

Preventive Behavior and Factors Associated with COVID-19 in Fully Vaccinated Adults: Cross-sectional Study

Comportamiento Preventivo y Factores Asociados a COVID-19 en Adultos Totalmente Vacunados: Estudio Transversal
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RESUMO

Objetivo: Avaliar fatores associados à adoção de comportamentos preventivos em uma população vacinada contra a covid-19. **Método:** Estudo transversal realizado em Guaramiranga, Ceará, primeira cidade do estado a vacinar integralmente sua população adulta. Foram entrevistados 2.830 residentes vacinados entre setembro de 2021 e dezembro de 2022. Analisaram-se variáveis sociodemográficas, clínicas e conhecimento sobre prevenção. **Resultados:** A maioria referiu lavar as mãos (65,3%) e usar máscara fora de casa (63,8%), mesmo após a vacinação (59,7%). Maior adesão ocorreu entre mulheres, adultos jovens e indivíduos com doenças crônicas ou maior conhecimento preventivo ($p < 0,05$). Baixa escolaridade associou-se a maior isolamento e distanciamento ($p < 0,05$). **Conclusão:** Mesmo com alta cobertura vacinal, comportamentos preventivos persistiram. O estudo destaca a importância da percepção de risco, do conhecimento em saúde e dos determinantes sociais na adesão contínua a medidas de proteção em contextos de alta imunização.

DESCRIPTORIOS: Covid-19; Comportamento preventivo; Percepção de risco; Educação em saúde; Imunização.

ABSTRACT

Objective: Understanding the factors influencing preventive behavior in vaccinated populations is essential for pandemic preparedness. This study assessed protective behaviors among adults vaccinated against COVID-19 in Guaramiranga, a small municipality in Ceará, Brazil, with approximately 5,073 inhabitants. Guaramiranga became the first municipality in the state to fully vaccinate its registered population, beginning on January 20, 2021. **Method:** A cross-sectional analytical study using structured digital questionnaires was conducted from September 2021 to December 2022. Outcome variables included self-reported adherence to hand hygiene, mask use, distancing, and isolation, analyzed in relation to sociodemographic characteristics, health conditions, and knowledge about SARS-CoV-2. **Result:** Among 2,830 participants (53.9% female; median age 39), the most frequent behaviors were handwashing (65.3%), mask use when leaving home (63.8%), and continued use post-vaccination (59.7%). Women and younger adults reported higher adherence ($p < 0.05$). Lower education was associated with greater isolation and distancing ($p < 0.05$), underscoring social determinants in health behavior. Individuals with chronic conditions and better knowledge about prevention were significantly more adherent. **Conclusion:** Despite full vaccination, most participants maintained preventive measures, which may have contributed to low local hospitalization and mortality rates. These findings reinforce the importance of tailored public health messaging and local preparedness efforts, particularly in socially diverse communities.

DESCRIPTORS: COVID-19; Preventive behavior; Risk perception; Health education; Immunization.

RESUMEN

Objetivo: Evaluar los factores asociados a la adopción de comportamientos preventivos en una población vacunada contra la COVID-19. **Método:** Estudio transversal realizado en Guaramiranga, Ceará, el primer municipio del estado en vacunar completamente a su población adulta. Se encuestaron 2.830 residentes vacunados entre septiembre de 2021 y diciembre de 2022. Se analizaron variables sociodemográficas, clínicas y de conocimiento preventivo. **Resultado:** La mayoría refirió lavado frecuente de manos (65,3%) y uso de mascarilla fuera del hogar (63,8%), incluso tras la vacunación (59,7%). La adherencia fue mayor entre mujeres, adultos jóvenes y personas con enfermedades crónicas o mayor conocimiento ($p < 0,05$). Menor escolaridad se asoció a más aislamiento y distanciamiento ($p < 0,05$). **Conclusión:** Apesar de la cobertura vacunal completa, se mantuvieron conductas preventivas. El estudio resalta la importancia de la percepción del riesgo, el conocimiento en salud y los determinantes sociales en la continuidad de medidas de protección en comunidades con alta inmunización.

DESCRIPTORIOS: COVID-19; Conducta preventiva; Percepción de riesgo; Educación en salud; Inmunización.

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INTRODUCTION

The COVID-19 pandemic, caused by SARS-CoV-2, constituted a serious global health emergency, revealing weaknesses in health systems and requiring coordinated responses. Non-pharmacological measures, such as social distancing, isolation, hand hygiene, and mask use, were essential, especially before mass vaccination⁽¹⁾. However, their effectiveness depended on population adherence, influenced by social, economic, and behavioral factors.

In Brazil, the pandemic highlighted profound regional inequalities. In Ceará, the first cases occurred in March 2020, and within a few weeks, the hospital network faced collapse, with increased bed occupancy. By the

end of the pandemic, the state had recorded more than 1.5 million cases and approximately 28,000 deaths.^(2,3)

As vaccination progressed in 2021, concerns arose about reduced adherence to protective measures. However, maintaining these behaviors remained crucial given the uncertainties surrounding the duration of immunity and the emergence of variants^(4,5).

Guaramiranga, a small tourist town in Ceará, was the first to achieve complete coverage of the first vaccine dose among adults, providing an opportune setting to study preventive behavior in a vaccinated population. Although the literature has explored vaccine hesitancy and initial adherence to protective measures, studies on their persistence after immuniza-

tion are scarce, especially in rural and tourist settings.

Investigating the social and behavioral determinants that underlie such practices is essential to guide health communication strategies and strengthen preparedness for future emergencies. This study aimed to describe the preventive behaviors adopted by vaccinated adults in Guaramiranga and analyze their association with sociodemographic characteristics, health conditions, and knowledge about COVID-19.

METHODS

This is a cross-sectional, population-based study with an analytical approach, carried out in the municipality of Guaramiranga, located in

the mountainous region of the state of Ceará, Brazil, between September 2021 and December 2022. The municipality has a tourist profile and had an estimated population of 5,193 inhabitants during the study period, of which 4,002 were adults aged 18 or over⁽⁶⁾. In early 2021, Guaramiranga was prioritized in the distribution of vaccines against COVID-19, receiving 5,187 first doses: 3,328 of CoronaVac (Sinovac/Instituto Butantan), 1,685 of AstraZeneca/Oxford/Fiocruz, and 174 of Pfizer–BioNTech (Comirnaty). Between March 2020 and February 2022, the municipality reported 4,663 suspected cases, with 1,565 confirmed cases and six deaths⁽²⁾.

Residents aged 18 or older who had received at least one dose of the COVID-19 vaccine ($n = 4,002$) were eligible. Recruitment occurred in person after vaccination, through invitation by trained interviewers, with an explanation of the objectives and obtaining of the Informed Consent Form. Participation was voluntary, and questions were clarified prior to collection.

Data were collected in person between September 2021 and December 2022 using a structured questionnaire with 66 items addressing sociodemographic profile, health conditions (such as smoking, alcohol use, physical activity, hypertension, and diabetes), and preventive behaviors (hand hygiene, mask use, isolation, and social distancing).

Interviews were conducted by previously trained healthcare professionals in Basic Health Units, community centers, or homes. Responses were recorded on tablets using electronic forms with automatic consistency checks, which reduced errors and enabled real-time validation.

The explanatory variables were: sex, age, education, marital status, employment status, housing conditions, smoking, alcohol consumption,

physical activity, and the presence of clinical morbidities.

The outcome variables corresponded to the adoption of protective behaviors to minimize the spread of COVID-19. Ideal behaviors were considered to include staying home during isolation, maintaining social distancing, wearing a mask, and washing hands frequently. To this end, the following were assessed: leaving home, including frequency and reasons (response to the question "What was your routine like during social isolation?"); social distancing (response to the question "Were you able to maintain social distancing?"); mask use (response to the questions "Do you wear a mask when you leave the house?" and "After being vaccinated, do you continue to wear a mask when you leave the house?"); and hand hygiene (response to the question "How often do you wash your hands with soap and water during the day?").

To verify the association between the adoption of protective behaviors against COVID-19 (not leaving home, maintaining social distancing, washing hands frequently, and wearing a mask, even after being vaccinated) and sociodemographic aspects, health conditions, and knowledge about risk factors for SARS-CoV-2 infection, the answers to the following questions were dichotomized: "What was your routine like during social isolation?" ("Left home" and "Didn't leave home"); "Were you able to maintain social distancing?" ("A lot" and "More or less/a little"); "How often do you wash your hands with soap and water during the day?" ("Frequently/sometimes" and "Never"); "When you leave home, do you wear a mask?" ("Frequently/sometimes" and "Never"); and "After being vaccinated, do you continue to wear a mask when leaving home?" ("Frequently/sometimes" and "Never").

Categorical variables were de-

scribed by absolute and relative frequencies, and their associations were tested using Pearson's chi-square or Fisher's exact test. The normality of continuous variables was assessed using the Shapiro–Wilk test and graphical inspection. Normally distributed variables were expressed as mean and standard deviation; non-normal variables were expressed as median and interquartile range. Differences between groups with asymmetric distribution were analyzed using the Mann–Whitney test. Multivariate Poisson regression models with robust variance estimated prevalence ratios (PR) and 95% CI. Variables with $p < 0.05$ in the bivariate analyses were included, with backward selection until $p < 0.10$ remained. Stata SE 15.0 software (Stata Corp LP, College Station, TX, USA) was used. Official data on COVID-19 cases and deaths (March 2020 to December 2022) were consulted for contextualization.

The study adopted the Health Belief Model⁽⁷⁾ and risk perception theory as theoretical frameworks, considering perceived susceptibility, severity, benefits, barriers, and incentives for action.

The research was approved by the Ethics Committee of the Christus University Center (opinion no. 4,997,175). All participants signed a consent form.

RESULTS

Participant characteristics

A total of 2,830 vaccinated individuals participated in the study. The majority were female (53.9%), self-identified as brown (94.1%), had completed high school (42.1%), were single (56.2%), and did not have private health insurance (98%). The median age was 39 years (interquartile range – IQR: 24), with 51.3% between 18 and 39 years, 33.5% between 40 and 59 years, and 15.2% were 60 years or older (Table 1).

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Table 1. Sociodemographic characteristics and impact of the pandemic on the income and work of study participants. Guaramiranga, Ceará, 2021-2022.

Variables	N	%
Sex		
Female	1.502	53,9
Male	1.286	46,1
Skin color		
White	96	3,4
Brown	2.646	94,1
Black	49	1,7
Others	21	0,7
Education (years of study)		
≤8	1.323	46,8
9-11	1.190	42,1
≥12	314	11,1
Marital status		
Married/Stable union	1.066	37,8
Divorced	67	2,4
Single	1.585	56,2
Widowed	103	3,7
Has health insurance?		
No	2.723	98,0
Yes	55	2,0
Main work situation before the pandemic began		
Business owner	9	0,3
Employed with a work permit	527	18,8
Employed without a work permit	611	21,8
Didn't work because he was retired/housewife/student	885	31,6
Searched for work but couldn't find it	45	1,6
Public servant	304	10,8
Self-employed/Worked without pay	427	15,2
How the pandemic affected family income		
It increased	375	13,3
It decreased significantly	134	4,7
It decreased a little	264	9,3
Was left without income	23	0,8
It remained the same	2.030	71,8
How the pandemic affected work		
Continued working	1.158	41,6
Continued working, but from home (home office)	131	4,7
Didn't work before and continued to work	1.091	39,1
Became unemployed	305	10,9
Lost their job	33	1,2
Had paid vacation	3	0,1

Started working after the pandemic	66	2,4
Has anyone in the household received any government financial benefits related to the pandemic?		
No	1.442	51,3
Yes (State government)	16	0,6
Yes (Federal government)	1.351	48,1
Was removed from in-person activities during the pandemic		
No	1.687	62,0
Yes	1.036	38,0

Working conditions and income

Household income remained unchanged for 71.8% of participants. Almost half (48.7%) reported that someone in the household received government financial benefits. Most respondents (62%) continued to work in-person, and 85.4% reported no change in employment status during the pandemic (Table 1).

Housing and health conditions

The median number of residents per household was 3 people (IQR: 1), ranging from 1 to 14 individuals. The majority lived in houses (98.4%), with regular garbage collection (96.5%), piped water supply (93.5%), internet access (89.3%), and sewage disposal (67.9%). The median number of rooms per residence was 5 (IQR: 2), ranging from 1 to 18 (Table 2). Al-

cohol consumption was reported by 21.5%, 18.8% reported doing some regular physical activity, and 7.2% were smokers. The main chronic conditions reported were hypertension (25.8%), diabetes (14.1%), heart disease (4.5%), cancer (3.8%), asthma or bronchitis (3.6%), depression (3.5%), and chronic kidney disease (2.6%).

Table 2. Preventive behaviors adopted during the COVID-19 pandemic and health-related perceptions among study participants. Guaramiranga, Ceará, 2021-2022.

Variables	N	%
Frequency of washing hands with soap and water during the day (n = 2,799)		
Sometimes	888	31,7
Often	1.846	66,0
Never	65	2,3
Wears a mask when leaving home (n = 2,794)		
Sometimes	904	32,3
Often	1.803	64,5
Never	87	3,1
Continued to wear a mask when leaving home after being vaccinated (n = 2,795)		
Sometimes	1.005	36
Often	1.690	60,5
Never	100	3,6
Acha que a pandemia provocou mudança no estado de saúde (n = 2.695)		
It stayed the same	2.368	87,9
It got better	79	2,9
It got much worse	32	1,2
It got a little worse	216	8,0
What was your routine like during social isolation (n = 2,704)?		
Stayed home all the time	743	27,5
Did not answer	3	0,1
Unsure	4	0,1

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Went out only for essential things like buying food and going to the pharmacy	1.392	51,5
Went out occasionally to buy food and stretch your legs	115	4,3
Went out all day every day for work or other regular activities	405	15,0
Went out every day for some activity	42	1,6
Who has entered the house (n = 2,685)		
Some close relatives	925	34,5
Friends, distant relatives, or others	53	2,0
Did not answer	7	0,3
Unsure	31	1,2
Only those who live in the house and no one else	1.669	62,2
How many times per week have these people entered the house (n = 2,024)		
Did not answer	158	7,8
Unsure	109	5,4
They visit once or twice a week.	1.546	76,4
They visit almost every day.	211	10,4
Practiced social distancing (n = 2,706)		
A lot	1.340	49,5
Somewhat	1.106	40,9
Very little	156	5,8
Unsure	2	0,1
A little	69	2,5
Practically isolated from the world	33	1,2
Frequency of feeling isolated from family or friends (n = 2,707)		
Often	290	10,7
Never	1.345	49,7
Rarely	1.018	37,6
Always	54	2,0
Frequency of feeling sad or depressed (n = 2,722)		
Often	236	8,7
Never	1.368	50,3
Rarely	1.084	39,8
Always	34	1,2
Frequency of feeling anxious or nervous (n = 2,717)		
Often	263	9,7
Never	1.282	47,2
Rarely	1.128	41,5
Always	44	1,6

Behaviors during the pandemic and knowledge about preventive measures

Frequent handwashing with soap and water was reported by 65.3% of participants. Among those who left home, 63.8% reported wearing masks,

and 59.7% maintained this habit even after vaccination. During periods of social isolation, 27.5% reported staying home, 51.5% went out only for essential activities, and 15.0% continued their usual routine (Table 2).

The most frequently cited pre-

ventive measures were: handwashing (86.0%), wearing a mask when leaving home (67.8%), avoiding touching eyes, nose, and mouth (63.3%), and using hand sanitizer (62.4%).

Regarding measures considered ineffective, 99.6% of participants re-

jected the use of hydroxychloroquine; 64.8% did not consider social distancing effective; and 60.9% did not recognize isolation as essential.

Analysis of associated factors

Sex, age, education, and marital status showed a statistically significant association with preventive behaviors. Women showed greater adherence to isolation (65.1%), social distancing (63.1%), and mask use (54.2%). Individuals aged 18 to 39 reported greater adherence to all practices, including staying home (43.9%) and maintaining social distancing (45.6%).

Education influenced specific behaviors: individuals with up to 8 years of education were more likely to adhere to isolation (43.9%) and social

distancing (40.6%), while those aged 9 to 11 reported greater frequency of handwashing (41.5%) and mask use (41.4%).

Single individuals demonstrated greater adherence to isolation (54.3%) and social distancing (52.3%) ($p < 0.001$). Participants with hypertension and diabetes showed greater adherence to preventive behaviors ($p < 0.005$) (Table 3).

Conditions such as cancer, depression, and poorer self-perceived health were also associated with higher rates of isolation and social distancing ($p < 0.01$) (Table 4). No significant associations were observed between chronic conditions and continued mask use after vaccination.

Knowledge about COVID-19

transmission and prevention, including handwashing, use of hand sanitizer, avoiding touching the face, mask use, social distancing, and isolation, was positively associated with the adoption of protective behaviors (Table 5).

In multivariate Poisson regression models with robust variance, distinct patterns of association were observed between sociodemographic and clinical variables and outcomes related to preventive behaviors. However, the patterns were not entirely consistent across behaviors, and no single explanatory model prevailed. This reflects the complexity of behavioral adherence in real-world contexts, where multiple interrelated factors influence individual decisions.

Table 3. Association between sociodemographic factors and adherence to preventive measures against COVID-19. Guaramiranga, Ceará, 2021-2022.

	Routine during social isolation (N=2.697)			Practiced social distancing (N=2.704)			How often they washed their hands (N=2.799)			Wore a mask when leaving home (N=2,794)			Once vaccinated, wore a mask when leaving home (N=2,795)		
	Did not leave home (n=743)	Left home (n=1,954)	p	A lot (n=1.373)	More or less/little (n=1,331)	p	Often/Sometimes (n=2.734)	Never (n=65)	p	Often/Sometimes (n=2.707)	Never (n=87)	p	Often/Sometimes (n=2.695)	Never (n=100)	p
Sex			*			*			0,26 2			0,01 0			0,11 6
Female	473 (65,1)	952 (49,4)		847 (63,1)	583 (44,1)		1.454 (54)	29 (46,8)		1.446 (54,2)	34 (40)		1.433 (54)	45 (45,9)	
Male	254 (34,9)	977 (50,6)		495 (36,9)	739 (55,9)		1.241 (46)	33 (53,2)		1.221 (45,8)	51 (60)		1.222 (46)	53 (54,1)	
Age group (years)			*			*			*			0,00 7			0,00 1
18-39	326 (43,9)	1043 (53,4)		626 (45,6)	745 (56)		1.382 (50,5)	47 (72,3)		1.372 (50,7)	56 (64,4)		1.358 (50,4)	68 (68)	
40-59	210 (28,3)	697 (35,7)		464 (33,8)	447 (33,6)		925 (33,8)	18 (27,7)		914 (33,8)	27 (31)		916 (34)	27 (27)	
≥60	207 (27,9)	214 (11)		283 (20,6)	139 (10,4)		427 (15,6)	0 (0)		421 (15,6)	4 (4,6)		421 (15,6)	5 (5)	
Ethnicity			0,11 2			0,00 1			0,57 5			0,25 9			0,21 9
White	27 (3,7)	60 (3,1)		63 (4,6)	25 (1,9)		91 (3,3)	3 (4,6)		91 (3,4)	0 (0)		92 (3,4)	0 (0)	
Brown	696 (94,4)	1.828 (94,1)		1.262 (92,5)	1.267 (95,8)		2.556 (94,1)	62 (95,4)		2.529 (94)	86 (98,9)		2.519 (94,1)	98 (98)	
Black	13 (1,8)	35 (1,8)		27 (2)	22 (1,7)		49 (1,8)	0 (0)		48 (1,8)	1 (1,1)		46 (1,7)	2 (2)	
Others	1 (0,1)	20 (1)		13 (1)	8 (0,6)		21 (0,8)	0 (0)		21 (0,8)	0 (0)		21 (0,8)	0 (0)	
Education (years of study)			*			*			0,03 3			0,01 4			0,02 1
≤8	413 (55,8)	862 (44,2)		682 (49,8)	595 (44,8)		1.290 (47,2)	23 (35,4)		1.281 (47,3)	29 (33,3)		1.274 (47,3)	39 (39)	
9-11	265 (35,8)	847 (43,4)		523 (38,1)	594 (44,7)		1.132 (41,5)	39 (60)		1.118 (41,3)	52 (59,8)		1.114 (41,4)	56 (56)	
≥12	63 (8,5)	244 (12,5)		166 (12,1)	141 (10,6)		309 (11,3)	3 (4,6)		305 (11,3)	6 (6,9)		304 (11,3)	5 (5)	
Marital status			*			*			0,14			0,74 1			0,65 6
Married/Stable Union	258 (35)	751 (38,5)		537 (39,3)	476 (35,9)		0 (0)	0 (0)		1.019 (37,8)	28 (32,2)		1.012 (37,7)	35 (35,4)	
Divorced	22 (3)	41 (2,1)		37 (2,7)	26 (2,0)		66 (3,9)	0 (0)		64 (2,4)	2 (2,3)		66 (2,5)	1 (1,0)	
Widowed	57 (7,7)	45 (2,3)		79 (5,8)	23 (1,7)		102 (6)	0 (0)		99 (3,7)	3 (3,4)		98 (3,6)	3 (3,0)	
Single	401 (54,3)	1.113 (57,1)		715 (52,3)	802 (60,4)		1.536 (90,1)	36 (100)		1.516 (56,2)	54 (62,1)		1.511 (56,2)	60 (60,6)	
Impact of the pandemic on work															
A	368 (41,6)	477 (53,9)	*	566 (64)	281 (31,8)	*	864 (97,6)	10 (1,1)	*	858 (96,9)	16 (1,8)	*	848 (95,8)	25 (2,8)	0,00 7
B	24 (3,4)	102 (5,2)	0,04 5	70 (5,2)	56 (4,2)	0,23	129 (4,8)	0 (0)	0,07 3	129 (4,8)	2 (2,4)	0,43 6	129 (4,9)	0 (0)	0,01 4
C	69 (9,7)	223 (11,5)	0,19 8	185 (13,8)	106 (8)	*	301 (11,2)	2 (3,1)	0,04 2	295 (11,1)	8 (9,4)	0,63 2	295 (11,1)	9 (9,2)	0,54 9
D	438 (61,6)	599 (30,8)	*	654 (48,8)	386 (29,2)	*	1.060 (39,4)	19 (29,7)	0,11 7	1.052 (39,5)	24 (28,2)	0,03 7	1.046 (39,4)	31 (31,6)	0,12 1

Caption: *p-value <0.001; A. Did not work because they were retired/housewife/student; B. Continued working at home; C. Stopped working; D. Did not work before and continued not working.

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Table 4. Association between clinical conditions and adoption of preventive behaviors against COVID-19. Guaramiranga, Ceará, 2021-2022.

	What was their routine like during social isolation? (N=2,697)			Practiced social distancing (N=2,704)		How often do they wash their hands (N=2,799)			Wear a mask when leaving home (N=2,794)			
	Did not go out (n=743)	Got out (n=1954)	p	Quite isolated (n=1373)	More or less/somewhat isolated (n=1331)	p	Sometimes/frequently (n=2734)	Never (n=65)	p	Often/Sometimes (n=2707)	Never (n=87)	p
Alcohol use	89 (12,5)	481 (24,8)	*	221 (16,5)	350 (26,6)	*	572 (21,8)	5 (8,2)	0,01	563 (21,7)	15 (17,6)	0,368
Have they ever smoked?	105 (14,7)	281 (14,6)	0,947	203 (15,3)	186 (14,1)	0,407	399 (15)	1 (1,6)	0,003	388 (14,7)	10 (11,5)	0,398
Do they exercise?	121 (16,9)	376 (19,4)	0,136	279 (20,8)	220 (16,7)	0,007	505 (19,1)	3 (4,7)	0,003	501 (19,2)	10 (11,6)	0,079
Diabetes			0,003			*			0,184			*
No	597 (80,6)	1657 (85,4)		1109 (81,2)	1153 (87,2)		2213 (83,9)	58 (92,1)		2191 (83,9)	78 (89,7)	
Yes	132 (17,8)	247 (12,7)		233 (17,1)	144 (10,9)		374 (14,2)	5 (7,9)		371 (14,2)	8 (9,2)	
Unsure	12 (1,6)	36 (1,9)		23 (1,7)	26 (2)		50 (1,9)	0 (0)		48 (1,8)	1 (1,1)	
Hypertension			*			*			0,016			0,019
No	474 (64)	1496 (76,6)		918 (67)	1056 (79,5)		1928 (72,8)	56 (88,9)		1909 (72,8)	75 (86,2)	
Yes	259 (35)	437 (22,4)		440 (32,1)	259 (19,5)		694 (26,2)	7 (11,1)		687 (26,2)	12 (13,8)	
Unsure	8 (1,1)	19 (1)		13 (0,9)	14 (1,1)		27 (1)	0 (0)		26 (1)	0 (0)	
Cancer			0,005			0,016			0,634			0,163
No	690 (92,9)	1863 (95,6)		1284 (93,7)	1276 (96,1)		2507 (94,9)	61 (96,8)		2478 (94,7)	86 (98,9)	
Yes	43 (5,8)	60 (3,1)		66 (4,8)	37 (2,8)		102 (3,9)	2 (3,2)		104 (4)	0 (0)	
Unsure	10 (1,3)	25 (1,3)		20 (1,5)	15 (1,1)		34 (1,3)	0 (0)		34 (1,3)	1 (1,1)	
Depression			0,001			*			0,181			0,416
No	694 (93,5)	1862 (95,5)		1277 (93,1)	1286 (97)		2507 (94,9)	63 (100)		2482 (94,9)	83 (95,4)	
Yes	26 (3,5)	68 (3,5)		65 (4,7)	29 (2,2)		94 (3,6)	0 (0)		90 (3,4)	4 (4,6)	
Unsure	22 (3)	19 (1)		30 (2,2)	11 (0,8)		42 (1,6)	0 (0)		43 (1,6)	0 (0)	
How do they rate their health?			*			*			0,111			0,813
Awful	5 (0,7)	5 (0,3)		7 (0,5)	3 (0,2)		10 (0,4)	0 (0)		9 (0,3)	0 (0)	
Bad	15 (2)	11 (0,6)		21 (1,5)	5 (0,4)		26 (1)	0 (0)		25 (1)	1 (1,2)	
Moderated	141 (19)	251 (12,9)		267 (19,5)	126 (9,5)		391 (14,8)	2 (3,3)		385 (14,7)	9 (10,5)	
Good	537 (72,5)	1516 (77,8)		949 (69,3)	1109 (83,5)		2005 (75,9)	53 (86,9)		1985 (76)	69 (80,2)	
Excellent	43 (5,8)	166 (8,5)		125 (9,1)	85 (6,4)		208 (7,9)	6 (9,8)		208 (8)	7 (8,1)	
Do they think the pandemic caused a change in their health status?			0,006			*			0,036			0,16
It got much worse	10 (1,4)	19 (1)		24 (1,8)	6 (0,5)		32 (1,2)	0 (0)		31 (1,2)	0 (0)	
It got a little worse	79 (10,7)	136 (7)		151 (11,1)	63 (4,8)		216 (8,2)	0 (0)		214 (8,3)	2 (2,3)	
It stayed the same	632 (85,8)	1719 (88,7)		1139 (83,8)	1219 (92,2)		2295 (87,5)	60 (100)		2273 (87,7)	81 (94,2)	
It got better	16 (2,2)	63 (3,3)		45 (3,3)	34 (2,6)		79 (3)	0 (0)		75 (2,9)	3 (3,5)	

Caption: *p-value <0,001.

Table 5. Association of knowledge about COVID-19 and COVID-19 prevention behaviors among study participants. Guaramiranga, Ceará, 2021-2022.

	Como foi sua rotina durante o isolamento social (N=2.697)			Fez distanciamento social (N=2.704)		Com que frequência lava as mãos (N=2.799)			Usa máscara ao sair de casa (N=2.794)			Uma vez vacinado, usa máscara ao sair de casa (N=2.795)		
	Não saiu (n=743)	Saiu (n=1954)	p	Bastante (n=1373)	Mais ou menos/pouco (n=1331)	p	Frequentemente / às vezes (n=2734)	Nunca (n=65)	p	Frequentemente / às vezes (n=2707)	Nunca (n=87)	p	Frequentemente / às vezes (n=2695)	Nunca (n=100)

O que você acha que pode proteger contra a covid-19?															
A	644 (86,7)	1781 (91,1)	0,00 1	1195 (87)	1234 (92,7)	*	2368 (86,6)	53 (81,5)	0,23 7	2338 (86,4)	80 (92)	0,13 3	2331 (86,5)	93 (93)	0,06
B	453 (61)	1339 (68,5)	*	866 (63,1)	930 (69,9)	*	1787 (65,4)	8 (12,3)	*	1766 (65,2)	23 (26,4)	*	1761 (65,3)	33 (33)	*
C	549 (73,9)	1362 (69,7)	0,03 3	1107 (80,6)	807 (60,6)	*	1854 (67,8)	52 (80)	0,03 7	1832 (67,7)	77 (88,5)	*	1826 (67,8)	83 (83)	0,001
D	331 (44,5)	770 (39,4)	0,01 5	712 (51,9)	390 (29,3)	*	1098 (40,2)	3 (4,6)	*	1078 (39,8)	22 (25,3)	0,00 6	1073 (39,8)	29 (29)	0,03
E	2 (0,3)	10 (0,5)	0,53	6 (0,4)	7 (0,5)	0,73 8	13 (0,5)	0 (0)	1	10 (0,4)	3 (3,4)	0,00 7	11 (0,4)	2 (2)	0,076
F	517 (69,6)	1241 (63,5)	0,00 3	1069 (77,9)	693 (52,1)	*	1707 (62,4)	48 (73,8)	0,06	1681 (62,1)	73 (83,9)	*	1675 (62,2)	83 (83)	*
G	300 (40,4)	692 (35,4)	0,01 7	676 (49,2)	318 (23,9)	*	990 (36,2)	2 (3,1)	*	970 (35,8)	19 (21,8)	0,00 7	968 (35,9)	24 (24)	0,014
H	2 (0,3)	9 (0,5)	0,73 8	3 (0,2)	8 (0,6)	0,11 8	11 (0,4)	0 (0)	1	10 (0,4)	1 (1,1)	0,29 4	10 (0,4)	1 (1)	0,331

Caption: * p-value <0.001. A. Wash your hands; B. Do not touch your mouth, nose, or eyes; C. Wear a mask whenever you leave the house; D. Stay at home and avoid contact with other people; E. Be young; F. Clean your hands with alcohol gel; G. When outside the house, do not be near other people; H. Take chloroquine.

DISCUSSION

This study analyzed the maintenance of preventive behaviors related to COVID-19 among fully vaccinated adults in the municipality of Guaramiranga, located in the mountainous region of the state of Ceará. This was the first municipality to be fully vaccinated following a local decision to conduct a pilot program in Ceará. The cross-sectional data provide relevant evidence on the persistence of protective practices, such as hand hygiene, mask use, and social distancing, even after widespread vaccination coverage. The adoption of these practices was associated with sociodemographic characteristics, health conditions, and knowledge about disease transmission, reinforcing the influence of risk perception and health literacy on individual behavior.

Women and younger adults demonstrated greater engagement in preventive behaviors, which is consistent with findings from some national and international studies^(4,5,7). The lower adherence among men reinforces the literature on gender-based differences in risk perception and health behavior. Although older adults are at higher risk for severe COVID-19, so-

cial and family dynamics can hinder their complete isolation, as observed in this study, in which households with older adults frequently received visitors.

Education showed a dual pattern of association: individuals with lower educational levels reported more isolation and distancing, possibly due to occupational restrictions, while those with higher education demonstrated greater adherence to mask use and hand hygiene, a pattern also observed in other populations⁽⁸⁻¹⁰⁾.

Housing conditions and employment status were not found to be relevant determinants in this study, possibly due to the particularities of Guaramiranga, a small municipality with relative socioeconomic stability and benefiting from government financial assistance during the pandemic. This result differs from that observed in large urban centers, where housing insecurity, informal work, and financial insecurity were associated with lower adherence to protective measures^(8,11). On the other hand, a study conducted with elderly people in Belo Horizonte revealed greater adherence to preventive behaviors among individuals with lower incomes, suggesting that, in certain contexts, the perception of vulnerability can drive self-protection practices, even in the face of socioeconomic limitations⁽¹²⁾.

In the present study, conditions such as arterial hypertension, diabetes mellitus and multimorbidity were

associated with greater adherence to preventive practices, in line with findings in Brazil^(13,14) and in other countries^(10,15,16). Despite widespread reports of psychological distress during the pandemic^(17,18), Few participants reported mental health problems, possibly due to protective factors such as social cohesion and aspects of the rural lifestyle, a hypothesis that deserves future investigation.

Physical activity was not associated with preventive behaviors, which may reflect a reduced perception of vulnerability among physically active individuals⁽¹⁹⁾. Although Syukkur and Sipollo (2022) did not directly assess physical activity, their findings corroborate that risk perception and health status are more predictive of protective behaviors than sociodemographic variables⁽¹⁶⁾.

Knowledge about COVID-19 and risk perception were central to maintaining preventive behaviors. Individuals with a greater understanding of effective measures reported greater adherence. However, the undervaluation of social distancing and isolation by some participants raises concerns about potential gaps in public communication and the spread of misinformation, which has also been reported in other regions of Brazil⁽²⁰⁾.

The Health Belief Model offers an appropriate theoretical framework for interpreting these findings⁽⁷⁾. Participants who perceived themselves as susceptible, whether due to age, gender, or comorbidities, demonstrated

greater adherence. The perception of personal and collective benefits also favored protective behaviors, while barriers such as misinformation and reduced risk perception after vaccination acted as obstacles.

International comparisons reinforce these interpretations. In Thailand, Piboon et al. ⁽²¹⁾ observed that older adults maintained preventive measures due to risk perception and effective communication. Interestingly, in the present study, participants with lower educational levels reported more isolation and distancing, which may be more related to occupational contexts or social restrictions than to a higher risk perception, differing from the findings of Pappageorge et al. ⁽⁹⁾, who attributed lower adherence to structural limitations. This indicates that educational strategies adapted to the local context can mitigate structural disadvantages and promote greater health equity.

Adherence to mask use in Guaramiranga (63.8%) was lower than that observed in other Brazilian contexts, where studies have identified high frequency of use (95.5 to 97.1%), especially among women and older adults. These findings reinforce the role of sociodemographic characteristics and risk perception in the adoption of preventive behaviors, even in phases prior to mass vaccination ^(22,23). Similar results were found in rural areas outside Brazil, such as Uganda, where 70.8% of residents reported continued mask use during the pandemic ⁽²⁴⁾. Such evidence suggests that factors such as small population size, community cohesion, and local access to health information contribute to the sustainability of protective measures.

Social trust also appears to play a relevant role. A US study identified personal risk perception as the main predictor of preventive behaviors ⁽²⁵⁾. In Guaramiranga, community ties and reliable local sources of informa-

tion may have mitigated behavioral fatigue and sustained protective practices.

While similar studies were conducted in high-income countries at the beginning of the pandemic, this study offers original contributions by highlighting the persistence of preventive behaviors after vaccination in a small, rural, tourist municipality. This contextualized evidence is valuable for public health strategies in low- and middle-income countries, where structural and cultural factors influence behavioral resilience. The findings support that preventive practices can be maintained in cohesive and well-informed communities, even without enforcement, highlighting the role of trust and social capital in long-term policies.

Limitations include the cross-sectional design, which impedes causal inferences, and the use of self-reported data, which is subject to recall bias and social desirability. Generalizability may also be limited by local specificities, such as high vaccination coverage and community mobilization. On the other hand, the study has strengths: a large, representative sample, data collection during the pandemic, and interpretation based on a structured theoretical model. Despite its limitations, it provides relevant insights into sustained adherence to protective behaviors after vaccination, suggesting that qualified information, social cohesion, and institutional trust are crucial for their continuation. Future research should investigate the longitudinal evolution of these behaviors and the impact of communication strategies in similar contexts.

CONCLUSION

This study investigated adherence to COVID-19 preventive behaviors among vaccinated adults in Guaramiranga, Brazil, and identified

significant associations with age, sex, education, comorbidities, and risk perception. Despite high vaccination coverage, most participants continued to practice hand hygiene and mask use, while social distancing and isolation were less consistent.

These findings highlight the role of health literacy and the local socio-cultural context in sustaining protective behaviors, even after vaccination. The results may inform future public health strategies aimed at improving adherence to preventive measures, especially in small municipalities with a tourist vocation. Additionally, this study emphasizes the value of behavioral surveillance in the post-vaccination phase and the importance of localized data to guide targeted interventions and strengthen community resilience in the face of future health emergencies.

REFERENCES

- Bedford J, Enria D, Giesecke J, Heymann DL, Ihekweazu C, Kobinger G, et al. COVID-19: towards controlling of a pandemic. *Lancet*. 2020;395:1015–8. [https://doi.org/10.1016/S0140-6736\(20\)30673-5](https://doi.org/10.1016/S0140-6736(20)30673-5)
- Brasil. Ministério da Saúde. Coronavírus Brasil [Internet]. Brasília: MS; [cited 2025 Feb 6]. Disponível em: <https://covid.saude.gov.br/>
- Lemos DRQ, D'Angelo SM, Farias LABG, Almeida MM, Gomes RG, Pinto GAC, et al. Health system collapse 45 days after the detection of COVID-19 in Ceará, Northeast Brazil: a preliminary analysis. *Rev Soc Bras Med Trop*. 2020;53:e20200354. <https://doi.org/10.1590/0037-8682-0354-2020>
- Lima DLF, Dias AA, Rabelo RS, Cruz IDR, Costa SC, Nigri FMN, et al. COVID-19 no Estado do Ceará, Brasil: comportamentos e crenças na chegada da pandemia. *Cien Saude Colet*. 2020;25:1575–86. <https://doi.org/10.1590/1413-81232020255.07192020>
- Ferreira LB, Lasmar MF, Ramos DF. Mudanças comportamentais da população da cidade de Rio Grande (RS) frente à pandemia. *Rev Soc Desenv*. 2021;10:e29010212413. <https://doi.org/10.33448/rsd-v10i2.12413>
- Instituto Brasileiro de Geografia e Estatística (IBGE). Cidades e Estados: Guaramiranga [Internet]. Brasília: IBGE; [cited 2024 Dec 28]. Disponível em: <https://cidades.ibge.gov.br/brasil/ce/guaramiranga/panorama>
- Shahnazi H, Ahmadi-Livani M, Pahlavanzadeh B, Rajabi A, Hamrah MS, Charkazi A. Assessing preventive health behaviors from COVID-19: a cross-sectional study with Health Belief Model in Golestan Province, Northern of Iran. *Infect Dis Poverty*. 2020;9:157. <https://doi.org/10.1186/s40249-020-00776-2>
- Bezerra ACV, Silva CEMD, Soares FRG, Silva JAM. Fatores associados ao comportamento da população durante o isolamento social na pandemia de COVID-19. *Cien Saude Colet*. 2020;25(Supl 1):2411–21. <https://doi.org/10.1590/1413-81232020256.1.10792020>
- Papageorge NW, Zahn MV, Belot M, Van Den Broek-Altenburg E, Choi S, Jamison JC, et al. Socio-demographic factors associated with self-protecting behavior during the COVID-19 pandemic. *J Popul Econ*. 2021;34:691–738. <https://doi.org/10.1007/s00148-020-00818-x>
- Wachira E, Laki K, Chavan B, Aidoo-Frimpong G, Kingori C. Factors influencing COVID-19 prevention behaviors. *J Prev*. 2023;44:35–52. <https://doi.org/10.1007/s10935-022-00719-7>
- Romero DE, Costa E, Lopes CS, Werneck GL, Szwarcwald CL. Idosos no contexto da pandemia da COVID-19 no Brasil: efeitos nas condições de saúde, renda e trabalho. *Cad Saude Publica*. 2021;37:e00216620. <https://doi.org/10.1590/0102-311x00216620>
- Dias IR, Janhaque VR, Vilas-Boas VA, Fusco SDFB, Nunes DP. Comportamento preventivo contra covid-19 e sua relação com as condições sociais e de saúde de pessoas idosas. *Rev Bras Geriatr Gerontol* [Internet]. 2024 [cited 2025 Jul 20];27. <https://doi.org/10.1590/1981-22562023026.230088.pt>
- Malta DC, Szwarcwald CL, Barros MBA, Gomes CS, Machado IE, Souza PRB, et al. Doenças crônicas não transmissíveis e mudanças nos estilos de vida durante a pandemia de COVID-19 no Brasil. *Rev Bras Epidemiol*. 2021;24:e210009. <https://doi.org/10.1590/1980-549720210009>
- Batista SR, Souza Júnior PRB, Andrade FB, Thumé E, Lima-Costa MF, Melo B, et al. Comportamentos de proteção contra COVID-19 entre adultos e idosos brasileiros que vivem com multimorbidade: Iniciativa ELSI-COVID-19. *Cad Saude Publica*. 2020;36(Supl 3):e00196120. <https://doi.org/10.1590/0102-311x00196120>
- Islam JY, Vidot DC, Camacho-Rivera M. Determinants of COVID-19 preventive behaviours among adults with chronic diseases in the USA: an analysis of the nationally representative COVID-19 Impact Survey. *BMJ Open*. 2021;11:e044600. <https://doi.org/10.1136/bmjopen-2020-044600>
- Syukkur A, Sipollo BV. Analysis of factors and situations influencing preventive behaviours for the spread of COVID-19 in adults with chronic diseases and older adults. *Babali Nurs Res*. 2022;3:202–11. <https://doi.org/10.37363/bnr.2022.33127>
- Barros MBA, Lima MG, Malta DC, Szwarcwald CL, Azevedo RCS, Romero D, et al. Relato de tristeza/depressão, nervosismo/ansiedade e problemas de sono na população adulta brasileira durante a pandemia de COVID-19. *Epidemiol Serv Saude*. 2020;29:e2020427. <https://doi.org/10.1590/s1679-49742020000400018>
- Lobo LAC, Rieth CE. Saúde mental e COVID-19: uma revisão integrativa da literatura. *Saude Debate*. 2021;45:885–901. <https://doi.org/10.1590/0103-1104202113024>
- Peixoto SV, Andrade FB, Szwarcwald CL, Lima-Costa MF. Comportamentos em saúde e adoção de medidas de proteção individual durante a pandemia do novo coronavírus: Iniciativa ELSI-COVID-19. *Cad Saude Publica*. 2020;36(Supl 3):e00195420. <https://doi.org/10.1590/0102-311x00195420>
- Carvalho KMD, Oliveira BLCA, Marins FR, França APA, Bezerra I. The belief in health in the adoption of COVID-19 prevention and control measures. *Rev Bras Enferm*. 2021;74(Supl 1):e20200576. <https://doi.org/10.1590/0034-7167-2020-0576>
- Piboon K, Chomchaipon J, Oupawongsapat D, Jaidee W, Jaidee PH, Pongsaengpan P, et al. Preventive behaviors of COVID-19 during the COVID-19 pandemic among community-dwelling older adults in Thailand. *PeerJ*. 2025;13:e19412. <https://doi.org/10.7717/peerj.19412>
- Santos SS, Zenatti CT, Anibal FF, Mestre CAA, Junior AC, Oishi J. Testagem para COVID-19 e comportamentos preventivos no início da pandemia: estudo transversal. *Saude Coletiva*. 2025;15(97):16392–415. <https://doi.org/10.36489/saudecoletiva.2025v15i97p16392-16415>
- Miguez FGG, Oliveira G, Enriquez-Martinez OG, Fonseca MJM, Griep RH, Barreto SM, et al. Fatores associados à adesão a comportamentos preventivos da COVID-19 em participantes do ELSA-Brasil. *Cad Saude Publica*. 2023;39(8):e00188322. <https://doi.org/10.1590/0102-311XPT188322>
- Lubega GB, Mendoza H, Nkeramahame J, Niyongabo F, Gonza J, Nakachwa B, et al. Community mask wearing as a COVID-19 preventive measure, its barriers, and motivators among rural households of Uganda: a mixed methods approach. *PLoS Glob Public Health*. 2022;2:e0000485. <https://doi.org/10.1371/journal.pgph.0000485>
- Wise T, Zbozinek TD, Michelini G, Hagan CC, Mobbs D. Changes in risk perception and self-reported protective behaviour during the first week of the COVID-19 pandemic in the United States. *R Soc Open Sci*. 2020;7:200742. <https://doi.org/10.1098/rsos.200742>

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DECLARATION OF FINANCIAL CONFLICTS OF INTEREST AND/OR AFFILIATIONS

The authors have declared no conflicts of interest.