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Food Insecurity Trajectories and Health Service Utilization: Longitudinal Evidence and Population Impact Among Adults and Older Adults in Southern Brazil

Mauren de Castro Ritta
Universidade Federal do Rio Grande
Rosália Garcia Neves
rosaliagarcianeves@gmail.com
Universidade Federal do Rio Grande
Eduardo Peglow
Universidade Federal do Rio Grande
Suele Manjourany Silva Duro
Universidade Federal de Pelotas
Mirelle de Oliveira Saes
Universidade Federal do Rio Grande

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Abstract

This study investigated the association between food and nutrition insecurity (FNI) trajectories and health service utilization among adults and older adults in southern Brazil. We conducted a longitudinal analysis of data from the SulCovid-19 study in Rio Grande, Rio Grande do Sul, Brazil, collected at baseline (2020–2021) and the first follow-up (2022–2023). The analysis included 2,929 participants at baseline and 1,927 at follow-up, all of whom had laboratory-confirmed COVID-19. FNI was assessed using the short version of the Brazilian Food Insecurity Scale. The outcomes included utilization of health services, including Primary Health Care Units, Emergency Care Units, and public and private emergency departments. We estimated prevalence and 95% confidence intervals (95% CI), performed chi-square tests and Poisson regression, and calculated population attributable fractions (PAFs). Persistent FNI was reported by 20.9% (95% CI: 19.1–22.8) of participants. Participants with persistent FNI were more likely to use Emergency Care Units (PR = 1.40; 95% CI: 1.23–1.59), Primary Health Care Units (PR = 1.19; 95% CI: 1.07–1.32), and emergency departments (PR = 1.99; 95% CI: 1.40–2.83). The PAF estimates suggested that eliminating FNI could reduce utilization of public emergency departments by up to 21% (95% CI: 0.06–0.35), Emergency Care Units by 10% (95% CI: 0.04–0.15), and Primary Health Care Units by 7% (95% CI: 0.02–0.11). FNI trajectories constitute an important indicator of social vulnerability and are associated with greater utilization of public health services. Systematic assessment of FNI in Primary Health Care, together with food and nutrition security policies, may improve population health and reduce pressure on the public health system.

Introduction

Food and nutrition insecurity (FNI) represents a condition of social, economic, and health vulnerability characterized by a lack of regular and sustained access to food of adequate quantity and quality (1). This condition is associated with mal- and undernutrition and may progress to hunger and nutritional deficiencies (2). Furthermore, FNI may contribute to the development of several diseases, including non-communicable diseases (NCDs), mental health disorders, and increased mortality because affected populations are more frequently exposed to inadequate food environments (3–5).

Brazil was removed from the United Nations (UN) Hunger Map for the first time in 2014, marking an important achievement. In subsequent years, however, public policies targeting vulnerable populations were weakened, including the Bolsa Família Program and the National Council for Food and Nutrition Security (CONSEA) (6). In this context, the Second National Survey on Food Insecurity in the Context of the COVID-19 Pandemic in Brazil (VIGISAN), conducted in 2021/2022, revealed a critical scenario in which FNI affected more than half of Brazilian households, while hunger exceeded 15.0% of the Brazilian population (7). This deterioration can be attributed in part to restrictions imposed during the COVID-19 pandemic, economic downturn, and rising unemployment, which adversely affected food production, availability, and access (8, 9). More recent studies indicate that severe FNI declined to 3.2% in 2024 and that Brazil was subsequently removed from the Hunger Map again, consistent with a United Nations

report estimating that < 2.5% of the Brazilian population was at risk of undernutrition or insufficient access to food (9, 10).

FNI is a marker of social vulnerability because it reflects multiple forms of socioeconomic deprivation and may influence health service utilization (11). Although the Unified Health System (SUS) guarantees the right to comprehensive healthcare, equitable access remains uncertain. A systematic review and meta-analysis found that individuals experiencing FNI had higher odds of hospitalization (OR = 1.44; 95% CI: 1.26–1.66) and emergency department visits (OR = 1.61; 95% CI: 1.39–1.87) (11). Similarly, a cohort study found that these individuals had more hospitalization days (IRR = 1.54; 95% CI: 1.06–2.24). These findings suggest that FNI is associated with poor health conditions and delayed use of health services, thereby increasing the use and costs of higher-complexity healthcare services (12).

In Brazil, where profound social inequalities coexist with a universal public healthcare system, understanding the relationship between FNI and health service utilization is essential for public policy planning. Primary Health Care (PHC) represents the main entry point to the healthcare system, whereas utilization of emergency care units and emergency departments may reflect worsening health conditions or barriers to timely preventive care (13). Therefore, this study aimed to examine the association between FNI trajectories and the utilization of different health services among adults and older adults in southern Brazil and to estimate the population attributable fraction (PAF) of FNI for the utilization of these services.

Methods

This longitudinal study was conducted in Rio Grande, a coastal port city in southern Brazil near the Uruguayan border. The municipality has an estimated population of 191,900 inhabitants and a Human Development Index (HDI) of 0.744, classified as high and similar to the national value of 0.724 during the same period (14). Its Gini index is 0.51, slightly lower than the national value of 0.60 but remains indicative of substantial income inequality (15).

The SulCovid-19 study was designed to investigate health indicators, pathways to COVID – 19 diagnosis, and differences in socioeconomic characteristics, major symptoms, and disease-related impairments. The study comprised two time points: baseline and the first follow-up. The present analysis used baseline data collected between June and October 2021 and first follow-up data collected between October 2022 and May 2023.

Eligible participants were aged ≥ 18 years, resided in the municipality, had symptomatic SARS-CoV-2 infection during the acute phase, and received a positive RT-PCR test result between December 2020 and March 2021. Individuals diagnosed in the municipality but residing in another city, individuals in the prison system, and those with cognitive limitations that prevented study participation were excluded.

The municipal epidemiological surveillance service provided a list of 4,014 individuals with positive RT-PCR results, including their names, addresses, telephone numbers, and symptom status. After

individuals with incomplete data were excluded, 3,822 were considered eligible for the baseline study, of whom 2,929 were interviewed. All baseline participants were contacted for follow-up, and data were obtained from 1,927 participants. At both time points, initial contact was attempted by telephone. When there was no response, a WhatsApp message was sent; if contact remained unsuccessful, a household visit was conducted. Participants who could not be located after five telephone contact attempts, one WhatsApp attempt, and three household visits at different times were considered lost to follow-up.

Data were collected using structured electronic questionnaires administered through REDCap and adapted for telephone or household interviews. Previously trained interviewers conducted all interviews. Further details of the SulCovid-19 study methodology are provided by Saes et al. (16). The study was approved by the Health Research Ethics Committee (CEPAS) of the Federal University of Rio Grande (FURG) (Certificate of Presentation for Ethical Review: 39081120.0.0000.5324).

Health service utilization was assessed using the following question: "Since our last interview until now, how many times have you needed to receive care at a health service?" The question was asked separately for eachservice type: Primary Health Care Unit, public emergency department, Emergency Care Unit, and private emergency department. Responses were recorded as the number of visits and dichotomized as "No" (0 visits) or "Yes" (one or more visits).

FNI was assessed using five questions from the short version of the Brazilian Food Insecurity Scale (EBIA) (17): 1) In the last 3 months, were you worried that the food in your household would run out before you had the means to buy, receive, or produce more food?; 2) In the last 3 months, did the food run out before you had enough money to buy more?; 3) In the last 3 months, did you lack money to have a healthy and varied diet?; 4) In the last 3 months, did you or any adult in your household ever reduce the amount of food at meals or skip meals because there was not enough money to buy food?; 5) In the last 3 months, did you ever eat less than you thought you should because there was not enough money to buy food? The response options were yes or no, allowing identification of whether Food and Nutrition Security (FNS) was compromised. FNI was defined as an affirmative response to at least one of the five questions. A trajectory variable combining FNI status at the two study periods (during and after the pandemic) was constructed to assess its association with the outcomes. The variable comprised four categories: persistent FNS (did not have FNI and continued not having it); recovery from FNI (had FNI and no longer had it); onset of FNI (did not have FNI and subsequently developed it); and persistent FNI (had FNI and continued having it).

All analyses were performed using Stata® version 15.0. Prevalence estimates and 95% confidence intervals (95% CI) were calculated for each outcome overall and according to FNI trajectory, and distributions were compared using the chi-square test. Poisson regression was used to estimate crude and adjusted prevalence ratios (PRs) and 95% CIs for the outcomes (health services) according to the exposure (FNI trajectory). The adjusted model included the variables sex, age, skin color, educational attainment, and employment in the previous month. PAF was also calculated to estimate the proportion of each outcome attributable to the exposure. The attributable fraction (AF) was calculated as AF = (PR

− 1) / PR, with FNI considered a risk factor. Additionally, to estimate the population attributable fraction (PAF), the prevalence of the exposure in the population was incorporated using the expression PAF = Pe (PR − 1) / [Pe (PR − 1) + 1], where Pe represents the proportion of exposed individuals. CIs were obtained using bootstrap resampling to improve the robustness of the estimates.

Results

A total of 3,822 individuals were selected to participate in the study. Of these, 2,919 were assessed at baseline (903 losses and refusals), and 1,927 completed the first follow-up (970 losses and refusals and 23 deaths), corresponding to a follow-up rate of 65.8%. Table 1 presents the characteristics of the baseline sample, the follow-up sample, and participants lost to follow-up. All three groups were predominantly female, aged 18–59 years, self-identified as White, had completed secondary education, and had paid employment in the previous month. The distributions were similar across groups, suggesting that attrition did not materially alter the measured characteristics of the follow-up sample.

Table 1
Sociodemographic and health characteristics of adults and older adults infected with SARS-CoV-2 at baseline (2021; n = 2,919) and the first follow-up (2023; n = 1,927), together with an analysis of loss to follow-up. SulCovid-19 Study, Rio Grande, Rio Grande do Sul, Brazil, 2020–2023.

Variables	Baseline	First follow-up	Loss to follow-up
	n = 2,919	n = 1,927	n = 970
	n (%)	n (%)	n (%)
Sex			
Male	1208(41.4)	739 (38.8)	451 (46.5)
Female	1711(58.6)	1167 (61.2)	519 (53.5)
Age			
18–59 years	2420 (83.3)	1518 (79.7)	821 (85.4)
≥ 60 years	484 (16.7)	387 (20.3)	140 (14.6)
Skin color			
White	2254 (77.9)	1471 (77.6)	740 (77.4)
Black, Brown, Yellow, and other	640 (22.1)	424 (22.4)	216 (22.6)
Education			
Never attended school	15 (0.5)	9 (0.5)	6 (0.6)
Primary education	713 (24.9)	474 (25.3)	230 (24.3)
Secondary education	1264 (44.2)	811 (43.2)	433 (45.8)
Higher education	871 (30.4)	581 (31.0)	277 (29.3)
Paid work in the previous month			
Yes	2189 (77.1)	1459 (77.4)	712 (76.4)
No	651 (22.9)	427 (22.6)	220 (23.6)

Figure 1 shows the prevalence of health service utilization, and Table 2 presents the distribution of FNI trajectories. Overall, 51.6% (95% CI: 49.3–53.9) of participants remained without FNI at both time points, 14.1% (95% CI: 12.6–15.8) had FNI at baseline but not at follow-up, 13.4% (95% CI: 11.9–15.0) developed FNI at follow-up, and 20.9% (95% CI: 19.1–22.8) had FNI at both time points (Table 2). Primary Health Care Units were the most frequently used service (58.7%; 95% CI: 56.4–61.0), followed by private emergency departments (46.8%; 95% CI: 44.5–49.2), Emergency Care Units (45.2%; 95% CI: 42.9–47.5), and public emergency departments (10.1%; 95% CI: 8.7–11.5).

Table 2
Distribution of food and nutrition insecurity trajectories according to health service utilization among adults and older adults in southern Brazil. SulCovid-19 Study, Rio Grande, Rio Grande do Sul, Brazil, 2020–2023 (n = 1,716).

Variables	Food and nutrition insecurity trajectory			
	Persistently food secure (No FNI → No FNI)	Exit from FNI (FNI → No FNI)	Entry into FNI (No FNI → FNI)	Persistent FNI (FNI → FNI)
	% (IC95%)	% (IC95%)	%(IC95%)	%(IC95%)
Overall	51.6 (49.3;53.9)	14.1 (12.6;15.8)	13.4 (11.9;15.0)	20.9 (19.1;22.8)
Primary Health Care Unit	47.0 (43.9–50.1)	15.2 (13.1–17.5)	14.1 (12.1–16.4)	23.7 (21.2–26.5)
Emergency Department	38.1 (31.2–45.5)	9.7 (6.0–15.0)	17.6 (12.7–24.0)	34.7 (28.0–42.0)
Emergency Care Unit	45.6 (42.1–49.0)	15.0 (12.6–17.6)	12.4 (10.3–14.9)	27.0 (24.0-30.2)
Private Emergency Department	59.8 (56.4–63.1)	12.5 (10.4–15.0)	12.9 (10.8–15.4)	14.7 (12.5–17.3)

Among participants who used Primary Health Care Units, 23.7% (95% CI: 21.2–26.5) had persistent FNI. The corresponding proportions among users of public emergency departments, Emergency Care Units, and private emergency departments were 34.7% (95% CI: 28.0–42.0), 27.0% (95% CI: 24.0–30.2), and 14.7% (95% CI: 12.5–17.3), respectively (Table 2).

In the adjusted analysis, onset of FNI was associated with a 13% higher prevalence of Primary Health Care Unit utilization (PR = 1.13; 95% CI: 1.01–1.28) and a 63% higher prevalence of public emergency department utilization (PR = 1.63; 95% CI: 1.06–2.49). Persistent FNI was associated with 19% and 99% higher prevalence of Primary Health Care Unit and public emergency department utilization, respectively (PR = 1.19; 95% CI: 1.07–1.32 and PR = 1.99; 95% CI: 1.40–2.83), as well as a 40% higher prevalence of Emergency Care Unit utilization (PR = 1.40; 95% CI: 1.23–1.59). Conversely, recovery from FNI and persistent FNI were associated with 19% (PR = 0.81; 95% CI: 0.69–0.95) and 31% (PR = 0.69; 95% CI: 0.59–0.81) lower prevalence of private emergency department utilization, respectively.

Table 3 also presents the PAF for each outcome, representing the proportion of health service utilization that might not have occurred if FNI had been eliminated from the population while other factors remained constant. The estimated PAF was 21% for public emergency department utilization (95% CI:

6.0–35.0%), 10% for Emergency Care Unit utilization (95% CI: 4.0–15.0%), and 7% for Primary Health Care Unit utilization (95% CI: 2.0–11.0%).

Table 3
Adjusted associations between food and nutrition insecurity trajectories and health service utilization, with population attributable fraction (PAFs), among adults and older adults in southern Brazil. SulCovid-19 Study, Rio Grande, Rio Grande do Sul, Brazil, 2020–2023 (n = 1,716).

Variables	**Food and nutrition insecurity trajectory**				
	Persistently food secure (No FNI → No FNI)	**Exit from FNI (FNI → No FNI)**	**Entry into FNI (No FNI → FNI)**	**Persistent FNI (FNI → FNI)**	**Population Attributable Fraction (PAF)**
	RP (IC95%)	RP (IC95%)	RP (IC95%)	RP (IC95%)	FAP (%) (IC95%)
Overall	1	1.11 (0.98–1.25)	1.13 (1.01–1.28)	1.19 (1.07–1.32)	7.0 (2.0–11.0)
Primary Health Care Unit	1	0.76 (0.44–1.30)	1.63 (1.06–2.49)	1.99 (1.40–2.83)	21.0 (6.0–35.0)
Emergency Department	1	1.12 (0.96–1.32)	1.03 (0.87–1.23)	1.40 (1.23–1.59)	10.0 (4.0–15.0)
Emergency Care Unit	1	0.81 (0.69–0.95)	0.88 (0.75–1.02)	0.69 (0.59–0.81)	-11.0 (-16.0-6.0)

*Adjusted for sex, age, skin color, education, and paid work in the previous month.

Discussion

FNI trajectories were associated with health service utilization among adults and older adults in southern Brazil, particularly with the use of public services during the COVID-19 pandemic. Participants who developed FNI or remained in this condition were more likely to use Primary Health Care Units, public emergency departments, and Emergency Care Units, suggesting a gradient according to the persistence of FNI. The PAF estimates indicated that a substantial proportion of demand for emergency services was associated with FNI. Conversely, recovery from FNI and persistent FNI were associated with lower utilization of private emergency departments, suggesting socioeconomic stratification in access to care and greater reliance on the public sector among socially vulnerable groups.

The prevalence of persistent FNI between baseline and follow-up indicates that this condition may endure, particularly in contexts of social vulnerability and health crises. During the COVID-19 pandemic, several countries experienced deterioration in food access, increased physical and mental morbidity, worsening NCDs, and poor control of pre-existing conditions, which translates into greater health service utilization across levels of care (3, 5). Approximately 41% of individuals in a South African study remained food insecure after one year of follow-up, whereas approximately 8% of participants in a Mexican study experienced persistent moderate or severe FNI over two years of the pandemic (18, 19). These findings suggest that FNI is not merely a temporary event but may persist in contexts of socioeconomic inequality.

The Brazilian and international literature reinforces that FNI is concentrated among socioeconomically disadvantaged groups and in settings with greater social inequality. Brazilian studies have found a higher prevalence of FNI among households headed by women, Black individuals, large families, and residents of poor regions (5, 20). In these settings, FNI reflects not only inadequate access to sufficient food but also precarious income, housing, employment, and access to public policies, indicating structural inequity (1, 9). Accordingly, the present findings reinforce the importance of considering FNI a social determinant of health and a marker of inequality alongside other factors that influence both the risk of illness and patterns of health service utilization (4, 7).

Primary Health Care Units were the most frequently used service, used by 58.7% of the sample, followed by private emergency departments, Emergency Care Units, and public emergency departments. This pattern underscores the central role of PHC as the main entry point to the SUS and as the coordinator of care, consistent with the National Health Policy guidelines (21, 22). Because PHC is located within communities, it supports patient-provider relationships and can address approximately 80% of health problems (21).

However, the strongest associations were observed for emergency services. Persistent FNI was associated with a 99% higher prevalence of public emergency department utilization and a 40% higher prevalence of Emergency Care Unit utilization. These associations may indicate that FNI acts as a barrier to timely preventive care or that health conditions worsened by inadequate nutrition lead individuals to seek higher-complexity health services. Similar associations between FNI and frequent emergency department utilization or higher hospitalization rates have been reported previously (23, 24).

The reorganization of health services during the pandemic is also important for interpreting these findings. Social distancing and isolation measures, the reclassification of services as “essential” or “non-essential,” and prioritization of COVID-19-related care resulted in the postponement of consultations, diagnostic tests, and procedures, particularly in Primary Health Care (PHC) and specialized outpatient clinics (25). Brazilian studies documented reductions in PHC activities, including follow-up of individuals with NCDs, which contributed to discontinuity of care and poor management of health conditions (26, 27).

Sarti et al. (22) and Lima et al. (28) demonstrated that PHC was the first point of contact with the health system for a substantial proportion of individuals with COVID-19 symptoms, reaffirming its role as the main entry point even under considerable pressure. In the present study, greater utilization of PHC Units, Emergency Care Units, and public emergency departments among participants experiencing FNI may reflect the combined effects of social vulnerability, high burden of infectious disease, and the reconfiguration of health services, which increased demand, particularly for higher-complexity care. In contrast, individuals with greater socioeconomic resources may have used the private sector to avoid perceived limitations, waiting times, or delays in accessing the public system during the pandemic (9, 29).

The PAF estimates further underscore the relevance of FNI to the sustainability of the health system. The estimates indicated that up to 21.0% of public emergency department visits, 10.0% of Emergency Care Unit visits, and 7.0% of PHC Unit visits might have been avoided if FNI had been eliminated. These findings indicate that FNI extends beyond insufficient access to food and reflects a broader set of social and economic vulnerabilities that directly affect health service utilization (11).

From a public policy perspective, these findings suggest that actions aimed at mitigating or eliminating FNI may improve population health and well-being while reducing costs and increasing health system efficiency (1, 7, 9). Relevant measures include strengthening income transfer programs, expanding food and nutrition security policies, supporting family farming, and increasing the availability of public facilities that provide access to food, such as low-cost public restaurants and community kitchens (1, 7, 9). The strengths of this study include its longitudinal design, which enabled assessment of FNI trajectories during and after the COVID-19 pandemic and their associations with the utilization of public and private health services among participants previously infected with SARS-CoV-2. The inclusion of participants from different socioeconomic strata within the municipality also enabled a broader analysis of health inequalities. Furthermore, the use of EBIA, a validated instrument widely applied in national studies, facilitates comparison with the literature and supports the robustness of the findings. Finally, calculation of the PAF provided an estimate of the potential impact of FNI on demand for health services, generating useful evidence for health planning and public policy development.

This study has some limitations including potential recall bias as some information was self-reported. Additionally, the use of telephone surveys, which was necessary because of pandemic-related restrictions, may have influenced participation and the quality of some information collected.

These findings have important social implications because they identify FNI as a marker of vulnerability associated with an additional burden on the public health system. They support systematically incorporating FNI assessment into routine healthcare practice through validated instruments. In addition to the EBIA, the Brazilian Ministry of Health recommends the use of the Food Insecurity Risk Screening Tool (Triagem para Risco de Insegurança Alimentar – TRIA) in PHC to facilitate screening. This tool helps identify families experiencing difficulty accessing food (30, 31, 32).

Conclusions

This study demonstrated that FNI trajectories were associated with greater utilization of public health services in southern Brazil. Persistent FNI showed a cumulative association with healthcare demand and represented an important marker of social vulnerability, with implications for individual health and health system sustainability. These findings reinforce the need for continued investment in FNS policies that uphold the human right to adequate food, reduce health inequities, and alleviate pressure on services within the SUS.

Declarations

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Author's contributions statement

R.G.N. performed the statistical analyses. M.C.R., R.G.N. and E.P. wrote all sections of the article and worked on the literature review. S.M.S.D. and M.O.S. critically reviewed the entire manuscript. All authors approved this version of the manuscript.

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Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available due the data are not public but are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

All research participants authorized after reading the informed free term. The consent was given via telephone before starting the questions. The subjects approved their participation in the study through informed consent, including those with no education level. People who were identified as unable to respond, due to lack of understanding or health condition, a key informant was interviewed after informed consent was provided. Informed Consent for the participation of illiterate people was also given through their legal representatives All interviews and consents were recorded. Research has minimal risk. Participation is voluntary and the respondent has the option to stop responding at any time. All information collected is confidential. All methods were carried out in accordance with relevant guidelines and regulations. The project was submitted and approved by the Ethics and Research Committee of the Federal University of Rio Grande with Opinion number 4,375,697.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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Figures

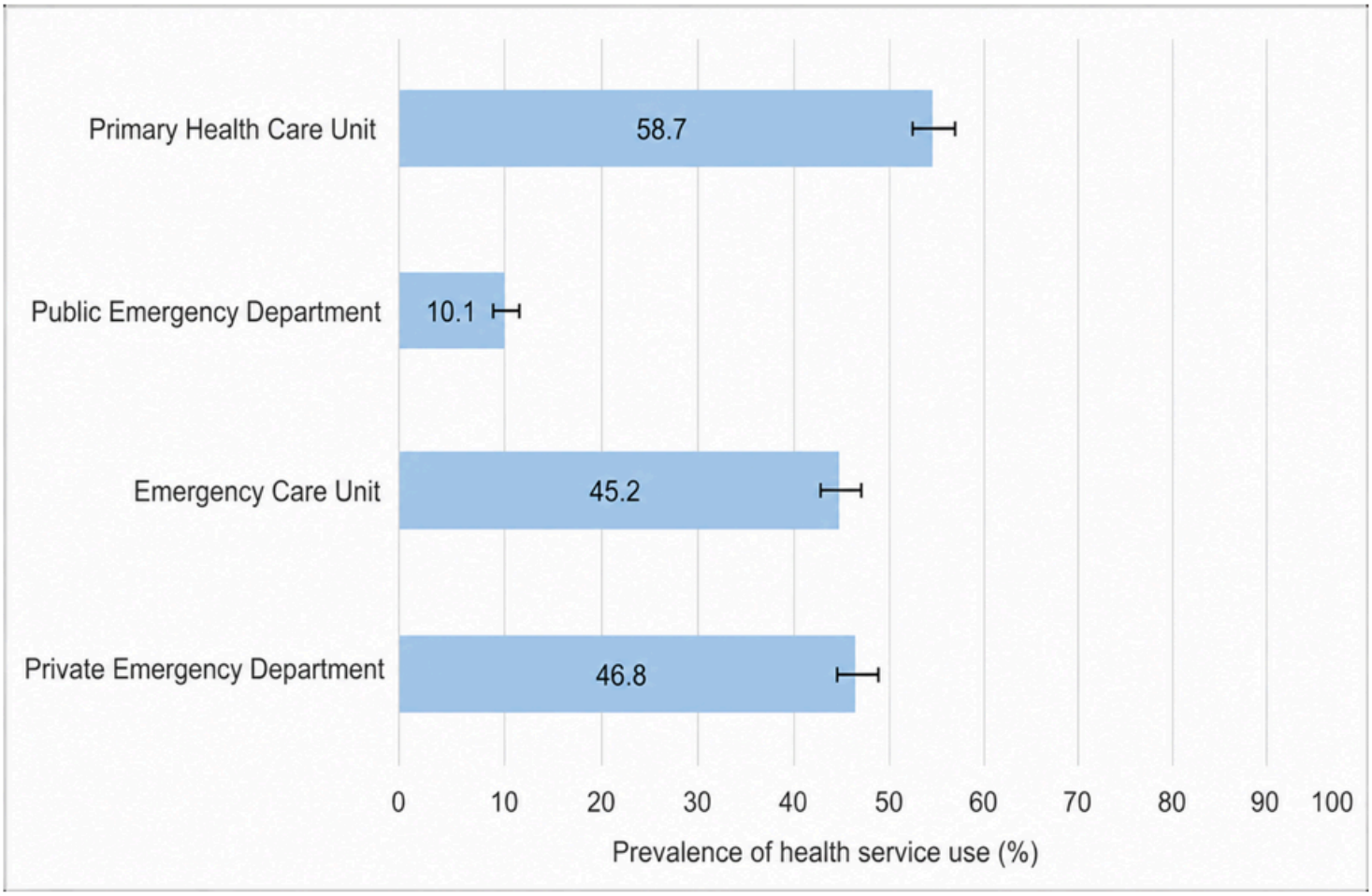


Figure 1

Prevalence of utilization of different healthcare services among adults and older adults in southern Brazil. SulCovid-19 Study, Rio Grande, Rio Grande do Sul, Brazil, 2021–2023 (n = 1,927).