

Informal and Formal Caregivers' Nutritional Status, Food Insecurity and Caregiver Burden

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Received: May 08, 2024; Published: July 01, 2024

Abstract

Introduction: Caregiving has an association with poorer health outcomes, physical stress and emotional stress, due to caregivers' predisposition to leave their own basic needs unfulfilled in favor of those of the care recipient. Furthermore, there is an association between caregiving and financial constraints, thus, informal caregivers are more vulnerable to food insecurity. Lastly, it is reasonable to deem that caregivers' food insecurity, which is often accompanied by a higher emotional burden, might negatively influence their nutritional status and, indirectly, decrease the quality of the care provided.

Objectives: This study aims to characterize informal and formal caregivers' nutritional status, food insecurity level and caregiver burden, and to study the associations between those three conditions.

Methodology: In this cross-sectional study, data collection was performed through two questionnaires developed by the investigation team, applied on-site and online. Nutritional status was assessed through body mass index (BMI) and the adherence to a healthy diet lifestyle (using the "Brief and initial evaluation of dietary habits" scale). Food insecurity was screened by the scale from the "INFOFAMILIA" project. Caregiver burden was assessed through the four-point Zarit Burden Interview developed to be used in Portugal.

Results: Informal caregivers' BMI, compared to formal caregivers, was significantly higher (mean = 27.5 kg/m², SD = 6.7 vs. mean = 24.8, SD 4.3, p = 0.018); nevertheless, this study didn't find significant differences concerning their level of adherence to healthy diet patterns (1.4% vs. 0.0% low adherence, p = 0.952). Food insecurity had a higher prevalence among informal caregivers (44.7% vs. 27.1%, p = 0.040) and was predicted by not practicing physical exercise, a higher BMI, the presence of caregiver burden and having intermediate (7 to 9 years) of education. Caregiver burden was more prevalent among informal caregivers (61.7% vs. 20.1%, p < 0.001), and it had two protector factors: literacy level (middle school level) and type of caregiver (formal caregiver). Finally, it wasn't found a significant relation between caregivers' weight status and food insecurity (OR = 1.12, 95%CI: 0.52; 2.41) nor between caregivers' weight status and caregiver burden (OR = 1.40, 95%CI: 0.64; 2.96). However, a higher level of food insecurity was associated to higher caregiver burden score (mean = 6.0, SD = 3.5 vs. mean = 4.5, SD = 3.1, p = 0.007).

Conclusion: Caregivers, in particular the informal ones, exhibited an inadequate nutritional status (concerning their BMI values). Besides, food insecurity and caregiver burden were prevalent among this population. Lastly, caregivers' weight status, food (in) security and caregiver burden were not related to each other. The present study seems to suggest that people who provide any type of care are a risk group for higher BMI, food insecurity and caregiver burden; nonetheless this is even more noticeable in informal caregivers.

Keywords: Informal Caregivers; Formal Caregivers; Nutritional Status; Food Insecurity; Caregiver Burden

Introduction

A substantial proportion of the Portuguese population (approximately 230 thousand individuals) live with a health disability or deficiency; thus, they rely up on regular assistance of, at least one of, the following types of caregivers: informal (e.g. relatives) and formal (professionals) [1-3].

This is a demanding and stressful function since, in addition to caregivers' economic struggles and/or scarce resources, they also need to handle multiple obligations and look after their own health [2,4,5]. Accordingly, caregivers tend to leave their own basic needs unfulfilled (and frequently exhibit poorer health status and a physical and emotional burden) in favor of the unmet needs of the care recipient [2,6].

As a matter of fact, the relevance of the monitorization and willingness to understand caregivers' emotional and psychological problems is already acknowledge in the literature [5]. This burden has a negative influence on every element of the caregivers' lives, namely their family dynamic, sleep quality and eating patterns [7]. Additionally, caregivers, especially informal caregivers, tend to have financial constraints [8]. This might be a result of the reduction of their formal work time or even their lay off, that is usually needed with the arise of their caregiving responsibilities [8]. Consequently, food insecurity (i.e. the physical and financial uncertainty of being able to have a nutritional, hygienic and sustainable diet) is prevalent among informal caregivers [8,9]. Moreover, since food insecurity is associated with obesity and caregiver burden, it is plausible to assume that when food security isn't guaranteed, caregivers' health is negatively impacted [9].

To conclude, both types of caregivers are a risk group to numerous conditions. Therefore, it is essential that more studies are conducted regarding caregivers' physical and mental health to raise awareness regarding this vulnerable population.

Objectives of the Study

This study's objective is to characterize both types of caregivers (informal and formal) concerning their nutritional status, food insecurity and caregiver burden.

Additionally, this research work also aims to investigate the association between informal and formal caregivers' nutritional status, food insecurity level and caregiver burden.

Methodology

Population and sample

There were included one hundred and eighty one caregivers in this study: 47 informal caregivers were recruited from Gondomar municipality program named "+CUIDAR" (52.2% participation rate) and 144 formal caregivers were recruited from the "Support to Independent Lives Centers" project (24.4% participation rate).

Ethics

The conduction of the present research work was previously authorized by the Ethic Committee of the Faculty of Nutrition and Food Sciences' Ethics Commission from Oporto University (67/2021/CEFCNAUP/2021) [10].

Every participant has registered their informed consent, in line with the Declaration of Helsinki and Portuguese legislation, after being enlightened the study's subject and purpose [10,11]. It was assured as well that this was a voluntary participation and that the research team would guarantee confidentially during all procedures [10,12,13].

Materials and methods

Data gathering

This was an observational cross-sectional study. Data was collected through an inquiry form developed by the investigation team. The questionnaire for informal caregivers was applied in paper format and online (Google Forms at the University of Porto's online platform), but participants always filled their own questionnaires by themselves. Formal caregivers' questionnaire was applied only in online format. The questionnaires comprised information regarding the care receipt (child/teenager/adult/older adult). It was also included the following data.

Sociodemographic

Age (years), sex (male/female/doesn't want to say), nationality, marital status (married/widow(er)/divorced/single) and literacy level (primary/elementary/middle school/high school/post-secondary/higher education) [14]. Educational level was recoded into five levels, combining primary and elementary school into one single group, and nationality was recoded into Portuguese or non-Portuguese.

Lifestyle

Physical exercise practice (yes/ no), alcoholic and smoking habits, daily sleep hours and diet habits. Dietary habits were screened by the 11-item "Brief and initial evaluation of dietary habits" scale, that allows a fast and easy way to measure the level of adherence to a healthy diet pattern during the previous trimester. This tool's score (0 to 22 points) was acquired through the sum of all items and classified each individual in one of these 3 levels: "high adherence to healthy dietary habits" when the score was ≥ 18 points; "moderate adherence to healthy dietary habits" whenever the score was between 8 and 17 points; and "low adherence to healthy dietary habits" when the sum of the items was ≤ 7 points [15-17].

Anthropometric

Self-reported height (cm) and weight (kg) were used to compute Body Mass Index (BMI), classified in accordant to the WHO categories [18].

Caregiver burden

It was assessed through the European Portuguese short form (four-points) of Zarit Burden Interview (ZBI-4). This tool was already validated in community-dwelling caregivers, in Portugal. ZBI-4 is a scale that has four closed questions about caregivers' feelings concerning: the absence of time to focus on themselves; stress-inducing management practices; emotional burden; and doubts regarding the person they are taking care of. Each question is evaluated from zero to four points (total: 0 to 16 points). After the sum of all the points assessed in the questionnaire, caregivers who scored ≥ 7 points, are designed caregivers with caregiver burden [19,20].

Food insecurity level

Food insecurity was screened with the short Food Insecurity Scale from the "INFOFAMILIA" project. This scale comprises 14 interrogations regarding to the previous trimester (3 months), with a "yes/no" answer. It also includes nine other questions concerning their perception of two topics: their own and their relatives' diet habits changes and the economic-induced changes in the access to health services. The number of affirmative answers to the questions, establishes the final score of this scale. The presence/absence of minors in the household settles the cut-off points to the scale. After the final scores are obtained, the family screened falls into four possible categories: food security, mild insecurity, moderate insecurity, or severe food insecurity [8].

Data processing - statistical analysis

This study’s statistical analysis was performed with the Software Package for Social Sciences (SPSS®) for Windows Version 28.0. It was considered a confidence level of 95%.

Descriptive analyses of categorical variables were displayed as absolute (n) and relative (%) frequencies. As for the quantitative variables, the normality of the distribution was assessed through skewness e kurtosis coefficients. Since all the results had a normal distribution, their means and standard deviations were used. The comparisons between informal and formal caregivers were made using Student’s t tests (for quantitative data), Mann-Whitney’s tests (for ordinal data) or chi-square tests (for nominal data). Pearson correlations were used to measure the associations between the scores regarding caregivers’ adherence to healthy diet habits and caregiver burden.

Binary logistic regression analysis was used to identify the predictors of adherence to healthy dietary habits, caregiver burden and food security based on sociodemographic and lifestyles characteristics. Both raw (unadjusted) and adjusted models are presented. The adjusted models were performed using a forward procedure.

Results

Table 1 presents the characterization and comparison between types (informal or formal) of caregivers regarding sociodemographics, lifestyles, BMI, adherence to healthy dietary habits, food insecurity and caregiver burden.

	Total	Formal caregivers	Informal caregivers	P-value
Age (years), mean (SD) n = 186	43 (12)	41 (10)	50 (15)	< 0.001*
Sex, n (%) n = 187				0.051†
Female	148 (79.1%)	116 (82.9%)	32 (68.1%)	
Male	39 (20.9%)	24 (17.1%)	15 (31.9%)	
Marital status, n (%) n = 190				0.119†
Single	59 (31.1%)	51 (35.4%)	8 (17.4%)	
Divorced	33 (17.4%)	25 (17.4%)	8 (17.4%)	
Widowed	3 (1.6%)	2 (1.4%)	1 (2.2%)	
Married	95 (50.0%)	66 (45.8%)	29 (63.0%)	
Nationality, n (%) n = 191				1.000†
Portuguese	179 (93.7%)	135 (93.8%)	44 (93.6%)	
Other	12 (6.3%)	9 (6.2%)	3 (6.4%)	

Educational Level, n (%) n = 187				
Elementary school (Until 6 th grade)	14 (7.5%)	2 (1.4%)	12 (25.5%)	< 0.001 [†]
Middle school (7 th to 9 th grade)	25 (13.4%)	16 (11.4%)	9 (19.1%)	
High school (10 th to 12 th grade)	64 (34.2%)	55 (39.3%)	9 (19.1%)	
Post-secondary education	18 (9.6%)	13 (9.3%)	5 (10.6%)	
University degree	66 (35.3%)	54 (38.6%)	12 (25.5%)	
Practices physical exercise, n (%) n =191				
Yes	85 (44.5%)	70 (48.6%)	15 (31.9%)	0.062 [‡]
No	106 (55.5%)	74 (51.4%)	32 (68.1%)	
Smokers, n (%) n = 191				0.136 [‡]
Yes	54 (28.3%)	45 (31.3%)	9 (19.1%)	
No	137 (71.7%)	99 (68.7%)	38 (80.9%)	
Drinks alcoholic beverages, n (%) n = 187				
Yes	36 (19.3%)	23 (16.3%)	13 (28.3%)	0.087 [‡]
No	151 (80.7%)	118 (83.7%)	33 (71.7%)	
Body mass index (kg/m ²), mean (SD) n = 191	25.3 (4.8)	24.8 (4.3)	27.5 (6.7)	0.018 [*]
Body mass index (kg/m ²), n (%) n = 191				0.098 [†]
Normal (BMI ∈ [18.5; 25.0] kg/m ²)	109 (57.1)	86 (61.0)	21 (50.0)	
Overweight (BMI ∈ [25.0; 30.0] kg/m ²)	42 (22.0)	35 (24.8)	9 (21.4)	
Obese (BMI ≥ 30 kg/m ²)	32 (16.8)	20 (14.2)	12 (28.6)	
Food (IN)security score, median (p25; p75) n = 191	0.0 (0.0; 1.0)	0,0 (0.0; 1.0)	0.0 (0.0; 2.0)	0.072 [*]
Food insecurity, n (%) n = 191				0.040 ^P
Food Insecure	60 (31.4%)	39 (27.1%)	21 (44.7%)	
Food Secure	131 (68.6%)	105 (72.9%)	26 (55.3%)	

Caregiver burden score, mean (SD) n = 191	5,0 (3,3)	4,1 (2,8)	7,5 (3,5)	<0,001*
Caregiver burden, n (%) n = 191				<0,001‡
With	58 (30,4%)	29 (20,1%)	29 (61,7%)	
Without	133 (69,6%)	115 (79,9%)	18 (38,3%)	
Adherence to healthy dietary habits score, mean (SD) n = 191	14,9 (3,1)	15,0 (3,0)	14,5 (3,2)	0,397*
Level of adherence to healthy dietary habits, n (%) n = 191				0,952 ^P
Low adherence	2 (1,0%)	0 (0,0%)	2 (1,4%)	
Moderate adherence	153 (80,1%)	38 (80,9%)	115 (79,9%)	
High adherence	36 (18,8%)	9 (19,1%)	27 (18,8%)	

Table 1: Sociodemographic characteristics, caregiver burden, adherence to healthy dietary habits and food insecurity among formal and informal caregivers.

*: Independent Samples Student’s t test.

‡: X² test.

‡: Fisher’s exact test.

^P: Mann-Whitney’s test.

Informal caregivers were significantly older (mean = 50 years, SD = 15 vs. 41, SD = 10, p < 0.001) and less educated (25.5% vs. 38.6% with university degree, p < 0.001) than formal caregivers.

The prevalence of caregiver burden was significantly higher in informal caregivers (61.7% vs. 20.1%, p < 0.001). Food insecurity among informal caregivers was significantly higher (44.7% vs. 27.1%, p = 0.040) compared to formal caregivers. In what concerns nutritional status, there was a significant higher BMI (mean = 27.5 kg/m², SD = 6.7 vs. 24.8, SD = 4.3, p = 0.018) among informal caregivers, in comparison with formal caregivers, but there were no significant differences considering the level of adherence to an healthy diet pattern.

Table 2 displays the results concerning caregivers’ adherence to healthy dietary habits and caregiver burden stratified by food security and food insecurity. Food insecure caregivers had significantly higher caregiver burden scores than food secure caregivers (mean = 6.0, SD = 3.5 vs. 4.5, SD 3.1, p = 0.007). When this comparison was made by type of caregivers (informal and formal), the differences were not significant, despite the same tendency was found in both groups. We didn’t find a significant relationship between caregivers’ food insecurity and the level of adherence to healthy dietary habits, independently of the type of caregiver (p > 0.05).

	Food Insecurity	Without Food insecurity	P-value
Caregivers, n (%) n = 191	60 (31.4)	131 (68.6)	
Adherence to healthy Dietary Habits Score, Mean (SD)	14.3 (3.2)	15.1 (3.0)	0.115
Caregiver Burden Score, Mean (SD)	6.0 (3.5)	4.5 (3.1)	0.007
Formal caregivers, n (%) n = 144	39 (27.1)	105 (72.9)	
Adherence To Healthy Dietary Habits Score, Mean (SD)	14.7 (3.1)	15.1 (3.0)	0.270
Caregiver Burden Score, mean (SD)	4.7 (2.9)	3.9 (2.7)	0.072
Informal caregivers n (%) n = 47	21 (51.2)	26 (63.4)	
Adherence to healthy dietary habits score, mean (SD)	13.6 (3.4)	15.3 (2.8)	0.081
Caregiver burden score, mean (SD)	8.3 (3.5)	6.9 (3.5)	0.168

Table 2: Caregivers' adherence to healthy dietary habits score and caregiver burden score stratified by presence and absence of food insecurity.

We performed binary logistic regression models to predict food insecurity, caregiver burden and adherence to healthy dietary habits based on sociodemographic and lifestyles characteristics. The results of both univariate and multivariate models are presented in table 3.

	Healthy Diet		Caregiver burden				Food Insecurity			
	Crude Exp(β) (95%CI)	P-value	Crude Exp(β) (95%CI)	P-value	Adjusted Exp(β) (95%CI)	P-value	Crude Exp(β) (95%CI)	P-value	Adjusted Exp(β) (95%CI)	P-value
Sex (ref.: Male)										
Female	2.32 (0.77; 7.02)		1.35 (0.61; 3.00)	0.461	-	-	1.48 (0.67; 3.28)	0.334	-	-
Age (years)	1.03 (1.00; 1.06)	0.047	1.01 (0.99; 1.04)	0.353	-	-	0.99 (0.97; 1.02)	0.689	-	-
BMI (kg/m ²)	-	-	-	-	-	-	1.11 (1.04; 1.18)	0.003	1.10 (1.02; 1.18)	0.011
Caregiver burden (ref.: No)										
Yes	1.38 (0.64; 2.96)	0.407	-	-	-	-	2.37 (1.24; 4.52)	0.009	3.21 (1.46; 7.08)	0.004
Educational level (ref.: Elementary)		0.389		0.004		0.039		0.057		0.015
Middle school	1.16 (0.24; 5.58)	0.855	0.04 (0.01; 0.22)	0.001	0.03 (0.00; 0.30)	0.003	1.08 (0.29; 4.01)	0.905	6.94 (1.26; 38.52)	0.027
High school	0.45 (0.10; 2.02)	0.297	0.10 (0.25; 0.40)	0.031	0.26 (0.04; 1.72)	0.163	0.42 (0.13; 1.37)	0.151	1.27 (0.29; 5.58)	0.749
Post-secondary	1.41 (0.27; 7.28)	0.681	0.17 (0.04; 0.85)	0.001	0.32 (0.04; 2.48)	0.278	0.39 (0.88; 1.67)	0.203	1.01 (0.18; 5.76)	0.993
University degree	0.99 (0.24; 4.03)	0.986	0.10 (0.03; 0.41)	0.046	0.22 (0.04; 1.40)	0.109	0.29 (0.09; 0.97)	0.045	1.04 (0.23; 4.60)	0.964
Physical exercise (ref.: Doesn't practice)										

Practices	1.73 (0.83; 3.59)	0.141	0.92 (0.50; 1.72)	0.797	-	-	0.41 (0.21; 0.78)	0.007	0.46 (0.22; 0.98)	0.043
Type of caregiver (ref.: informal)										
Formal	0.97 (0.42-2.25)	0.952	0.16 (0.08-0.32)	<0.001	0.15 (0.06-0.39)	<0.001	0.46 (0.23-0.91)	0.026	-	-
Alcoholic habits (ref.: No)										
Yes	1.06 (0.42-2.67)	0.901	2.15 (1.02-4.54)	0.046	-	-	0.94 (0.43-2.08)	0.886	-	-
Smoking habits (ref.: No)										
Yes	0.68 (0.29-1.60)	0.373	1.2 (0.62-2.28)	0.576	-	-	2.24 (1.16-4.33)	0.016	-	-
Healthy diet (ref.: High adherence)										
Low/moderate Adherence	-	-	1.4 (0.64-2.96)	0.407	-	-	1.12 (0.52-2.41)	0.783	-	-
Food insecurity (ref.: Food secure)										
Food insecure	1.12 (0.52-2.41)	0.783	2.37 (1.24-4.52)	0.009	2.40 (1.07-5.44)	0.033	-	-	-	-

Table 3: Factors associated with caregivers' food insecurity, burden and healthy diet.

In the models for adherence to healthy dietary habits no independent variable was a significant predictor and, therefore, no adjusted model is presented.

Regarding caregiver burden, the adjusted model explained 31.9% of the total variance (Nagelkerke's $R^2 = 0.319$). Participants with middle school education (vs. elementary, OR = 0.03, 95%CI: 0.00; 0.30) and formal caregivers (OR = 0.15, 95%CI: 0.06; 0.39) had lower odds of presenting caregiver burden, while food insecure participants were 2.4 times more likely to present caregiver burden (OR = 2.40, 95%CI: 1.07; 5.44).

Lastly, the adjusted model explained 23.6% of variance (Nagelkerke's $R^2 = 0.236$) regarding food insecurity. According to this model, caregivers had significantly less chance of food insecurity when they practiced physical exercise (OR = 0.46, 95%CI: 0.22; 0.98), while higher BMI ($\text{Exp}(\beta) = 1.10$, 95%CI: 1.02; 1.18), caregiver burden (OR = 3.21, 95%CI: 1.46; 7.08) and middle school education (vs. elementary, OR = 6.94, 95%CI: 1.26; 38.52) were associated to higher odds of food insecurity.

Discussion

This research work's sample involved informal and formal caregivers, that presented some analogous sociodemographic and lifestyle characteristics, such as: sex (higher proportion of females), marital status (most of them were married), nationality (mainly Portuguese), smoking and drinking habits (most didn't smoke nor drink alcoholic beverages), and sedentarism (more than 50% were sedentary). In agreement with what is stated in the literature, formal caregivers, compared to the informal ones, of this sample were significantly younger and had a higher level of education [21]. Our results regarding age (mean age of 50 years) and sex (with 68.1% of females) go in line with a national research conducted in 2021, that characterized Portuguese informal caregivers. That study and exhibited that the majority of Portuguese caregivers were females, over 45 years-old and presented an educational level of high school or university education [22]. However, it is impossible to make a similar comparison of the findings regarding Portuguese formal caregivers, as, until this moment, there are no other articles characterizing formal caregivers.

Concerning the assessment of nutritional status based on BMI, informal caregivers' BMI, compared to formal caregivers, was significantly higher (mean = 27.5 kg/m², SD = 6.7 vs. 24.8, SD = 4.3). Our findings regarding caregivers' BMI are in accordance with the values described in the literature for this group: mean = 23.8 kg/m², SD = 4.1 [26] to 32.2, SD = 7.7 [23].

Nevertheless, obesity is an intricate disease that has multiple risk factors, such as emotional strain and lifestyle behaviours (e.g. unhealthy diet and sedentarism) [24]. Therefore, we are unaware if our sample's high BMI values were a direct consequence of caregiving. However, some other studies acknowledged that several informal caregivers worsened their BMI classification when they started providing care to someone. As a matter of fact, these caregivers were more likely of gaining weight excessively, were less educated, and had more stress [25]. Other article contemplated two explanations for caregivers' weight fluctuation: 1) the care receipts with a worse nutritional status comprise a higher burden, which indirectly affects caregivers' nutrient intake, and 2) caregivers were incapable to cook well-balanced meals and, consequently, presented worse nutritional status [26].

Our research findings seem to indicate that there is no relationship between caregivers' food habits their BMIs. In fact, literature had shown that informal caregivers' dietary habits do not deteriorate during the caregiving process. Additionally, their nutritional scores are comparable to those of individuals who are not caregivers, as previously reported in studies [27,28]. This absence of influence is also noticeable through a comparison of our results with the general Portuguese population, because, although their healthy eating habits were assessed thru a different methodology, the general population's adherence to the Mediterranean dietary pattern (in a national study) was equivalent to the adherence to healthy dietary habits evaluated in our study: 18.8% and 18%, respectively [29].

The prevalence of food insecurity was higher among informal caregivers than among formal caregivers (44.7% vs. 27.1%, $p = 0.030$). Moreover, this prevalence among informal caregivers is higher than what is reported in the literature (24.4%) [9]. At the time our study was conducted, we only found one study that investigated food insecurity in informal caregivers, and there wasn't any article that addressed food insecurity among formal caregivers. As such, to be able to adequately discuss this topic, more studies in samples with different characteristics are necessary. Moreover, despite the fact that we can't truly know the impact of these high prevalence of food insecurity in these caregivers, in a previous research 6.9% of their sample stated that one of the main complications they had to deal because of caregiving was the economic burden [9]. In our study, food insecurity had an association with sedentarism, bigger BMI values, caregiver burden and having a middle school level when compared to lower education. In a previous study, younger ages and lower salaries had an association with caregivers' food insecurity [9]. In regard to the Portuguese population, two studies in Portugal identified that the food insecurity principal associated factor was a lower education level, which is in line with our results [29,30]. Finally, in our sample, caregiver burden scores were significantly superior in caregivers with food insecurity, compared with the food secure care providers. This association wasn't studied previously; despite that, it's known that stress related to financial problems is a risk factor for caregiver burden [31].

Concerning caregiver burden, our study revealed that this condition was present in 61.7% of informal caregivers and in 20.1% of formal caregivers. This disparity regarding the prevalence of caregiver burden among informal and formal care providers was already described in other article, of which 26.7% of formal caregivers and 45.7% of informal caregivers presented signs of mental distress [21]. Additionally, our investigation showed that caregivers had higher odds of exhibiting caregiver burden if they had a middle school education (seven up to nine years) or if they were formal caregiver. In the literature there are some studies that recognised a few factors that increase the risk of having caregiver burden, such as: sex (being a female), literacy level (low education), household (cohabitating with the person being cared), time of care provision (higher time), personal problems (depression, loneliness, financial issues and feeling reluctantly to provide care) [31]. However, more research projects regarding this theme are needed to sustain these results and to better search the relationships between the caregiver burden related factors.

Even though our investigation didn't find a significant relationship between caregivers' weight status and caregiver burden, this can be justified by the well-known fact that the relationship between stress and eating habits is complicated. In matter of fact, individuals under stress conditions can equally loose hunger or feel the need to overeat [32]. However, there's the underlying assumption that the stress related to caregiving chores may lead to caregivers to neglect their own health, thus, they may impair their weight status [28]. As a

matter of fact, a meta-analysis that incorporates longitudinal studies has demonstrated that stress is associated to a higher percentage of adiposity and to a higher risk of weight gain [32].

Limitations of the Study

This study has some limitations. Our sample has a disproportionate distribution, as just 24.6% of our caregivers are informal caregivers, which may imply a participation bias. Lastly, this is a cross-sectional study, therefore it's impossible to establish causal relationships. Accordingly, in the future, prospective cohorts and intervention studies shall be conducted to comprehend the direct impact of caregiving in caregivers' weight/nutritional status, food insecurity level and caregiver burden, as well as the relationships between these. In contrast, we highlight its original perspective as its main strength, because, so far, only a few amounts of research works have evaluated and compared informal and formal caregivers and there is no other investigation that evaluated the adequacy of these population groups' eating patterns. Hence, our study prompts to the importance to monitor this group population health status as a way to enhance it and, indirectly, improve the quality of caregivers' ability to provide care.

Conclusion

This was a cross-sectional study that included forty-seven informal and hundred and forty-four formal caregivers and aimed to determine the following conditions: 1) nutritional status; 2) food insecurity level; 3) caregiver burden. Regarding caregivers' nutrition status, informal caregivers, in comparison with formal caregivers, had a significantly higher BMI, however they weren't significantly different concerning their level of adherence to healthy food habits.

In our sample, 44.7% of informal and 27.1% of formal care providers live without food security. This food insecurity was linked to sedentarism, higher BMI values, presence of caregiver burden and having a middle school education level. Likewise, in our whole sample, caregiver burden scores were significantly superior in food insecure caregivers, compared with the food secure caregivers.

Lastly, 61.7% of informal and 20.1% of formal caregivers presented caregiver burden, for which having a middle school education level and being a formal caregiver were protective factors.

Author Disclosures

The authors report no conflicts of interest.

Funding Support

None.

Authors' Contribution

The authors' responsibilities were as follows-FC, BT, JMS and CA designed the research and drafted the manuscript; FC, BT and CA conducted the research; FC, BT, RP and CA analysed data; FC wrote this paper and had primary responsibility for final content; BT and CA reviewed and edited the paper. All authors have read and approved the manuscript.

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Volume 19 Issue 7 July 2024

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