same shift for at least 6 months before participating in the main study; (2) not taking part in the pilot study.

All of the eligible volunteers from the night shift ($n = 22$) were included in the study. In order to have an equal number of volunteers in all three shifts, random samples of 22 subjects were drawn from the morning and

the afternoon shifts. Before the beginning of the study, they filled a questionnaire about socioeconomic and lifestyle variables.

Pilot-test

Out of the 132 garbage collectors, 26 took part in a pilot-test (11 morning, eight afternoon, seven night shift workers) but did not participate in the main study. The pilot test was carried out in order to make sure that the personal data questionnaire, the physical activity questionnaire (Bouchard, Tremblay, LeBlanc, Savard, & Theriault, 1983) and the nutritional survey method (Gibson, 1990), were clear for the subjects. These 26 participants filled the personal questionnaire, which allowed the experimenters to spot and make corrections for unclear questions.

The pilot-test was also performed in order to adapt Gibson's Nutritional Survey Method (1990) to this population of garbage collectors, adapting the household measures to those they habitually used. This consisted in developing a standardized method for dietary enquiry, making sure that all foods and liquids were remembered and reported, as well as time of intake, etc. The pilot study provided a basis for a better description of household measures (spoons, glasses, plates, cups) and of food types difficult to quantify precisely (rice, beans, cheese, margarine, sugar, mayonnaise, cakes, beef, fish).

Nutritional survey

The intake of foods and drinks was investigated using one 24 h recall and two 24 h records (Gibson, 1990), during three non-consecutive working days, previously determined by the researchers. One of those days was Monday or Tuesday, and two were between Wednesday and Sunday. This choice of days allowed a representation of the days with major workload (Monday and Tuesday), as well as other days (Wednesday–Sunday). Intakes at all meals and snacks were reported according to time of intake. For the 3-day food survey, subjects also recorded retiring and rising times as well as the activities performed over 24 h using a standardized questionnaire (Bouchard et al., 1983). This questionnaire allowed 24 h energy expenditure to be assessed based on data from Bouchard et al. (1983). The estimated energy expenditure was computed from the number of hours spent in different activities, multiplied by corresponding expenditure factor for each activity.

The participants received instructions about answering the questions during group sessions at the work site. This included instructions about physical activity items, quantities of food (glasses, cups, spoons), food preparation (recipes, commercial brands, restaurant names) and recording meal starting times on research forms.

In the main study, the amounts of food and drink ingested were estimated by the experimenters on the basis of the information provided by the subjects in household

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