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Incidence of weight gain in hospital workers: survival analysis

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Abstract *Weight gain in adult life may be responsible for chronic diseases, and follow-up of this may be a subsidy to avoid these diseases. The objective was to analyze the weight gain and associated factors in workers of a private hospital in the city of Rio de Janeiro. This is a retrospective cohort of 686 workers, who performed at least two occupational health exams (admission and periodic) between 2010 and 2015. The Kaplan-Meier method and the Cox proportional hazards regression model were used. The incidence of weight gain of hospital workers was 22 cases / 100 person-years. The weight gain in workers over 30 years old was 35% lower ($p < 0.001$) when compared to weight gain in those up to 30 years of age. Regarding schooling, the incidence rates of weight gain among workers at primary and secondary levels were higher, with a magnitude of up to 61%, compared to those at a higher level ($p < 0.001$); And in the closed sector it was 63% higher when compared to the open sector ($p < 0.001$). Weight gain is a multifaceted and complex phenomenon, being the work sectors of a hospital unit a strong causer of occurrences of the event.*

Key words *Weight gain, Hospitals, Health personnel, Medical examination*

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Introduction

Higher frequency of weight gain has been described in the literature about transition phases of life, for example: from childhood to adolescence, from adolescence to adulthood, especially at labor market entry, and, in the case of women, in the early pre- and post-menopausal stages. In most studies, is associated with the incidence of cardiovascular diseases (CVD)[1,2]. In addition, it is known that there are different patterns of body weight gain, which vary according to sex and level of education[1]. However, the issue has still not been ratified by research findings and several authors have sought better ways to understand it.

In the transition from childhood to adolescence and from adolescence to adulthood, weight gain has been considered as a predictor of cardiovascular risk. It is associated with a high risk of arterial hypertension and diabetes mellitus type II[2]. Weight gain at the beginning of adulthood seems to pose a higher risk of coronary heart disease than when it occurs later[3].

The association of weight gain (especially among people who are active in the labor market) with cardiovascular risk has been markedly focused on shift workers and people working irregular shifts, (e.g. night shifts[4,5]), working long hours[6], those who have become unemployed[7] and retirees[8].

An important aspect in studies on weight gain is that weight changes do not affect all segments of society in the same way, and the different paths of nutritional status are due to socioeconomic differences[1]. In studies which have addressed the relationship between increased BMI and age, such relationship was more accentuated in the group with low socioeconomic level[9]. Among hospital workers, this situation is no different; the scenario of excess weight and obesity is in line with the average Brazilian population among workers with previous and current unfavorable socioeconomic conditions[10]. In a study with 780 American male workers, which used information on occupational health assessments, weight gain was found to occur among younger workers, who were more inclined to consume foods with lower nutritional value at meals[11].

The most frequent patterns of body weight gain during adulthood, in addition to maintenance, are gradual weight increase over the years of life, and weight gain and weight loss, whether intentional or not, referred to as cyclical weight, also known as "yoyo dieting effect", which is associated with obesity and may have higher incidence rates of hypertension, diabetes and some cancers, as a consequence[12-14].

It should be noted that a possible relationship between weight gain and work can be obscure and reveal itself slowly, over the course of several years, hence it is difficult to determine the relationship between obesity and work. Explanations for weight gain are mostly based on food habits and physical activity patterns which are influenced by an unhealthy lifestyle[15,16]. However, these habits and behaviors can vary as a result of work routine. Hospital workers, especially those who provide direct care, engage in tension-filled activities, characterized by frequent coexistence with the physical and emotional suffering of patients, overload of activities in the work shift, heavy workload, low remuneration and lack of professional recognition[17, 18] This routine often impacts the life of these workers, for example, by reducing their time for meals, leisure, rest, sleep, etc., thus bringing consequences that can lead to weight gain[19, 20].

Unhealthy weight gain can influence the working capacity of individuals; similarly, work can influence weight gain, because workers spend one quarter of their lives in the workplace, on average[21].

The objective of this research, therefore, was to analyze weight gain and associated factors - sex, age, level of education, smoking, diabetes, high cholesterol, high blood pressure - in workers of a private hospital located in Rio de Janeiro, Brazil.

Methods: experimental design, population, statistical analysis and ethical aspects

This is a dynamic retrospective cohort study about a population of workers of a private hospital in the city of Rio de Janeiro. Inclusion criterion was: having undertaken at least two Occupational Health assessments (pre-employment screening and employee health screening) between the years of 2010 and 2015. Of the total of 818 eligible workers whose body mass had been measured two or more times, 74 were excluded because their records were incomplete: there was no information on sex, age, level of education, tobacco use and chronic diseases. The diseases that are part of the hospital information system are self-reported, and the following information was made available: diabetes (yes or no), considering the last test taken, and glycemia equal or greater than 126 mg/dl, in accordance with the

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Brazilian Society of Diabetes; cholesterol (yes or no), considering the last test taken and value equal to or greater than 240mg/dl, according the Brazilian Society of Cardiology.

Blood pressure was measured by a medical professional during the employee health screening with a Missouri aneroid sphygmomanometer and classified as high blood pressure, according to the guidelines of the Brazilian Society of Hypertension (2010), which considers hypertensive individuals with systolic and/or diastolic blood pressure greater than or equal to 140 mmHg and 90 mmHg, respectively.

Anthropometric measurements were recorded by a nursing technician in the Labor Medicine sector. They had the following measurements: body mass, using a digital scale (Model Personal no. 9917-2008, Filizola) with maximum capacity of 180kg and minimum capacity of 2kg and precision of 100g; and height, measured using a stadiometer fitted to a scale with maximum height of 192 cm and accuracy of 0.1cm.

In addition, workers who lost weight in the study period (n = 58) were excluded, because the object of this study was weight gain. Thus, 686 professionals were included in this analysis. The information has been made available on Excel® spreadsheets It was extracted directly from the database used in the labor medicine department of the hospital network.

The covariates were: sex (males and females); age range (up to 30 years old; 31 to 40 years old; 41 years or older); level of education (up to primary education, secondary education, higher education, data not provided).

The covariate comorbidities was addressed after the professionals confirmed that they have at least one of the diseases (diabetes, high cholesterol and high blood pressure). The behavior in use was the habit of smoking (yes or no).

In 2000, Bianchi[22] proposed a classification for hospital environments into open and closed sectors. Open sectors are units of hospitalization, emergency and hospital infection control committee (HICC) while closed sectors are intensive care units (ICU), surgical center and sterile processing department (SPD). In addition to these sectors, there are administrative sectors (back office) where professionals work in management and supervision, management, logistics, and pharmacy.

In the present study, hospital sectors were categorized according to Bianchi[22]: open sectors (unit of hospitalization, emergency, diagnosis and therapy support service (DTSS), Hospital Infection Control Committee (HICC), continuing education, social service); closed sectors (semi-intensive care, intensive care unit (ICU), surgical center, sterile processing department (SPD)), and administrative (support services, infrastructure, management and logistics).

The time of follow-up of workers in the study was defined as the difference between the year of the last medical examination (employee health screening or exit health assessment) and the year of the first medical examination (pre-employment health assessment) the workers had undertaken. Censoring occurred when workers were dismissed before the end of the four-year follow-up.

The outcome, namely, weight gain (yes or no), was checked by the difference between the last measured weight (employee health screening or exit health assessment) and the weight measured in the pre-employment health assessment. Weight gain was considered to be positive for individuals who showed an increase in weight exceeding 5% compared with the weight recorded in the pre-employment health assessment.

Descriptive analyses were performed to check the frequencies of variables. Incidence rate was calculated by considering the number of hospital workers who gained weight during the study period, divided by the sum of time of follow-up of workers in the study (person-time).

The Kaplan-Meier method was used in the exploratory analysis of the variables. To compare the survival curves, the hypotheses were tested with Peto's and the log-rank tests, and a significant difference was found in weight gain among the study groups[23].

Multiple modeling was used in the semi-parametric Cox proportional hazards regression model[23]. This technique was used because it provides estimates of risk ratios of the study factors, hence it can assess the impact of some risk factors or prognostic factors over time until the occurrence of the event of interest[24]. In the fitted models, the variables with a p value of ≤ 0.2 were included, except for sex, which was maintained because of its epidemiological significance.

Residual analysis was performed through Schoenfeld's residual-based test, which examines whether the estimated effect for each variable is maintained throughout the entire time, i.e., if the proportionality assumed by the model actually exists[24].

The analyses were performed in Software R Studio version 3.2.1 (RStudio) using the survival package for analysis of the model.

The study was approved by the Ethics Committee of the D'Or Institute for Research and Education, technical opinion number 1,168,551 on July 28, 2015.

Results

The incidence rate of weight gain of hospital workers was 22 cases/100 person-years. The average follow-up time in the study was 2.3 years, with a standard deviation of 1.16, while the median was two years. Mean weight gain in the period was three kilos (SD = 5.7692).

Most of the study population was composed of women (77.3%), of up to 40 years of age (77.3%) and with complete secondary education (52.2%). The results of the distribution of the workers into the sectors indicated presence of 37.8% in the open sectors and 36.3% in the closed sectors of the hospital.

Smoking was reported by 2.8% of the study population. Diabetes, cholesterol and high blood pressure were present in 1.2%, 3.4% and 4.8% of workers, respectively. More than half of the study population gained weight (51.8% - n = 355) (Table 1).

The survival curves of weight gain are shown in Figure 1. The curves in the first year of follow-up showed similar behavior for age range. Until the second year, it was found that the ranges of up to 30 years and 31 to 40 years showed a higher weight gain rate than in workers aged 41 years or older. In the third year of follow-up, the survival curves for age ranges from 31 to 40 years and 41 years or older are more similar and will remain so until the last year, when they overlapped, showing a lower weight gain rate than in workers of up to 30 years of age. (Figure 1). The log-rank test ($p < 0.001$) and Peto's test ($p < 0.001$) confirm the difference in weight gain as compared with age.

Weight gain rates were similar at all levels of education up to the second year and began to differ in the third year; the classification of secondary education showed the highest weight gain rate among workers, and it remained until the end of follow-up.

In the assessment of weight gain per hospital sectors, the curve of the open sectors showed the lowest rate of weight gain among workers. For level of education and hospital sector, the tests confirmed the difference in weight gain ($p < 0.001$) (Figure 1).

Table 2 shows a crude association between weight gain and sociodemographic characteristics, health, behavior, hospital sectors. Age range showed an inverse relationship with incidence rate of weight gain; the rate of workers aged 31 years or older is 35% lower when compared with that of workers up to 30 years. For level of education, it was found that weight gain rate among workers is higher at all levels when compared with the level of those with higher education, with magnitude of up to 61% ($p < 0.001$). According to types of hospital sectors, it was found that the incidence rate of weight gain was 63%

Table 1. Data on sociodemographic characteristics, health, behavior, hospital sector and weight gain by workers of a private hospital in Rio de Janeiro, between 2010 and 2015.

Characteristics	n	%
Sex		
Females	530	77.3
Males	156	22.7
Age range		
Up to 30 years old	258	37.6
31 - 40 years old	272	39.7
41 years or older	156	22.7
Level of education		
Up to Primary Education	63	9.2
Secondary Education	358	52.2
Higher Education	212	30.9
Data not provided	53	7.7
Smoking		
No	667	97.2
Yes	19	2.8
Diabetesa		
No	678	98.8
Yes	8	1.2
High Cholesterola		
No	663	96.6
Yes	23	3.4
High blood pressure		
No	653	95.2
Yes	33	4.8
Comorbidity		
No	631	92.0
Yes	55	8.0
Hospital sector		
Open	259	37.8
Closed	249	36.3
Administrative	178	25.9
Weight gain		
No	331	48.2
Yes	355	51.8

[a]Reported by workers.

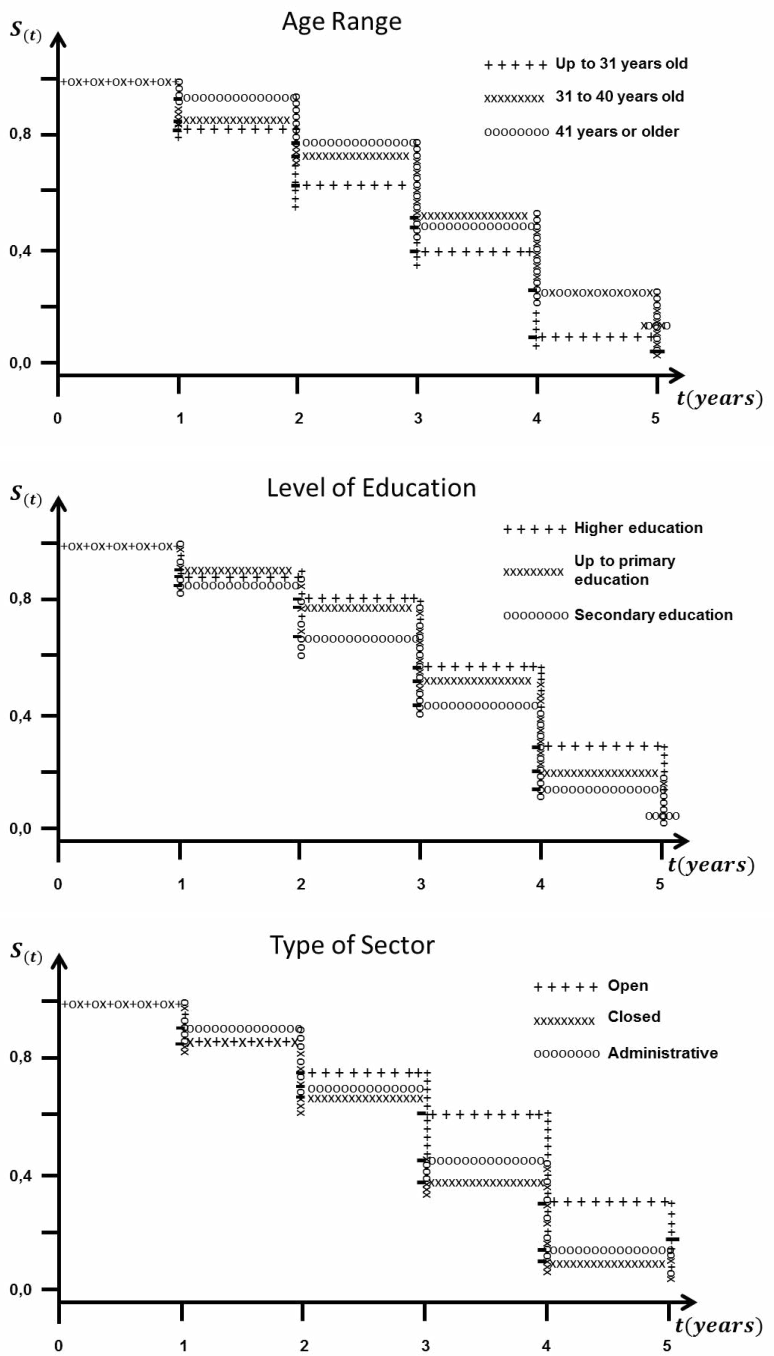

Figure 1. Kaplan-Meyer charts of age, education, and type of weight gain in a private hospital in Rio de Janeiro from 2010 to 2015.

higher among workers of closed sectors and 44% higher in administrative sectors, when compared with open sectors.

Table 3 shows three fitted models. In models I and II, weight gain rates remain lower for workers above 30 years of age, when compared with those

Table 2. Gross incidence rate ratio between weight gain and data on sociodemographic characteristics, health, behavior and hospital sector in hospital workers between 2010 and 2015.

Variables	Incidence rate ratio (95% CI)	p-value
Sex		
Males	1	-
Females	1.03 (0.80-1.32)	0.821
Age range		
Up to 30 years old	1	-
31 - 40 years old	0.65 (0.52-0. º83)	0.00044
41 years or older	0.64 (0.49-0.85)	0.00214
Level of education		
Higher Education	1	-
Up to Primary Education	1.32 (0.90-1.93)	0.1634
Secondary Education	1.61 (1.26-2.05)	0.0001
Smoking		
No	1	-
Yes	1.04 (0.52- 2.10)	0.916
Diabetesa		
No	1	-
Yes	0.64 (0.27-1.57)	0.333
High Cholesterola		
No	1	-
Yes	1.06 (0.57-2.00)	0,848
High blood pressure		
No	1	-
Yes	0.81 (0.48-1.39)	0.453
Comorbidity		
No	1	-
Yes	0.85 (0.57-1.28)	0.432
Hospital sector		
Open	1	-
Closed	1.63 (1.27-2.09)	0.000127
Administrative	1.44 (1.10-1.89)	0.007505

[a]Reported by workers.

up to 30 years; workers with secondary education showed a weight gain rate which was 55% higher when compared to those with higher education. They were both statistically significant. In Model III, fitted by age, sex, and level of education, the closed sector shows a magnitude of 61%, as the sector of hospital workers with higher incidence rate of weight gain, compared to workers of the open sector (CI 1.24-2.09).

Schoenfeld's residual-based analysis was performed with model III, while accepting the null hypothesis of risk equality over time, thus proving that the risk of weight gain is proportional and, therefore, the variables are not time dependent ($p = 0.08$).

Discussion

The findings of the present study indicate a significant association, during the years of follow-up, between weight gain and age, level of education and work in the closed hospital sector (semi-intensive care, ICU, surgical center, sterile processing department). The incidence rate of weight gain among workers of the hospital was 22 cases per 100 person-years. This rate was higher than the one found in the study of Veloso et al.[25], namely, 17 cases/100 person-years. Those authors investigated workers of Bahia who had been assessed in the Occupational Health Medical Control Program, run by the Brazilian Industrial Social Services (SESI), and their results suggest the independent effect of food from catering services offered by companies on weight gain in low-income strata. The undesirable weight gain effect may be attributed to the excessive energy value of the meals offered, and the workers from lower socioeconomic strata have a preference for foods they consider to be "stronger", i.e., with a higher concentration of calories.

The association between weight gain and sex was not statistically significant in the present study. Scherr et al.[26] also found no significant association between weight gain and sex in 654 health care and industrial workers in Switzerland. In a systematic review to evaluate weight gain in women, Wane et al.[27] concluded that although women in early adulthood are more vulnerable to weight gain, causes were not clearly identified in the studies that examined the specific determinants of weight gain.

In all age ranges present in the study, there was a statistically significant association with weight gain; however, younger adult workers showed a higher rate of weight gain when compared with older adults. A prospective study conducted with 17,294 Finnish adults who were examined twice after an interval of 4 to 7 years (mean 5.7 years), showed that mean weight increased in those who were aged less than 50 years, while there was little change in men aged 50-70 years and women aged 50-60 years, and it declined rapidly in subsequent ages. About 9% of men and four per cent of women gained 10 kg or more, and weight gain was more common among young people[28].

Table 3. Cox proportional hazards models fitted for weight gain in hospital workers between 2010 and 2015.

Variables	Incidence rate ratio (CI 95%)
Model I	
Age range (31 to 40 years old)	0.66 (0.52-0.83)
Age range (41 years or older)	0.64 (0.48-0.85)
Females	1.05 (0.81-1.35)
Model II	
Age range (31 to 40 years old)	0.66 (0.52-0.85)
Age range (41 years or older)	0.63 (0.47-0.86)
Females	1.07 (0.82-1.39)
Level of education (up to P. Education)	1.47 (0.98-2.21)
Level of education (up to S. Education)	1.55 (1.21-1.97)
Model III	
Age range (31 to 40 years old)	0.64 (0.50-0.82)
Age range (41 years or older)	0.63 (0.46-0.86)
Females	1.03 (0.80-1.34)
Level of education (up to P. Education)	1.46 (0.93-2.29)
Level of education (up to S. Education)	1.48 (1.15-1.91)
Sector (closed)	1.61 (1.24-2.09)
Sector (administrative)	1.21 (0.90-1.65)

Model I: fitted by age range and sex. Model II: fitted by age range, sex and level of education. Model III: fitted by age range, sex, level of education and sector.

This result corroborates the study of Kwon et al.[29], who found no association between weight gain and the age range of 20 to 30 years in 1,605 workers in Korea. In studies conducted in India (Vellore Birth Cohort)[2] and in the United States (Behavioral Risk Factor Surveillance System)[3], the authors found greater weight gain between 15 and 28 years of age and 18 and 29 years, respectively. However, these findings are still controversial, as in the studies of Boyce et al.[30] with call center employees, and Scherr et al.[26], with health care and pharmaceutical industry workers, in which the findings showed a positive association between weight gain and increasing age. In the study of Montzel et al.[31], the authors found no significant difference between age and nutritional status in the analysis over three decades of workers at a tertiary care public hospital of Porto Alegre, Brazil.

Mozaffarian et al.[32] reported that weight gain occurs gradually, approximately 0.5 kg per year. Labor market entry changes the feeding routine of young workers: for example, the offer of food at the workplace (hence there is no need to go long distances), vending machines set up in the work environment which sell snacks and sweets, difficulty in keeping regular meal times. These changes may influence the weight gain of these workers[33].

There was an inverse association between level of education and weight gain; workers with secondary education were those that had the highest rate of weight gain, while workers with higher education were those who had the lowest rates. According to Fonseca et al.[34], these results corroborate the evidence reported in international studies about the existence of an association between level of education and weight gain patterns[12,35].

The association between weight gain and types of hospital sectors showed a higher rate in workers from closed sectors when compared to open sectors. The fact that the former workers remain in closed environments and have meals indoors, under a higher level of stress, may have contributed to a higher rate of weight gain among them[36]. The bibliographic survey conducted for this study found no studies in the literature that associated weight gain with hospital sectors.

One of the limitations of the present study is the use of retrospective data from the system of registration of regular health assessments of employees of the hospital, which hindered the use of standardized information. In addition, incomplete, unavailable and self-reported data limited the analyses and may have influenced the results. Although it is a limitation, it should be emphasized that the use of secondary computerized and standardized data on regular health assessments can enable robust cohort studies, because this type of epidemiological design has a high cost of investment. A longitudinal study to evaluate weight gain in workers may be an important marker of weight change over the life cycles of workers; also, it may provide further insights on the health profile of the working class for the purpose devising strategies for health promotion and weight gain prevention in working environments.

The strong point of the present study was to highlight the influence of work sectors on weight gain, because there was a strong and significant association even with a single work-related variable.

Conclusion

This study showed weight gain among the hospital workers throughout the four-year follow-up. Factors that influence weight gain are multifaceted and complex; however, workplace sectors can contribute, to a large extent, to the occurrence of the event. Another important fact which corroborates the literature is greater gain weight by young workers, which indicates the need to focus on this age group. The increase in the number of studies on weight gain can broaden the knowledge of this theme, and they should support strategies to ensure that health workers have quality of life at work, which, therefore, requires initiatives that include interventions to prevent weight gain.

Collaborations

TP Araújo and OB Aguiar participated in the conception, planning, analysis, interpretation and writing of the work, and MJM Fonseca participated in the interpretation and writing of the work. All authors approved the final version submitted.

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