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Interrelationships between nursing workers' state of nutrition, socio demographic factors, work and health habits

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Abstract *The interrelationships between professional nursing workers' state of nutrition, variables relating to their socio demographic relationships, their professional work, and health behavior, were examined based on a correspondence analysis technique. This is a sectional study carried out involving 917 nursing professionals in a public hospital in Rio de Janeiro. The results show the formation of four groups, three of them grouped under BMI (body mass index) categories. The obese individuals group included poor health, current socio economic conditions, unfavorable past conditions, and former night shift workers. The low/adequate group showed the most favorable conditions, while the group of overweight individuals also included smoking, alcohol consumption, and current night shift work (up to five nights per two-week period). Specifically, among the interrelationships between the states of nutrition levels, we highlight those relating to current and previously evaluated socio economic conditions, and underscore the life-long importance of social indicators.*

Key words *Body Mass Index, Obesity, Night shift work, Nursing, Cluster Analysis*

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Introduction

Obesity is a chronic disease, of multiple factor origin, characterized by excess body fat. It is closely associated with chronic degenerative disease[1-4], whose risks increase substantially when the BMI exceeds 25kg/m^2 [5].

In Brazil, the results of the 2008-2009 Family Budget Survey disclosed an accelerated increase in excess weight. Over a period of 34 years (1974/1975 through 2008/2009), the trend to excess weight among men increased from 18.5% to 50.1%. The respective statistics for women were 28.7% to 48.0%. Over this same period, the trend to obesity increased by more than four times for men and more than doubled for women[6].

Contemporary life styles differences, as compared with prior decades, have been considered a major reason for the prevalence of excess weight. These changes comprise the so-called "obesogenic environment"[7], a term coined by Swinburn et al.[8] referring to the physical, economic, social, and cultural aspects of an environment that could encourage a balance of positive energy, thereby promoting obesity.

Some authors suggest an inverse association between the socio economic status (SES), both current and previous, and weight gain[9-12]. This association suggests that the differential weight gain rhythm, according to the SES could, possibly, begin early in life, influenced by parental SES[10,13].

In addition to these factors, work environment aspects have also been associated with an increased risk of excess weight. Highlighted among these is shift work, particularly night shifts[14-17], excessive work load[18], and psychosocial stress in the workplace[19].

These factors are typical of nursing work in Brazil, where night shifts[20] are worked, in addition to long day shifts (12 hours). Moreover, here, multiple work bonds are common in the nursing profession[21]. The interaction of these factors can negatively impact such workers, both physiologically as psychologically[22,23], added to a potential for increase in weight.

Although a number of different studies have analyzed the determining factors of obesity and excess weight, our bibliographical search revealed no articles based on the correspondence analysis technique, aimed at visualizing BMI distribution and its relationship with several variables that influence weight gain. This approach becomes important in studies of the multi-factor results, as described by Carvalho and Struchiner[24], since it enables a simultaneous study of the relationships between a sizeable group of variables.

The aim of this study is to examine the interrelationship between the state of nutrition, socio demographic related variables, work, and the health behavior of nursing professionals working in a Rio de Janeiro public hospital, based on the correspondence analysis technique.

Methods

Population and information source

This is a sectional study carried out involving 1,182 nursing workers (nurses, nursing technicians, and nursing assistants) of a Rio de Janeiro public hospital, all of whom answered a questionnaire in 2006 when they took part in a survey entitled "Type, work, and health of nursing professionals: morbidity and its association with night shift work, long day shifts, and housework".

Definition of the variables

The variables applied in this study reflect aspects of state of nutrition, socio demographic conditions, work-related variables, and health behavior.

State of nutrition was classified based on weight and height data supplied. The BMI was classified under low/adequate (BMI1 $\leq$ 24,9), excess weight (BMI2 = 25,0 -29,9), and obesity (BMI 3 $\geq$ 30,0)[3].

The socio demographic variables used were: sex (female/male); age divided into averages (ages 16 to 44, 45 to 70); stated skin color (Caucasian, mixed race, Afro-Brazilian); education (elementary, high school, college level); *per capita* family income in US Dollars (USD), based on the foreign exchange rate of the period in which the data was collated (12/29/2006) – classified in accordance with the base salary of the period in which the data was collated (> $421.00 up to $421.00); marital status (married, single, divorced, separated, widowed); children (yes, no); prior economic circumstances based on the interviewee's perception of his/her family situation at the age of twelve, in relation to his/her current circumstances (moderately wealthy, poor, very poor); and maternal educational level (did not attend school, up to elementary, high school, or higher).

In the work context, the following variables were examined: professional category (nurse,

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auxiliary nurse, nursing technician); the working bond (permanent or impermanent); night shift (never worked a night shift, former night shift worker, working up to five night shifts per two-week period, six or more night shifts per two-week period)); professional work load (up to 40 hours a week, > 40 hours a week); and hours of housework, classified into averages (up 11 hours a week, > 11 hours a week).

The health-related variables were: auto perception of health (good, bad); self diagnosed hypertension (yes, no); insomnia (yes, no); smoking (smoker, ex-smoker, never smoked); alcohol consumption (yes, no); physical exercise (yes, no); fried food consumption (at least once a week, less than three times a month); fruit consumption (at least once a week, less than three times a month); vegetable consumption (at least once a week, less than three times a month).

Statistical analysis

The descriptive age analysis was based on the average, the standard deviation, and categorical variable percentages. The Chi Square test was applied based on a significance level of 20%, to test categorical variable associations.

Correspondence analysis and cluster analysis were applied to examine relationships between state of nutrition and socio demographic conditions, and work-related variables and health behavior.

Correspondence analysis is a multi-varied statistical technique, one that is both exploratory and descriptive, utilized for categorical data analysis[25]. This method enables visualization of the major relationships of a significant number of variables.

Data was treated in the stages described below. At first, the graphic representation obtained in the correspondence analysis enabled visualization of the distribution of relationship between all the categories. Each category was represented by one point, and the differences between the points represented the inter-category relationships.

Each auto valuation was considered to correspond to one of the axes that define multidimensional space, representing a total variance percentage. This percentage enabled evaluation of the capacity of each axis to represent a points cloud. The greater the percentage, the better the representation of the distribution of the points in space and, consequently, of the existing relationships between the categories[24].

The importance of each category of variable in the construction of the axes was evaluated via an absolute contribution. This absolute contribution analysis of the categories, in conjunction with observation of the position of the points on the graph in relation to the axes, aided in the interpretation of the factors and contributed to the conceptual categorization of the axes.

The cluster analysis complemented the correspondence analysis in identifying and dividing the groups.

The R program, version 2.15.0 (www.r-project.org) was utilized for these analyses.

Ethical aspects

This study was submitted to, and approved by, the Research Ethics Committees of Fiocruz and of the hospital involved in the study.

Results

Of the 1,182 nursing professionals investigated, the data of 265 (22.4%) were excluded, due to incomplete data on variables in the questionnaire. The group analyzed (N = 917) did not differ from the sample excluded from the study in respect of age, sex, education, BMI, and professional category (chi square test, p > 0,05).

Of the group studied, 85,9% were of the female sex. The average age was 40.9 (DP = 13,3). There was a majority of Caucasians; college level education; *per capita* family income of up to US$421.00; married individuals; and childless individuals. The BMI distribution of the population studied was 30.1% of overweight individuals and 16% of obese individuals.

Table 1 describes the BMI-based data. The predominance of excess weight and obesity was noted among the men (35.7% and 18.6, respectively), within an age range of 45 to 70 (37.6% and 21.8%, respectively), with education levels up to elementary level (40.5% and 27.8%, respectively), with children (35.4% and 20.4%, respectively), of Afro-Brazilian descent (37.4% and 17.8%, respectively), *per capita* income up to US$421.00 (31.4% and 17.2%, respectively), and with self diagnosed hypertension (37.2% and 30.2%, respectively).

The absolute contribution for each variables category can be interpreted as being part of the variation of the axis explained by the respective category (Table 1). Accordingly, the greater the absolute contribution, the greater the impor-

Table 1. Distribution of the survey population according to state of nutrition and Absolute Contribution in the two axes of greater auto value.

Variables	Symbol	Low/ Adequate	Excess weight	Obesity	p value	Absolute Contribution	
						Axis 1	Axis 2
Sex							
Female	S1	435 (55,2)	230 (29,2)	123 (15,6)	0,135	0,02	0,00
Male	S2	59 (45,7)	46 (35,7)	24 (18,6)		0,09	0,01
Age							
16 to 44	ID1	309 (66,9)	105 (22,7)	48 (10,4)	<0,001	6,74	2,86
45 to 70	ID2	185 (40,7)	171 (37,6)	99 (21,8)		6,85	2,91
Education							
Elementary	E1	25 (31,6)	32 (40,5)	22 (27,8)	<0,001	2,89	0,10
High school	E2	147 (46,4)	110 (34,7)	60 (18,9)		0,69	11,25
College	E3	322 (61,8)	134 (25,7)	65 (12,5)		1,72	8,27
Maternal Education							
Did not attend school	EM1	41 (36,3)	51 (45,1)	21 (18,6)	<0,001	1,65	0,49
To elementary level	EM2	292 (50,2)	187 (32,1)	103 (17,7)		0,72	0,01
High school or higher	EM3	161 (72,5)	38 (17,1)	23 (10,4)		5,27	0,40
Prior economic circumstances							
Moderately wealthy	SE1	240 (59,9)	103 (25,7)	58 (14,5)	<0,001	1,77	2,15
Poor	SE2	230 (51,9)	139 (31,4)	74 (16,7)		0,71	1,39
Extremely poor	SE3	24 (32,9)	34 (46,6)	15 (20,5)		1,08	0,28
Marital status							
Married	SC1	194 (47,5)	133 (32,6)	81 (19,9)	<0,001	0,91	0,01
Single	SC2	218 (66,7)	76 (23,2)	33 (10,1)		4,24	0,32
Divorced, separated, or widowed	SC3	82 (45,1)	67 (36,8)	33 (18,1)		1,78	0,86
Children							
Has child(ren)	NF1	201(44,2)	161(35,4)	93(20,4)	<0,001	3,47	0,06
No child(ren)	NF2	293(63,4)	115(24,9)	54(11,7)		3,42	0,06
Self described racial features							
Afro-Brazilian	C1	98 (44,7)	82 (37,4)	39 (17,8)	0,003	0,89	0,65
Mixed race	C2	175 (52,7)	107 (32,2)	50 (15,1)		0,01	2,28
Caucasian	C3	221 (60,4)	87 (23,8)	58 (15,8)		0,68	4,26
Income							
> USD 421.00	R1	204 (57,8)	99 (28)	50 (14,2)	0,158	1,21	11,04
Up to USD 421.00	R2	290 (51,4)	177(31,4)	97 (17,2)		0,75	6,51
Position							
Nurse	ENF	174 (65,4)	65 (24,4)	27 (10,2)	<0,001	0,88	5,96
Non-nurse	NENF	320 (49,2)	211 (32,4)	120 (18,4)		2,16	11,46
Work bond							
Permanent	V1	195 (41,8)	176 (37,8)	95 (20,4)	<0,001	6,69	2,52
Impermanent	V2	299 (66,3)	100 (22,2)	52 (11,5)		6,91	2,61
Working hours							
Up to 40 hours/week	HR1	219 (51,7)	142 (33,5)	63 (14,9)	0,110	2,33	0,73
> 40 hours/week	HR2	275 (55,8)	134(27,2)	84 (17)		2,01	0,63
Night shift work							
Never	TN1	136 (61,5)	57 (25,8)	28 (12,7)	0,002	0,22	2,35
In the past	TN2	141 (48,5)	96 (33)	54 (18,6)		2,20	1,72
Up to 5 nights/2-week period	TN3	91 (45,5)	76 (38)	33 (16,5)		0,85	0,39
> 6 nights/2-week period	TN4	126 (61,5)	47 (22,9)	32 (15,6)		4,78	0,35
Housework							
Up to 11 hours/week	TD1	274 (60,4)	123 (27,1)	57 (12,6)	<0,001	2,69	0,18
> 11 hours/week	TD2	220 (47,5)	153 (33,1)	90 (19,4)		2,64	0,17
Auto perception of health							
Good	PS1	420 (56,6)	225 (30,3)	97 (13,1)	<0,001	0,15	0,00
Bad	PS2	74 (42,3)	51 (29,1)	50 (28,6)		0,67	0,00

it continues

Table 1. continuation

Variables	Symbol	Low/ Adequate	Excess weight	Obesity	p value	Absolute Contribution	
						Axis 1	Axis 2
Self-diagnosed hypertension							
No	H1	415 (61,5)	186 (27,6)	74 (11)	<0,001	1,77	0,01
Yes	H2	79 (32,6)	90 (37,2)	73 (30,2)		4,94	0,01
Insomnia							
Yes	I1	121 (49,8)	79 (32,5)	43 (17,7)	0,328	0,44	0,22
No	I2	373 (55,3)	197 (29,2)	104 (15,4)		0,16	0,08
Alcohol consumption							
Yes	A1	178 (54,6)	97 (29,8)	51 (15,6)	0,943	0,00	0,51
No	A2	316 (53,5)	179 (30,3)	96 (16,2)		0,00	0,28
Smoking							
Smoker	T1	65 (45,8)	47 (33,1)	30 (21,1)	0,003	0,42	0,49
Ex-smoker	T2	63 (43,2)	54 (37)	29 (19,9)		1,50	0,05
Never smoked	T3	366 (58,2)	175 (27,8)	88 (14)		0,80	0,19
Fried food consumption							
At least once a week	FI1	360 (56,4)	183 (28,7)	95 (14,9)	0,060	0,60	0,85
Less than 3 times a month	FI2	134 (48)	93 (33,3)	52 (18,5)		1,36	1,96
Fruit consumption							
At least once a week	FU1	431 (53,4)	241(29,9)	135 (16,7)	0,296	0,09	0,17
Less than 3 times a month	FU2	63 (57,3)	35 (31,8)	12 (10,9)		0,73	1,24
Vegetable consumption							
At least once a week	VD1	456 (54)	255 (30,2)	134 (15,9)	0,887	0,01	0,06
Less than 3 times a month	VD2	38 (52,8)	21 (29,2)	13 (18,1)		0,11	0,78
Physical excercise							
No	EF1	338 (54,1)	184 (29,4)	103 (16,5)	0,761	0,05	1,22
Yes	EF2	156 (53,4)	92 (31,5)	44 (15,1)		0,10	2,61

Legend

Sigla	Variables
IMC1	low/adequate
IMC2	excess weight
IMC3	obesity
S1	female
S2	male
ID1	16 a 44 years old
ID2	45 a 70 years old
C1	afro-brazilian
C2	mixed race
C3	caucasian
E1	elementary
E2	high school
E3	college
R1	> USD421.00
R2	up to USD421.00
SC1	married
SC2	single
SC3	divorced, separated, or widowed
NF1	has child(ren)
NF2	no child(ren)
SE1	moderately wealthy
SE2	poor
SE3	extremely poor
EM1	did not attend school
EM2	to elementary level
EM3	high school or higher
ENF	nurse
NENF	non-nurse
V1	vpermanent
V2	impermanent

Sigla	Variables
TN1	never
TN2	in the past
TN3	up to 5 nights/2-week period
TN4	> 6 nights/2-week period
HR1	up to 40 hours/week
HR2	>40 hours/week
TD1	up to 11 hours/week
TD2	> 11 hours/week
PS1	good auto perception of health
PS2	bad auto perception of health
H1	self-diagnosed hypertension - no
H2	self-diagnosed hypertension - yes
I1	has insomnia
I2	no insomnia
T1	smoker
T2	ex-smoker
T3	never smoked
A1	alcohol consumption- yes
A2	alcohol consumption-no
FI1	fried food consumption - at least once a week
FI2	fried food consumption - less than 3 times a month
FU1	fruit consumption - at least once a week
FU2	fruit consumption - less than 3 times a month
VD1	vegetable consumption - at least once a week
VD2	vegetable consumption - less than 3 times a month
EF1	physical exercise - no
EF2	physical exercise - yes

tance of the category in the axis. In this case, the categories that most contributed to the first axis were the age range of 45 to 70 and 'impermanent bond'; the variable that contributed the least was 'alcohol consumption'. In the second axis, the categories that most contributed were 'education levels up to high school levels' and 'nurses', and the variable that contributed the least was 'auto perception of health'.

Table 2 shows self valuations and percentages of variances explained by each axis, which defines the multidimensional space. The first two dimensions explained 18.88% of the global data variation, the first contributing 12.95%, and the second 5.93%. Both these dimensions were utilized for subsequent analyses, since, from the second axis onwards, the explanation percentage diminished, became homogeneous, and relatively insignificant.

The graphic analysis of the first two axes (Figure 1) enabled visualization of the distribution of each category of variable, by configuring a points cloud in a multidimensional space, displaying the proximity between the variables categories. Groupings were defined based on the distribution of variables and their interrelationships. As a result, four groups were found to be formed, all of them heterogeneous with one another, selected based on a visual inspection of the graph generated by the correspondence analysis and confirmed by the dendrogram (Figure 2). This figure shows the formation of four groups when we applied a cut-off point at the stage of 2.5, and confirms the same grouping identified in the graphic representation arrived at via correspondence analysis.

Table 2. Dimensions, auto values, variation percentage, and accumulated percentage.

Dimensions	Auto values	Variation %	Accumulated variation %
1	0,18	12,95	12,95
2	0,08	5,93	18,88
3	0,07	4,74	23,62
4	0,06	4,35	27,97
5	0,06	4,06	32,03

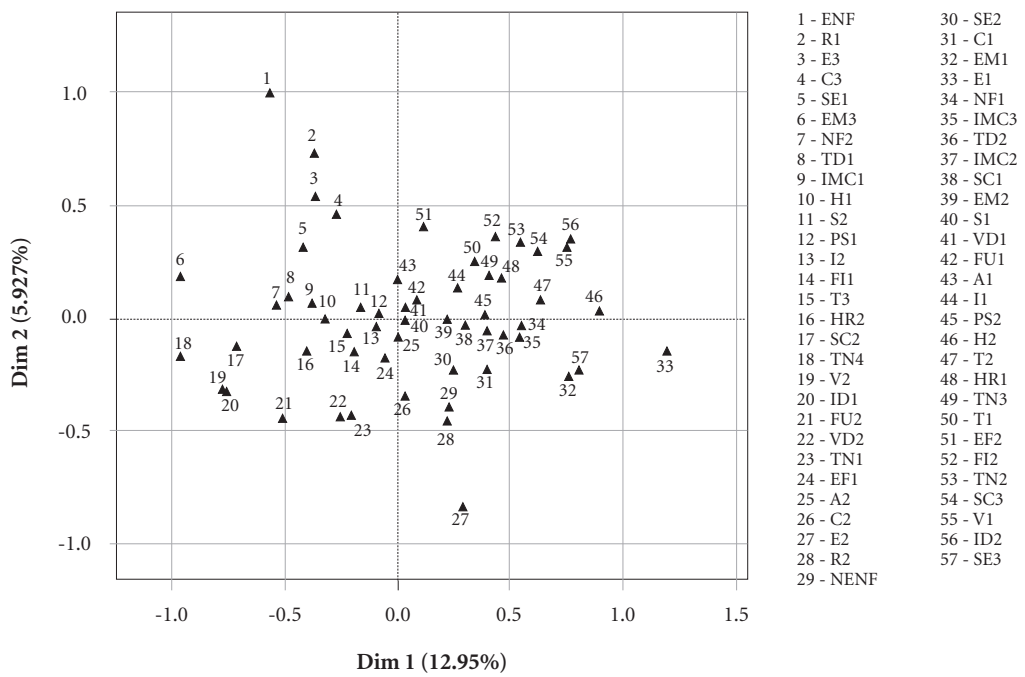

Figure 1. Graphic representation of the first two correspondence analysis axes.

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Predominant in the group within the obesity category (BMI3) are the following features: auto perception of bad health, insomnia, self-diagnosed hypertension, marital separation, divorce, and widowhood, of being Afro-Brazilians, permanent working bond, older (aged between 45 and 70); former night shift workers, low fried food consumption, mother who did not attend school, prior low economic position, and lower level of education.

The group including the 'overweight' category (BMI 2) showed a link with 'smokers', 'alcohol consumption, 'professionals who work up to five nights a week per two-week period', and 'men'.

The 'low/adequate' category (BMI 1) comprised nurses, professionals with a 'college education', 'higher *per capita* family income' (greater than US$421.00), 'moderately wealthy prior economic circumstances', 'skin color auto perceived as Caucasian', maternal education to high school or higher level, impermanent work bond, younger '(aged from 16 to 44)', 'lower housework load (up to 11 hours a week)', 'longer professional working hours (more than 40 hours per week)', 'greater exposure to night shift work' (more than six nights per two-week period), 'unmarried, 'childless, 'low fruit and vegetable consumption'.

A fourth group consists mainly of nursing technicians and assistants, with a '*per capita* family income of up to US$421,00', 'prior economic situation of poverty', 'skin color referred to as being of mixed race', 'high school education, 'self perception of good health', 'no insomnia, 'no auto-diagnosis of hypertension', 'greater fried food consumption', 'maternal education 'up to elementary level, 'greater fruit and vegetable consumption', 'non-smokers', 'no alcohol consumption, 'women, 'physical exercise (yes and no)', 'never any night shift work', 'housework more than eleven hours a week 11 hours a week', 'fewer working hours (up to 40 hours a week)', 'ex-smokers', married and some with children.

Discussion

The most important interrelationships of categories associated with the levels of states of nutrition identified were those relating to the individuals' current and prior socio economic circumstances, thus underscoring the importance of social determinants throughout life. Although, the less favorable current and prior socio economic conditions were maintained in

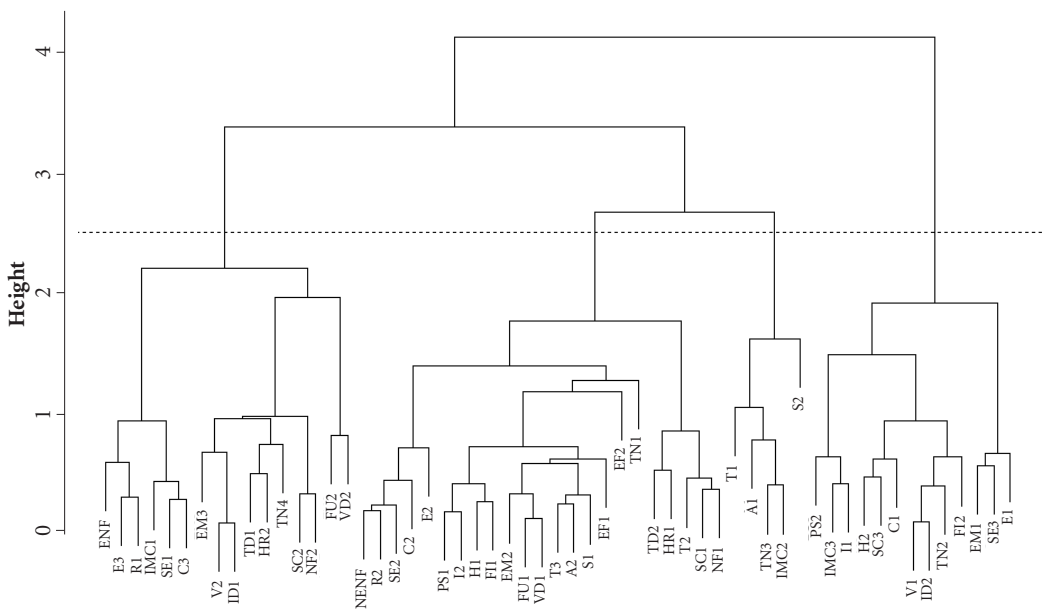

Figure 2. Dendrogram of the coordinates of the first two axes.

the obese group, these were more positive for the 'low/adequate' group. In fact, over the last few decades, an accumulation of evidence has been observed indicating that the incidence and progression of illnesses and incapacitation involve a complex relation of socio economic, behavioral, demographic, and psychosocial determinants. As noted by Kaplan et al.[26], these factors tend to be associated with occurrences of illness and also with the direction of an individual's health during a significant period of his/her life. This is how epidemiological models that examine the direction of life and health view the effects of exposure throughout life, particularly during more vulnerable periods in biological and social terms, and which could influence health when a more advanced age is reached[27]. In addition to genetic factors impacting chronic diseases, such as obesity, several social determinant aspects throughout life could favor or prevent weight gain, and this includes the influence of life *in utero*[28]. Models examining lifetime exposures show that the impact of a given exposure could be dependent on the age of, or on the stage of development to which, the individual was exposed[29]. Accordingly, obesity prevention strategies should begin very early in life.

The aspects of this work show that the obese group consisted of former night shift workers, i.e., individuals who work during the day but have past experience of working night shifts. The remit of this work is the impact of shift work, particularly night shifts, on weight gain[30]. Studies evaluating former night shift workers noted a greater weight gain in this group, as compared with individuals who had never worked a night shift[31,32]. Moreover, on leaving night shift work, they were more likely to continue experiencing sleeping difficulties[31,33]. It is not uncommon for sleep disruption to become associated with obesity and other health issues[16].

In fact, the category of individuals with no night shift experience leveled with the categories reflecting the best state of health, including no self diagnosed hypertension, a good perception of own health, and the absence of insomnia. Conversely, the unfavorable health aspects analyzed (auto perception of bad health, insomnia, and self diagnosed hypertension) were all linked under obesity.

In turn, excess weight was associated with individuals who work up to five night shifts per two-week period. A number of factors explain this greater weight gain among night shift workers. Chief among these is circadian maladjustment and changes in health behavior patterns[15,34-36]. These workers suffer from chronic nocturnal sleep deprivation. This changes successive biochemical events that, in turn, alter the release of hormones during sleep, such as the growth hormone, leptin, ghrelin, and cortisol[37]. Sleep deprivation and associated fatigue stimulate the urge to eat and reduce energy expended to increase energy reserves, thus resulting in weight gain[38]. Allied to these factors are difficulties in absorbing food during the night, based on the circadian organization function which is adapted to daytime activities[39].

Interacting with the biological aspects, night shift workers' behavior also affects weight gain, since they develop a tendency to more irregular feeding patterns than those of day shift workers. This includes a greater number of meals which can be easily prepared snacks during the night shift[40]. Lastly, this excessive weight gain could also arise from the lack of, or decrease in, physical exercise, particularly, on the day after the night shift[41], as a result of exhaustion and physical and mental tension.

A relationship between working hours and age could explain the grouping of the low/adequate individuals with frequent night shift work (six or more nights per two-week period) and with younger workers. Other studies of this population show that night work is more frequent and common among younger people[42] who, in turn may have been exposed to night shift work for a shorter time. Here, the evidence of increase in BMI, with the increase of time of exposure to night shift work[32,43] showing a lower BMI among younger people, explains this variables grouping. This is because the younger age and the lower period of exposure to night shift work contribute to the chances of eutrophy. However, the length of exposure to night shift work was not analyzed, which is one of the limitations of this study.

Another feature noted in the grouping of individuals in a low/adequate state of nutrition was the minimal consumption of fruit and vegetables. However, this category also consists of younger individuals. Studies point a positive association between the consumption of fruit and vegetables and age, since older people tend to recognize and value the relationship between eating habits and health[44]. Furthermore, the regular consumption of fruit and vegetables is relatively low among the Brazilian population[44-46].

The overweight category showed a grouping with smoking, alcohol consumption, and men. Smoking and excess alcohol consumption are

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life style patterns relating to social, cultural, environmental, and behavioral changes, all of which have contributed to weight gain[47-49]. Our findings bear out conclusions reached over the last few years of the trend to excess weight, mostly among men[6,50,51]. A comparison between the surveys carried out by the *IBGE* (Brazilian Institute of Geography and Statistics) from 1974 through 2009, such as the National Family Expenditure Study (1974-1975), the National Health and Nutrition Survey (1989), and Family Budget Surveys (2002-2003 and 2008-2009), stress that, over the last few years, men tend to gain the most weight.

There is one group representing a varied pattern, which showed a connection between intermediary socio demographic conditions, improved states of health (auto perception of good health, no insomnia, and no self diagnosed hypertension), healthier life styles (greater consumption of fruit and vegetables, non-smokers, no alcohol consumption) and some unfavorable categories (lower income levels, more housework, and greater consumption of fried foods). However, this group was not linked with any state of nutrition categories. A partial explanation for this profile is the fact that, in this modeling type, no *a priori* selection is made of the variables that will compose the final model, and all variables are analyzed simultaneously. The groupings formed by measured features (categories of variables) are homogeneous among themselves and heterogeneous in relation to other groups[52].

The complex nature of obesity etiology is inherent to an understanding at various levels. There are countless factors of differing levels of influence (biological, behavioral, group, and macro social levels)[53], all of them with implications for the development of the disease; these factors influence one another and, furthermore, are occasionally influenced by the disease itself[54].

In addition to the points raised in this study, certain limitations must be stressed. An important one is the application of BMI to analyze the state of nutrition of the individuals concerned, given that this does not enable us to analyze the body composition. However, the ease of obtaining body and stature composition in population basis studies, and its good correlation with mortality and morbidity justify its use in epidemiological studies as an adiposity marker[55-57].

Correspondence analysis enabled us to examine the interrelationship between state of nutrition and work, health, and socio demographic features, resulting in the extraction of the maximum possible data. It was a useful tool and enabled us to identify well defined groups in terms of state of nutrition. If, on the one hand this correspondence analysis was extremely useful in identifying states of nutrition profiles, given the convoluted nature of the problem and its connection with articulated complex systems, on the other hand, the conformity of the groups did not permit inferences to be made regarding the findings. Accordingly, the results described herein are restricted to the population studied.

We hope that the results of this study will contribute to promoting preventive public health strategies. These would aid in the planning of preventive actions and to the management of excess weight and of obesity, and would also encourage periodic monitoring of health in a work context.

Collaborations

K Siqueira worked on data analysis and interpretation, statistical analysis, for the text of the manuscript, and for the critical review of the manuscript in the context of vital intellectual content. RH Griep worked on the concept and design of the survey, on analyzing and interpreting data, on the text of the manuscript, and for the critical review of the manuscript in the context of vital intellectual content. L Rotenberg worked on the concept and design of the survey, on interpreting data, and on the critical review of the manuscript in the context of vital intellectual content. A Costa worked on analyzing and interpreting data, statistical analysis, and on the critical review of the manuscript in the context of vital intellectual content. E Melo worked on the critical review of the manuscript in the context of vital intellectual content. MJ Fonseca worked on analyzing and interpreting data, on the text of the manuscript, and on the critical review of the manuscript in the context of vital intellectual content.

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