

# Food Insecurity in Portugal during the COVID-19 Pandemic: Prevalence and Associated Sociodemographic Characteristics

Ana Aguiar<sup>a, b</sup> Isabel Maia<sup>a, b</sup> Marta Pinto<sup>c, d</sup> Raquel Duarte<sup>a, b, c, e, f</sup>

<sup>a</sup>EPIUnit - Instituto de Saúde Pública, Universidade do Porto, Porto, Portugal; <sup>b</sup>Laboratório para a Investigação Integrativa e Translacional em Saúde Populacional (ITR), Porto, Portugal; <sup>c</sup>Unidade de Investigação Clínica da ARS Norte, Porto, Portugal; <sup>d</sup>Faculdade de Psicologia e Ciências da Educação, Universidade do Porto, Porto, Portugal; <sup>e</sup>Instituto de Ciências Biomédicas Abel Salazar, Universidade do Porto, Porto, Portugal; <sup>f</sup>Serviço de Pneumologia, Centro Hospitalar de Vila Nova de Gaia/Espinho, Vila Nova de Gaia, Portugal

## Keywords

COVID-19 · Food insecurity · Pandemic · Prevalence · Public health · Sociodemographic characteristics

## Abstract

**Introduction:** The current worldwide COVID-19 pandemic has been having a considerable impact not only on health but also on the economy of societies, emphasizing food insecurity as a significant public health concern. **Aim:** The objective of this study was to characterize the scenario of food insecurity in Portugal during the COVID-19 pandemic and explore its related sociodemographic characteristics. **Methodology:** This is a cross-sectional study, using data from an online survey, performed from November 2020 until February 2021, including 882 residents aged 18 years or older in Portugal. Data on sociodemographics and food security status were collected, the latter was evaluated using the United States Household Food Security Survey Module: Six-Item Short Form. Crude and adjusted logistic regression models were performed (covariates: education, household income perception, and the working status during the COVID-19 pandemic). The odds ratio (OR) and respective 95% confi-

dence intervals (CI) were estimated. **Results:** Most participants were women (71.3%), with a mean age of 36.8 years (SD 11.0). Food insecurity prevalence was 6.8%. Less-educated individuals ( $\leq 12$  years of schooling; OR 2.966; 95% CI 1.250–7.042), and those who were and remained unemployed since the beginning of the pandemic (OR 2.602; 95% CI 1.004–6.742) had higher odds of belonging to a food-insecure household, regardless of education, working status during the COVID-19 pandemic, and household income perception. Moreover, lower odds of belonging to a food-insecure household were observed among those reporting a comfortable household income (OR 0.007; 95% CI 0.001–0.062) than those who perceived their household income as insufficient, independently of education and the working status during the COVID-19 pandemic. **Conclusions:** These findings highlight the population groups that are at a greater risk of food insecurity during the current COVID-19 pandemic. Effective public health strategies should be developed aiming to address food insecurity during this crisis, especially among the higher risk groups.

© 2022 The Author(s). Published by S. Karger AG, Basel on behalf of NOVA National School of Public Health

## Insegurança alimentar em Portugal durante a pandemia de COVID-19: prevalência e características sociodemográficas associadas

### Palavras Chave

COVID-19 · Insegurança alimentar · Pandemia · Prevalência · Saúde pública · Características sociodemográficas

### Resumo

**Introdução:** A atual pandemia mundial por COVID-19 tem vindo a causar um impacto considerável não apenas na saúde, mas também na economia das sociedades, enfatizando a insegurança alimentar como um importante problema de saúde pública. **Objetivo:** Caracterizar o cenário de insegurança alimentar em Portugal durante a pandemia por COVID-19 e explorar as características sociodemográficas relacionadas. **Metodologia:** Trata-se de um estudo transversal, que utiliza dados de um inquérito online, realizado entre novembro de 2020 a fevereiro de 2021, incluindo 882 residentes em Portugal com idade igual ou superior a 18 anos. Recolheram-se dados sociodemográficos e de situação de segurança alimentar, sendo que esta última foi avaliada por meio da escala “United States Household Food Security Survey Module: Six-Item Short Form.” Foram calculados modelos de regressão logística brutos e ajustados (covariáveis: escolaridade, perceção de rendimento familiar e situação perante o trabalho durante a pandemia de COVID-19). Foram estimados Odds Ratio (OR) e respetivos intervalos de confiança a 95% (IC). **Resultados:** A maioria dos participantes era do sexo feminino (71,3%), com média de idade de 36,8 anos (DP 11,0). A prevalência de insegurança alimentar foi de 6,8%. Indivíduos com menor escolaridade ( $\leq 12$  anos de estudo; OR 2,966; IC 95% 1,250–7,042), e aqueles que estavam e permaneceram desempregados desde o início da pandemia (OR 2,602; IC 95% 1,004–6,742) apresentaram maior odds de pertencer a um agregado familiar com insegurança alimentar, independentemente da escolaridade, situação perante o trabalho durante a pandemia por COVID-19 e perceção de rendimento familiar. Além disso e, independentemente da escolaridade e da situação perante o trabalho durante a pandemia por COVID-19, foi observado menor odds de pertencer a um agregado familiar com insegurança alimentar, aqueles que relataram perceção de rendimento familiar confortável (OR 0,007; IC 95% 0,001–0,062) comparativamente aqueles que perceberam o seu rendimento familiar como insufici-

ente. **Conclusões:** Estes resultados destacam os grupos populacionais que estão em maior risco de insegurança alimentar durante a atual pandemia por COVID-19. Estratégias eficazes de saúde pública devem ser desenvolvidas com o objetivo de endereçar a insegurança alimentar durante esta crise, especialmente entre os grupos de maior risco.

© 2022 The Author(s). Published by S. Karger AG, Basel on behalf of NOVA National School of Public Health

### Introduction

Food insecurity (FI), which can be defined “as limited or uncertain access to sufficient, nutritious food for an active, healthy life” [1], is a worldwide public health problem. Traditionally present in low- and middle-income countries, FI is also of concern among high-income countries [2, 3]. FI has been shown to lead to adverse health outcomes [4–6], such as mental health issues [7–9], poor diet quality, and non-communicable diseases, such as diabetes and cardiovascular diseases [10].

The coronavirus disease 2019 (COVID-19) pandemic has had an unprecedented impact [11] since approximately mid-March 2020, not only on the population’s health, but also on social systems worldwide [12]. The inherent social and economic response to the COVID-19 pandemic has shown a negative influence on people’s working status, causing job losses and lay-offs, which may have decreased families’ incomes [13, 14]. Taken together, these changes may lead individuals and their families to become vulnerable to FI, increasing its prevalence and related health discrepancies, particularly among already at-risk population groups. Unfortunately, the aforementioned unprecedented nature of this pandemic seems to have created a window of opportunity for new households to be affected by FI [15].

In the USA [13, 16, 17], unprecedented levels of FI have been reported. Over the past 5 years, the US Department of Agriculture estimates of FI has been between 11 and 12% [16], while during the pandemic it more than tripled to 38% [17]. In Portugal, before the pandemic, the results from a large national study, National Food and Physical Activity Survey (IAN-AF), showed that from 2015 to 2016, 10.1% of families in Portugal experienced FI [18]. From these study, it was also clear that families with monthly incomes below the national minimum wage, and families with low education levels, have significantly more FI [18]. Moreover, and considering data collected after the beginning of the COVID-19 pandemic, and in the middle of a period of universal confinement,

the ReactCOVID study, conducted by the Directorate-General for Health throughout the national territory, showed a much higher prevalence of FI – 32.3% [19].

Considering this, and in light of Goal 2 of the Sustainable Development Goals (SDGs) – “End hunger, achieve food security and improved nutrition, and promote sustainable agriculture” [20] – it is of the utmost importance to explore the impact of the COVID-19 pandemic on the population’s food security status. Therefore, this study aimed to characterize the scenario of FI in a sample of Portuguese residents during the COVID-19 pandemic and to explore its related sociodemographic characteristics.

## Methods

### *Study Design and Participants*

A virtual cross-sectional snowball sampling survey was carried out. Being a Portuguese resident with 18 years of age or older were the inclusion criteria to participate in the study. The questionnaire was prepared online and, first, it was disseminated through social networking channels, namely Facebook®, Instagram®, LinkedIn®, WhatsApp® groups, and Twitter®. Secondly, the questionnaire was disseminated by using the personal mailing lists of the researchers involved.

Recruitment took place between November 2020 and February 2021 and included 929 participants. Of those, 882 participants were included in the present study, as they had complete data on food security status. Full and detailed information on the study methodology can be found elsewhere [21].

### *Sociodemographic Characteristics*

Data on sex, age, and education were collected. Education was classified as  $\leq 12$  completed schooling years, bachelor’s degree, and master’s degree or higher. For working status, a composed variable was created based on information on working status in January 2020 and on working status during the COVID-19 pandemic, by classifying individuals as: “remained employed,” “became unemployed,” “remained unemployed,” and “other” (including students, housewives, and retired participants).

Information on marital status was also collected, and participants were classified as married or in a civil partnership or single. Household size was accounted for the number of individuals living in the same house, and was classified into three categories: “1 person,” “2 persons,” and “ $\geq 3$  persons.” Household income perception was as classified as “insufficient,” “need to be careful about expenses,” “enough to meet needs,” or “comfortable.” Participants were also asked about their parish of residency, which was categorized into NUTS II categories: North, Center, Alentejo, Lisbon Metropolitan Area, Algarve, and Islands (Azores and Madeira) [22].

Food security status was assessed using the US Household Food Security Survey Module: Six-Item Short Form [23]. Participants were asked about the food eaten in their households and whether they could afford the food they need, related to the previous 12 months. The sum of affirmative responses to the six items in the module corresponds to the household’s raw score on the scale. The individuals’ household food security status was assigned as fol-

lows: “food secure” if the number of affirmative responses was equal to or less than one, “low food secure” if between two and four affirmative answers, or “very low food secure” if the number of affirmative responses was five or six.

To complement, an open-ended question was added for participants to comment on their experiences and perceptions of food security status changes since the beginning of the COVID-19 pandemic. Despite the scale used for food security status assessment not being fully validated for the Portuguese population, previous studies among Portuguese individuals have reported good internal consistency [24, 25].

### *Statistical Analysis*

The sample characteristics were reported as counts and percentages for categorical variables, and as the mean and standard deviation (SD) for continuous variables.  $\chi^2$  or Fisher’s exact tests were employed to compare categorical variables, as appropriate. For continuous variables, Student’s *t*-test or analysis of variance were used.

Logistic regression models were performed, and the odds ratio (OR) and the respective 95% confidence intervals (CI) were computed. For these analyses, food security status as food security and FI (including low and very low food security) was used. The final model was adjusted for education, working status during the COVID-19 pandemic, and household income perception.

Data were analyzed using the Statistical Package for Social Sciences (SPSS) 26.0 (IBM Corp., Armonk, NY, USA) [26]. A significance level of 5% was used.

## Results

Most participants were women (71.3%), 76.7% had a university degree, 44.7% were married, and 65% lived in the country’s northern region. In addition, participants had a mean age of 36.8 (SD 10.9), and most were employed and had continued to be employed since the pandemic started (78.4%). Concerning the food security status of the households, 6.8% were described as being food insecure: 5.0 and 1.8% reported low and very low food security status, respectively (Table 1).

Individuals belonging to a food-insecure household were more often women ( $p = 0.072$ ), with lower education level ( $\leq 12$  years of schooling;  $p < 0.001$ ) and had a slightly higher mean age ( $p = 0.385$ ), compared with food-secure households. Also, participants from food-insecure households were more likely to remain unemployed ( $p < 0.001$ ) and to refer to the need to be careful about expenses ( $p < 0.001$ ) compared with individuals from food-secure households (Table 2).

Individuals with  $\leq 12$  years of education (OR 7.846; 95% CI 3.679–16.732), unemployed before and since the beginning of the pandemic (OR 7.898; 95% CI 3.590–17.378), and those who became unemployed (OR 4.296; 95% CI 2.025–9.111) were significantly more likely to experience FI (Ta-

**Table 1.** Sociodemographic characteristics of the studied sample ( $n = 882$ )

Sex	
Female	627 (71.3)
Male	253 (28.7)
Age, years	36.8±11.0
Education level	
≤12 years	203 (23.3)
Bachelor's degree	310 (35.5)
Master's degree or superior	360 (41.2)
Marital status	
Married/in a civil partnership	393 (44.7)
Not married	486 (55.3)
Parish of residence	
North	564 (65.0)
Center	92 (10.6)
Alentejo	11 (1.3)
Lisbon Metropolitan Area	177 (20.4)
Algarve	18 (2.1)
Islands (Azores and Madeira)	6 (0.7)
Working status during the COVID-19 pandemic	
Continued employed	628 (78.4)
Become unemployed	68 (8.5)
Continued unemployed	42 (5.2)
Others	63 (7.9)
Household income perception	
Insufficient	38 (4.4)
Need to be careful about expenses	214 (24.5)
Enough to meet needs	340 (38.9)
Comfortable	281 (32.2)
Household size	
1 person	138 (15.9)
2 persons	264 (30.4)
≥3 persons	467 (53.7)
Food security status	
Food security	822 (93.2)
Very low food security	60 (6.8)
Situation regarding food has changed	
Yes	145 (23.9)
No	462 (76.1)
Positive diagnosis of COVID-19	
Yes	39 (4.5)
No	835 (95.5)

Data are presented as  $n$  (%) or the mean±SD.

ble 2). Moreover, participants reporting the need to be careful about expenses (OR 0.196; 95% CI 0.094–0.406) were less prone to belong to a food-insecure household (Table 2).

Furthermore, independent of working status during the COVID-19 pandemic and household income perception, those with lower educational levels have almost three times greater odds of being in the FI category (OR 2.966; 95% CI 1.250–7.042), compared to those in the master's degree or superior educational level group. Also,

participants who were unemployed before and since the beginning of the pandemic (OR 2.602; 95% CI 1.004–6.742) and those reporting the need to be careful about expenses (OR 0.201; 95% CI 0.085–0.475) remained more likely to be food insecure (Table 2).

## Discussion

In a sample of Portugal's residents, a prevalence of FI of 6.8% was found. Characteristics such as being less educated (≤12 years of schooling), unemployed, and having a perception of insufficient household income were observed to be associated with greater odds of being in an FI household in Portugal. Additionally, when asked about their perception of household income, we observed that those perceiving the household income as “comfortable,” “enough to meet needs,” and “need to be careful about expenses” were negatively associated with FI, compared with those who categorized their income as “insufficient.”

The prevalence of FI was lower than previously described in Portuguese households before the COVID-19 pandemic. In the IAN-AF Survey 2015–2016, a prevalence of FI of 10.1%, was reported [18]. Also, Maia et al. [24], found a higher prevalence estimate of FI in middle- and older-aged urban adults in Portugal (16.6%) at the time of the 2008 economic crisis recovery.

More recently and during the COVID-19 pandemic, Madeira (an island belonging to Portugal), estimated that 33.6% of adults and their families were at risk of FI [27]. In comparison to our sample, this group of participants was older (55.1% ≥60 years), more often reported being in a difficult or very difficult financial situation (55.1%), had a low educational level (48.3%), and 38.1% were unemployed.

Furthermore, after the beginning of the COVID-19 pandemic, and amid general lockdown, the ReactCOVID study reported a prevalence of FI, weighted for the Portuguese population, of 32.3% [19]. The prevalence found in these studies is much higher when compared to ours. However, the discrepancy in the results could be justified by the use of different scales, limiting comparisons.

Education is a crucial social determinant of health [28]. Previous studies have found that a low educational level is associated with FI [29, 30]. Concerning household income perception, previous evidence, including Portuguese studies [24, 31, 32], reported that having a low or insufficient household income is positively associated with FI. This corroborates our findings as the individuals who had the perception of a comfortable household income were less likely to belong to an FI household.



**Table 2.** Association between sociodemographic characteristics and FI

	FS (n = 822, 93.2%)	FI (n = 60, 6.8%)	p value	Crude OR (95% CI)	Adjusted OR (95% CI) <sup>a</sup>
Sex					
Male	230 (28.0)	23 (39.0)	0.072	1	1
Female	591 (72.0)	36 (61.0)		0.609 (0.353–1.050)	0.922 (0.449–1.894)
Age, years	36.8±10.9	38.0±11.9	0.385	1.010 (0.987–1.034)	1.015 (0.985–1.046)
Education level					
Master's degree or superior	351 (43.0)	9 (15.8)	<b>&lt;0.001</b>	1	1
Bachelor's degree	296 (36.3)	14 (24.6)		1.845 (0.787–4.322)	1.025 (0.383–2.745)
≤12 years	169 (20.7)	34 (59.6)		<b>7.846 (3.679–16.732)</b>	<b>2.966 (1.250–7.042)</b>
Marital status					
Married/in a civil partnership	366 (44.7)	27 (45.0)	0.963	1	1
Not married	453 (55.3)	33 (55.0)		0.978 (0.583–1.673)	0.851 (0.425–1.704)
Parish of residence					
North	528 (65.3)	36 (60.0)	0.472	1	1
Center	84 (10.4)	8 (13.3)		1.397 (0.628–3.108)	1.980 (0.737–5.321)
Alentejo	10 (1.2)	1 (1.7)		1.467 (0.183–11.777)	(–) <sup>b</sup>
Lisbon Metropolitan area	165 (20.4)	12 (20.0)		1.067 (0.542–2.098)	1.210 (0.511–2.862)
Algarve	16 (2.0)	2 (3.3)		1.833 (0.406–8.284)	3.793 (0.588–24.476)
Islands (Azores and Madeira)	5 (0.6)	1 (1.7)		2.933 (0.334–25.779)	3.046 (0.251–36.967)
Working status during the COVID-19 pandemic					
Continued employed	601 (80.2)	27 (51.9)	<b>&lt;0.001</b>	1	1
Became unemployed	57 (7.6)	11 (21.2)		<b>4.296 (2.025–9.111)</b>	1.591 (0.653–3.877)
Continued unemployed	31 (4.1)	11 (21.2)		<b>7.898 (3.590–17.378)</b>	<b>2.602 (1.004–6.742)</b>
Others	60 (8.0)	3 (5.8)		1.113 (0.328–3.777)	0.456 (0.091–2.292)
Household income perception					
Insufficient	19 (2.3)	19 (32.2)	<b>&lt;0.001</b>	1	1
Need to be careful about expenses	179 (22.0)	35 (59.3)		<b>0.196 (0.094–0.406)</b>	<b>0.201 (0.085–0.475)</b>
Enough to meet needs	336 (41.3)	4 (6.8)		<b>0.012 (0.004–0.038)</b>	<b>0.021 (0.006–0.074)</b>
Comfortable	280 (34.4)	1 (1.7)		<b>0.004 (0.000–0.028)</b>	<b>0.007 (0.001–0.062)</b>
Household size					
1 person	130 (16.0)	8 (14.0)	0.921	1	1
2 persons	246 (30.3)	18 (31.6)		1.189 (0.503–2.808)	1.266 (0.423–3.790)
≥3 persons	436 (53.7)	31 (54.4)		1.155 (0.518–2.575)	1.013 (0.370–2.772)

Data are presented as n (%) or the mean ± SD. Bold values are statistically significant. 1 = reference. FI, food insecurity; FS, food security. <sup>a</sup> Adjusted for education, working status during the COVID-19 pandemic and household income perception. <sup>b</sup> OR <0.001.

Unemployed individuals showed a 2.6 greater odds of belonging to an FI household. It has been reported that being employed is consistently associated with lower odds of FI [33, 34]. Thus, this not only supports our findings, but previous research in Portugal has also stated that unemployed individuals were more likely to be food insecure [30].

Some limitations of this study should be mentioned. Given the limited resources available and time sensitivity of the COVID-19 outbreak, we adopted the snowball sampling strategy. The strategy was not based on a random selection of the sample, and the included sample may not reflect the actual pattern of the general population. Thus, the possibility of selection bias cannot be dis-

carded. Nevertheless, the snowball sampling method is still very valuable and convenient nowadays – such as during the COVID-19 pandemic – in overcoming constraints due to the governments' social physical distance measures. Also, the current data were collected through an online survey. Thus, there may be an underrepresentation of some groups of the population, such as those who were also more likely to experience FI, which cannot be discarded [35]. Moreover, all data collected in the survey were self-reported, which may be subject to social desirability bias. Despite this possibility of social desirability bias, the fact that the survey was completed online and no personal information allowed for the identification of the participants could diminish this concern. Also, because

this study has a cross-sectional design, inferences about causality cannot be made. Furthermore, despite the scale used for the food security status assessment not being fully validated for Portugal, previous Portuguese studies have reported good internal consistency [24, 25].

The COVID-19 pandemic has had wide-ranging impacts on the lives of Portuguese residents, including increased health risks and disruptions to employment, schooling, and daily routines [36]. This study relies on data collected over 3 months when many lockdown measures were applied across the entire country and aimed to examine the association between household FI and sociodemographic characteristics.

As for the strengths of this study, it can be pointed out that our study provides timely and important insights on the burden of FI during the pandemic. Indeed, before the onset of the COVID-19 pandemic, the SDGs highlighted the relevance of monitoring and reducing FI [37]. COVID-19 posed the threat of aggravation of FI and alterations of the SDGs goals, namely through food supply chain disruptions that create higher food prices and food shortage, especially in countries already affected by high levels of FI [38]. Additionally, school children faced the lack of proper meals with the interruption of classes [39]. Our study provides a relevant contribution regarding the scenario of FI and the identification of its sociodemographic associates during the COVID-19 pandemic, even using a younger and highly educated sample of adults.

## Conclusion

Although the FI prevalence found was lower than those previously described in Portuguese households, this research concluded that FI is a critical aspect that affected the social and environmental status before the pandemic. Individuals with a lower educational level, who were unemployed before the pandemic, and those who became unemployed after the pandemic started, were significantly more prone to experience FI. The findings of this study also highlight the relevance of the development of public health policies to deal with this issue to promote food security, which is of the utmost relevance for the accomplishment of Goal 2 of the SDGs.

## Acknowledgements

We would like to thank all of the participants who answered the questionnaire. This research initiative would not be possible without your participation.

## Statement of Ethics

Ethical approval was obtained from the Ethics Committee of the Institute of Public Health of the University of Porto (CE20166). By accessing the questionnaire through the link, all participants were asked to give their informed consent according to the Ethical Principles for Medical Research involving human subjects expressed in the Declaration of Helsinki and the current national legislation. The questionnaire was confidential, and no data allowing personal identification were collected.

## Conflict of Interest Statement

The authors declare that there are no conflicts of interest.

## Funding

This work was financed by Portuguese Funds through FCT – Foundation for Science and Technology, I.P., under the projects UIDB/04750/2020 and LA/P/0064/2020. This study was also supported by the PhD Grant 2020.09390.BD of Ana Aguiar, co-funded by the Fundação para a Ciência e a Tecnologia (FCT) and the Fundo Social Europeu (FSE) Program. Isabel Maia holds a PhD Grant (Ref. SFRH/BD/117371/2016), co-funded by the FCT and the POCH/FSE Program. The funders had no role in study design, data collection and analysis, decision to publish, or manuscript preparation.

## Author Contributions

A.A., M.P., and R.D. formulated the initial research questions and study methodology. All authors contributed to refining the research and study methodology. A.A. and I.M. were responsible for data analysis. All authors were involved in data interpretation. A.A. wrote the first draft of the paper. I.M., M.P., and R.D. reviewed the document. All authors provided inputs on and approved the final version of the manuscript.

## Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author, Ana Aguiar. The data are not publicly available since the data that were collected by the corresponding author is part of her PhD project in Public Health that is currently in the second year. For this reason, the databases cannot be shared now. The materials (scales and questionnaire) used in the research are available. The materials can be obtained from the research protocol published in the article by Aguiar et al. [21] or by e-mailing the corresponding author.

## References

- 1 Food and Agriculture Organization. *An introduction to the basic concepts of food security*. Rome: FAO Food Security Programme, Food and Agriculture Organization, The United Nations; 2008.
- 2 Holben DH, Taylor CA. Food insecurity and its association with central obesity and other markers of metabolic syndrome among persons aged 12 to 18 years in the United States. *J Am Osteopath Assoc*. 2015;115(9):536–43.
- 3 Martin-Fernandez J, Grillo F, Parizot I, Cailavet F, Chauvin P. Prevalence and socioeconomic and geographical inequalities of household food insecurity in the Paris region, France, 2010. *BMC Public Health*. 2013;13:486.
- 4 Bruening M, Dinour LM, Chavez JBR. Food insecurity and emotional health in the USA: a systematic narrative review of longitudinal research. *Public Health Nutr*. 2017;20(17):3200–8.
- 5 Gundersen C, Ziliak JP. Food insecurity and health outcomes. *Health Aff*. 2015;34(11):1830–9.
- 6 Pooler JA, Hartline-Grafton H, DeBor M, Sudore RL, Seligman HK. Food insecurity: a key social determinant of health for older adults. *J Am Geriatr Soc*. 2019;67(3):421–4.
- 7 Hadley C, Tegegn A, Tessema F, Asefa M, Galea S. Parental symptoms of common mental disorders and children's social, motor, and language development in sub-Saharan Africa. *Ann Hum Biol*. 2008;35(3):259–75.
- 8 Hadley C, Tegegn A, Tessema F, Cowan JA, Asefa M, Galea S. Food insecurity, stressful life events and symptoms of anxiety and depression in east Africa: evidence from the Gilgel Gibe growth and development study. *J Epidemiol Community Health*. 2008;62(11):980–6.
- 9 Sorsdahl K, Slopen N, Siefert K, Seedat S, Stein DJ, Williams DR. Household food insufficiency and mental health in South Africa. *J Epidemiol Community Health*. 2011;65(5):426–31.
- 10 Nkambule SJ, Moodley I, Kuupiel D, Mashamba-Thompson TP. Association between food insecurity and key metabolic risk factors for diet-sensitive non-communicable diseases in sub-Saharan Africa: a systematic review and meta-analysis. *Sci Rep*. 2011;11:5178.
- 11 Kaiser Family Foundation. *State data and policy actions to address coronavirus [Internet]*. San Francisco: Kaiser Family Foundation; 2020. Available from: <https://www.kff.org/health-costs/issue-brief/state-data-and-policy-actions-to-address-coronavirus/> (accessed March 2020).
- 12 Findlay L, Arim R. *Canadians report lower self-perceived mental health during the COVID-19 pandemic*. Ottawa: Statistics Canada; 2020.
- 13 ILO. *The impact of the COVID-19 pandemic on jobs and incomes in G20 economies [Internet]*. Geneva: International Labour Organization; 2020. Available from: [https://www.ilo.org/wcmsp5/groups/public/---dgreports/---cabinet/documents/publication/wcms\\_756331.pdf](https://www.ilo.org/wcmsp5/groups/public/---dgreports/---cabinet/documents/publication/wcms_756331.pdf) (accessed March 2020).
- 14 Paes Mamede R, Simões A. *Portugal: uma análise rápida do impacto da COVID-19 na economia e no mercado de trabalho [Internet]*. Geneva: Organização Internacional do Trabalho; 2020. Available from: [https://www.ilo.org/wcmsp5/groups/public/---europe/---ro-geneva/---ilo-lisbon/documents/publication/wcms\\_754606.pdf](https://www.ilo.org/wcmsp5/groups/public/---europe/---ro-geneva/---ilo-lisbon/documents/publication/wcms_754606.pdf) (accessed June 2020).
- 15 Wolfson JA, Leung CW. Food insecurity and COVID-19: disparities in early effects for US adults. *Nutrients*. 2020;12(6):e1648.
- 16 Coleman-Jensen A, Rabbitt MP, Gregory CA, Singh A. *Household food security in the United States in 2018*. Washington: Economic Research Service, United States Department of Agriculture; 2019.
- 17 Fitzpatrick KM, Drawwe G, Harris C, Drawwe G. *Assessing U.S. food insecurity in the United States during COVID-19 pandemic [Internet]*. Fayetteville: Fulbright College of Arts & Sciences, University of Arkansas; 2020. Available from: [https://fulbright.uark.edu/departments/sociology/research-centers/community-family-institute/\\_resources/community-and-family-institute/ revised-assessing-food-insecurity-brief.pdf](https://fulbright.uark.edu/departments/sociology/research-centers/community-family-institute/_resources/community-and-family-institute/ revised-assessing-food-insecurity-brief.pdf) (accessed May 2020).
- 18 Lopes C, Torres D, Oliveira A, Severo M, Alarcão V, Guiomar S, et al. *Inquérito alimentar nacional e de atividade física, IAN-AF 2015-2016: relatório de resultados [Internet]*. Porto: Universidade do Porto; 2017. Available from: <https://ian-af.up.pt/> (accessed May 2020).
- 19 Ministério da Saúde; Direção-Geral da Saúde. *React-Covid inquérito sobre alimentação e atividade física em contexto de contenção social [Internet]*. Lisbon: Direção-Geral da Saúde; 2020. Available from: [https://www.dgs.pt/programa-nacional-para-a-promocao-da-atividade-fisica/ficheiros-externos-pnpaf/rel\\_resultados-survey-covid-19-pdf.aspx](https://www.dgs.pt/programa-nacional-para-a-promocao-da-atividade-fisica/ficheiros-externos-pnpaf/rel_resultados-survey-covid-19-pdf.aspx) (accessed June 2020).
- 20 United Nations. *The 17 goals: sustainable development goals [Internet]*. New York: Department of Economic and Social Affairs; 2021. Available from: <https://sdgs.un.org/goals> (accessed May 2020).
- 21 Aguiar A, Pinto M, Duarte R. Psychological impact of the COVID-19 pandemic and social determinants on the Portuguese population: protocol for a web-based cross-sectional study. *JMIR Res Protoc*. 2021;10(10):e28071.
- 22 Statistics Portugal. *Administrative division [Internet]*. Lisbon: Statistics Portugal; 2021. Available from: [https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine\\_cont\\_inst&INST=6251038&xlang=pt](https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_cont_inst&INST=6251038&xlang=pt) (accessed May 2021).
- 23 United States Department of Agriculture. *U.S. household food security survey module: six-item short form*. Washington: Economic Research Service, US Department of Agriculture; 2012. Available from: <https://www.ers.usda.gov/media/8282/short2012.pdf> (accessed May 2021).
- 24 Maia I, Monjardino T, Frias B, Canhão H, Branco JC, Lucas R, et al. Food insecurity in Portugal among middle-and older-aged adults at a time of economic crisis recovery: prevalence and determinants. *Food Nutr Bull*. 2019; 40(4): 504–13. <https://doi.org/10.1177/0379572119858170>.
- 25 Maia I, Monjardino T, Lucas R, Ramos E, Santos AC. Household food insecurity and socio-demographic determinants in young adults: findings from a Portuguese population-based sample. *Int J Public Health*. 2019;64(6):887–95.
- 26 IBM. *IBM SPSS statistics for windows: version 26*. Armonk: IBM; 2019.
- 27 Costa L, Henriques E, Esmeraldo T. COVID-19: risco de insegurança alimentar e fatores associados na Madeira. *Acta Port de Nutr*. 2020;23:6–12.
- 28 The Lancet Public Health. Education: a neglected social determinant of health. *Lancet Public Health*. 2020;5(7):e361. [http://dx.doi.org/10.1016/S2468-2667\(20\)30144-4](http://dx.doi.org/10.1016/S2468-2667(20)30144-4).
- 29 Dastgiri S, Mahdavi R, TuTunchi H, Faramarzi E. Prevalence of obesity, food choices and socio-economic status: a cross-sectional study in the north-west of Iran. *Public Health Nutr*. 2006;9(8):996–1000.
- 30 Gregório MJ, Rodrigues AM, Graça P, Sousa RD, Dias SS, Branco JC, et al. Food insecurity is associated with low adherence to the Mediterranean diet and adverse health conditions in Portuguese adults. *Front Public Health*. 2018; 6: e38. <https://doi.org/10.3389/fpubh.2018.00038>.
- 31 Alvares L, Amaral TF. Food insecurity and associated factors in the Portuguese population. *Food Nutr Bull*. 2014;35(4):395–402.
- 32 Gooding HC, Walls CE, Richmond TK. Food insecurity and increased BMI in young adult women. *Obesity*. 2012;20(9):1896–901.
- 33 Gunderson C, Ziliak JP. Food insecurity research in the United States: where we have been and where we need to go. *Appl Econ Perspect Policy*. 2017;40(1):119–135.
- 34 Loopstra R, Reeves A, Tarasuk V. The rise of hunger among low-income households: an analysis of the risks of food insecurity between 2004 and 2016 in a population-based study of UK adults. *J Epidemiol Community Health*. 2019;73(7):668–73.

- 35 Perrin A, Atske S. [7% of Americans don't use the Internet: who are they?](#) Washington: Pew Research Center; 2021. <https://www.pewresearch.org/fact-tank/2021/04/02/7-of-americans-dont-use-the-internet-who-are-they/> (accessed May 2021).
- 36 Carmo R, Tavares I, Cândido AF, editors. *Uwasm olhar sociológico sobre a crise Covid-19 em livro*. Lisbon: Observatório das Desigualdades. CIES-Iscte; 2020. <https://www.observatorio-dasdesigualdades.com/2020/11/29/umolharsociologicosobreacovid19emlivro/> (accessed May 2021).
- 37 Food and Agriculture Organization; International Fund for Agricultural Development; UNICEF; World Food Program; WHO. [The state of food security and nutrition in the world 2020](#). Rome: Food and Agriculture Organization; 2020.
- 38 Cruz NM, Almeida FP, Nayal MB. [The impact of COVID-19 on the Sustainable Development Agenda: a business opportunity to reframe success](#). Lisbon: Center for Responsible Business and Leadership, Católica Lisbon School of Business and Economics; 2020. Available from: <https://intra.clsbe.lisboa.ucp.pt/research-note-the-impact-of-covid-19-on-the-sustainable-development-agenda-a-business-opportunity-to-reframe-the-future->.
- 39 Borkowski A, Ortiz Correa JS, Bundy DAP, Burbano C, Hayashi C, Lloyd-Evans E, et al. [COVID-19: missing more than a classroom: the impact of school closures on children's nutrition](#). Florence: UNICEF Office of Research – Innocenti, World Food Programme, United Nations; 2021. Innocenti Working Paper (WP-2021-01).