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RESEARCH ARTICLE

Adolescents' behavioral changes and preventive practices against COVID-19 in South Africa: The influence of household characteristics

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Abstract

The South African government instituted a countermeasure against COVID-19 in March 2020, which had a significant impact on many individuals, particularly the youth. However, there is a limited understanding of how household characteristics influenced adolescents' behavioral changes and their adoption of preventive measures during the pandemic. This study aimed to explore the relationship between the role of household characteristics and adolescents' behavioral responses to COVID-19 in South Africa. Using the latest data from the South African National Income Dynamics-Coronavirus Rapid Mobile Survey (Wave 5), which includes responses from 5581 (99.9%) youths aged 15 – 24, we analyzed changes in their behaviors and the preventive measures they adopted. The study controlled for various household, demographic, and socioeconomic characteristics of the respondents. We utilized cross-tabulations and an ordinal logistics regression model to determine the relationship between the covariates and the outcome of behavioral changes and preventive measures adopted. Our findings revealed that none of the respondents adopted all recommended precautionary measures for COVID-19, while 55.7% exhibited low behavioral changes, and only 2.7% exhibited higher behavioral changes throughout the pandemic. The results indicate that, at both the individual and household levels, factors such as gender, educational attainment, source of household income, and access to electricity increase the odds of behavioral changes against COVID-19 in South Africa. In addition, among household-level factors, adolescents without access to water were more likely to adopt one to three preventive measures compared to those with access to water (52.2% vs. 47.9%, $p < 0.001$). Therefore, to effectively prevent the spread of infection in South Africa, it is pertinent to address these household characteristics and encourage preventive measures tailored to these factors.

Keywords: Adolescent; Behavioral changes; Preventive measures; COVID-19

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1. Introduction

The South African government instituted a countermeasure against COVID-19 in March 2020 (Adebiyi *et al.*, 2021), which had a significant impact on many individuals, particularly the youth. However, there is a limited understanding of how household characteristics influenced adolescents' behavioral changes and their adoption of preventive measures during the pandemic. COVID-19 was transmitted primarily through close contact with infected individuals (Garba *et al.*, 2020) and spread through physical contact or droplets that were inhaled or came into direct contact with the eyes, nose, or mouth (Li, 2021). According to Allan *et al.* (2022), the World Health Organization, the Africa Center for Disease Control (Africa CDC), and the CDC and Prevention, instituted precautionary to curb the spread of the virus and they encouraged individuals to adopt prescribed measures, including social distancing, frequent hand-washing, and the regular use of face masks. During this period, the most common symptoms were dry cough, fever, and tiredness (Simpeh & Amoah, 2023). Due to the severity of the infection, many nations made concerted efforts to publicize both behavioral measures introduced and the preventive practices, as well as the symptoms of the virus, to minimize its spread (Wet-Billings & Anyanzu, 2022).

In South Africa, both printed and electronic media were used to inform citizens about the spread of the COVID-19 infection and the importance of testing for the virus (Nawe & Garaba, 2021). These campaigns, including the contributions of health-care professionals, played a significant role in controlling the infection and mitigating the mortality rates associated with COVID-19 (Wet-Billings & Anyanzu, 2022). However, during this period, many hospitals faced severe shortages of personal protective equipment, beds, and oxygen for infected patients, which placed a significant strain on the health-care system (Moyo *et al.*, 2021). This situation demonstrates the numerous challenges faced by the South African health-care system and underscores that public education campaigns and regulations for prevention and symptom monitoring have not always been fully effective.

Many countries in Sub-Saharan Africa (SSA), including South Africa, faced challenges in managing their health-care systems during this period. The COVID-19 regulations, particularly the lockdown, which forbade people from leaving their homes except for essential reasons, disrupted daily life for everyone (Eyawo *et al.*, 2021; Nechifor *et al.*, 2021; Wet-Billings & Anyanzu, 2022). From March to May 2020, a "hard lockdown" at levels 5 and 4 enforced the strictest regulations, including banning the sale of alcohol and tobacco, closing stores and malls, and suspending in-person schooling (Carlitz & Makhura, 2021; Dorward *et al.*, 2021; Wet-Billings & Anyanzu, 2022). During this period, there was an increase in mental and emotional stress, intimate partner violence, and unemployment (Ndlovu *et al.*, 2022; Posel *et al.*, 2021). A study found that adults who lost their jobs due to the lockdown in South Africa experienced higher rates of depression than those who remained employed (Posel *et al.*, 2021). Many parents also struggle with the demands of working from home or being unemployed while supporting their children (Cantillon *et al.*, 2021; Rich *et al.*, 2022). In addition, in many communities, families, including young people, were infected. This resulted in increased responsibilities for young people due to the impact of household factors (Rich *et al.*, 2022). Low-income households and those with special needs were particularly impacted by the pandemic in South Africa (Rich *et al.*, 2022). These factors also affected youth employment and education, and the ensuing lockdown along with additional household responsibilities likely made it difficult for young people to learn effectively and adhere to safety procedures (Rich *et al.*, 2022; Wet-Billings & Anyanzu, 2022).

The health belief model (HBM) provides a theoretical foundation for understanding how behavioral changes and preventive practices were adopted during the COVID-19 pandemic. The HBM is one of the earliest models in the study of health behavior, developed by social psychologists Irwin M. Rosenstock *et al.* in the 1950s (Drestalita *et al.*, 2022; Jones & Wallis, 2022; Roberts & David, 2021). It is a theoretical framework that explains and predicts health-related behaviors in populations or groups. Its original purpose was to identify the factors contributing to people's refusal to participate in health-care surveillance initiatives. The HBM states that a person's health-related decisions are influenced by their beliefs about their susceptibility to sickness, the severity of the medical conditions, the benefits of taking preventive actions, and the barriers to those actions (Campos-Mercade *et al.*, 2021; Jones & Wallis, 2022). Considering the perceived benefits, The HBM, for example, highlights how an adolescent's understanding of their presumed susceptibility to the COVID-19 virus and the severity of its effects might impact their decision-making when it comes to whether or not to embrace preventative therapy. Low preventive measures and behavioral changes among young people may also be caused by adolescents' inadequate financial strength to cope with the realities surrounding the infection where they congregate (Duby *et al.*, 2022). In addition, poverty and lack of access to basic amenities such as radio, televisions, water, and electricity contributed to increased infection among young people in South Africa due to limited knowledge of the disease's symptoms (Muchanga,

2020). To develop targeted interventions addressing the issues and challenges households faced in accessing health-care services during the COVID-19 period—which had a negative impact on many South African households—it is imperative to understand these dynamics within the framework of health behavior models.

To fully understand the effect of behavioral changes and preventive measures among adolescents during the COVID-19 pandemic in South Africa and to identify the household factors influencing health-seeking behavior, it is crucial to examine micro-level national data such as the National Income Dynamics Study—Coronavirus Rapid Mobile Survey 2021 (NIDS-CRAM; Wave 5). The specific household factors affecting adolescents' behavioral changes and preventive measures throughout the COVID-19 outbreak in SSA, particularly in South Africa, remain unclear. This study aims to provide evidence that could support the development and implementation of behavioral health programs during pandemics. Thus, the objectives of this study are to (i) estimate the levels of behavioral changes and preventive measures adopted during the COVID-19 period in South Africa and (ii) explore the role of household characteristics on young people during this time.

2. Methods

For this study, we utilized data from the NIDS-CRAM; Wave 5. The NIDS-CRAM was developed by academics from South African universities to track the socioeconomic and health impacts of the COVID-19 pandemic in the country. The survey aimed to assess the effects of the government-imposed lockdown on South African households. The sample for this study was drawn from the National Household Survey, referred to as the NIDS. We focused on adolescents aged 15 – 24 years, using data from the NIDS-CRAM (Wave 5) (Ingle *et al.*, 2021) to evaluate the impact of the COVID-19 pandemic outbreak on social and economic effects in South Africa. The fifth wave of the survey, conducted from April 6, 2021, to May 11, 2021 (Ingle *et al.*, 2021), was chosen because it was the most recent at the time this study was conceived. It provided updates and analysis of the trend in household living conditions during the pandemic. The data is freely available for research at https://www.gtac.gov.za/nids-cram-releases-wave-5-results/. The survey sample included 2150 males and 3431 females, totaling 5581 individuals. However, only adolescents aged 15 – 24 years were included in our analysis. The NIDS-CRAM (Wave 5) survey consisted of four main questionnaires, covering household, individual, social, economic, schooling, and housing factors. In addition, data from NIDS-CRAM 2021 (Wave 5) were used to assess the prevalence of household characteristics among young people during the COVID-19 period in South Africa. We used data from this wave to evaluate how household characteristics affected adolescents' behavioral changes and preventive measures adopted during the COVID-19 pandemic in South Africa.

2.1. Study sample

The sample for this study was extracted from the latest data available from NIDS-CRAM 2021 (Wave 5), which included 5581 youths (99.9%) aged 15 – 24 years who listed preventive measures and ways their behaviors changed due to the COVID-19 infection. The study comprised 2150 males and 3431 females. Among the respondents, more than 50% reported minimal behavioral changes, whereas 60.1% did not adopt any preventive measures throughout the COVID-19 outbreak.

2.1.1. Statement of ethics

Ethics approval for the NIDS-CRAM survey was granted by the Commerce Faculty Ethics Committee of the University of Cape Town and the Research Ethics Committee: Social, Behavioral, and Education Research of the University of Stellenbosch.

2.2. Study variables and measures

2.2.1. Outcome variables

This research investigated (i) behavioral changes due to COVID-19 and (ii) preventive measures adopted by adolescents during the pandemic. The NIDS-CRAM 2021 (Wave 5) ranked behavioral changes into seven rankings (Appendix A1), while preventive measures were ranked into six rankings (Appendix A2). Appendix A1 presents the measurement of adolescents' responses to behavioral changes during the COVID-19 period. These responses were tracked over 7 weeks of telephone interviews and categorized into three levels: (i) low, (ii) medium, and (iii) high. Appendix A2 outlines the measurement of preventive practices adopted by adolescents, based on 6 weeks of telephone interviews. These responses were categorized into (i) none, (ii) 1 – 3 preventive measures, and (iii) 4 – 7 preventive measures.

2.2.2. Independent variables

The primary independent variables considered in this investigation were "household characteristics." Adolescent respondents were asked about their households in terms of (i) access to electricity, (ii) access to water, (iii) source of income of the household, and (iv) whether household members received grants. Some of these variables were recorded using binary responses (yes/no), whereas others involved categorical responses.

The covariate variables used in this study included gender (male/female) and ethnicity/race (African, White, Colored, and Indian/Asian). In the South African context, "Africans" refers to Black South Africans. The term "Colored" was used by the South African government from 1950 to 1991, to describe individuals of mixed European ("White") and African ("Black") or Asian ancestry. This term is also used more broadly to refer to Black expatriates in South Africa. In addition, the study considered a province of residence and the highest level of education. These covariates capture key demographic factors of adolescents. Demographic factors have been documented to be more connected to young people's attitudes and perceptions toward infections such as COVID-19 pandemics (Hager *et al.*, 2020; Yang *et al.*, 2020). In this study, gender was categorized as male and female. Research indicates that the level of education is related to changes in behaviors during pandemics (Odimegwu *et al.*, 2019; Pförtner *et al.*, 2022; Van *et al.*, 2010). More educated youth are more likely to be aware of preventive measures associated with pandemics, which may lead to protection against the spread of the virus. Education levels in this study were classified as: "National certificate," "senior certificate," "below senior certificate," "Adult Basic Education and Training (ABET)," and "no schooling." The ABET is a program in South Africa that provides basic education and skills training to adults who have not completed their formal education. The ethnicity/race was expressed through a combination of physical, behavioral, and cultural attributes of the respondents in this study. This approach captures the variety of groups in an area along with their relative representation (Vyas & Kumaranayake, 2006). This variable was chosen to ascertain how adolescents and/or young people responded to the behavioral and preventive measures instituted by the government during the COVID-19 pandemic in South Africa. The province of residence was defined as the geographical location where the respondents resided, including the Western Cape, Eastern Cape, Northern Cape, Free State, KwaZulu-Natal, North West, Gauteng, Mpumalanga, and Limpopo.

2.3. Analysis plans

Descriptive statistical methods were used to analyze the responses regarding households, demographics, and socioeconomic variables. Cross-tabulations were employed to examine the percentages of identified behaviors that changed and preventive practices adopted. The likelihood of behavior changes and preventive practices by the respondent and household characteristics was calculated using the ordinal logistic regression model, with the outcome modified into low, medium, and high behavior changes, as well as none, 1 – 3, and 4 – 7 preventive practices. The ordinal regression method was chosen in this study due to the order of satisfaction of the dependent variables. To account for the ordinal outcomes, various ordinal logistics regression models exist. In this study, we used the proportional odds model (POM), which is commonly employed in epidemiology and public health research. The POM compares cumulatively higher categories rather than focusing solely on specific categories. The statistical models adopted for this study focus on the POM model's decisions.

3. Results

3.1. Description of adolescents and young adults included in the NIDS-CRAM (Wave 5)

Table 1 presents the background characteristics of the adolescents (15 – 24 years) included in the study. The research encompassed 2150 males and 3431 females, with females representing a higher proportion (61.5%). A significant majority of the respondents were from the African/Black ethnic group (86.6%) at the time of the survey. Most of the adolescents and young adults captured in the study were from the KwaZulu-Natal province. Regarding education, slightly more than half of the respondents (51.6%) held a senior school certificate. Among the respondents, only 44.3% were employed, whereas 41% of the respondents came from households that relied on government grants. However, most respondents lived in households that did not receive any COVID-19 grants from the government. Only a small number of individuals (10.7%) indicated that they are from households that received COVID-19 grants from the government to mitigate the effects of the COVID-19 pandemic in South Africa.

3.2. Measures of behavioral changes and levels of preventive practices among adolescents and young adults throughout the COVID-19 outbreak

Figure 1 illustrates that there were no significant behavioral changes in adolescents and young adults during the COVID-19 period. The results indicate that 56% of adolescents experienced low behavioral changes during the COVID-19 pandemic. Similarly, 41% of the respondents reported medium-level behavioral changes, while only 3% of the respondents had high behavioral changes. In addition, Figure 1 reveals that no significant preventive measures were adopted by adolescents and young adults during the COVID-19 period. The data show that 61% of adolescents did not adopt any preventive measures during the COVID-19 pandemic. Meanwhile, 35% of the respondents adopted one to three preventive measures, and only 4% adopted four to seven or more preventive measures.

Table 1. Distribution of adolescents and young adults (15 – 24 years) who changed behaviors or adopted some preventive measures according to selected background/household characteristics (COVID-19 NIDS-CRAM, 2020, South Africa)

Background characteristics	Participants	Percentage
Gender		
Male	2,150	38.5
Female	3,431	61.5
Ethnicity		
African/Black	4,834	86.6
Colored	463	8.3
Asian/Indian	44	1.0
White	240	4.3
Province		
Western Cape	7.36	7.4
Eastern Cape	546	9.8
Northern Cape	334	5.9
Free State	335	6
KwaZulu-Natal	1,638	29.3
North West	332	5.9
Gauteng	853	15.3
Mpumalanga	534	9.6
Limpopo	598	10.7
Education level		
National certificate	53	0.9
Senior cert	2,462	44.1
Below senior cert	2,881	51.6
ABET	19	0.3
No schooling	166	3.0
Household access to electricity		
Yes	5,298	94.9
No	283	5.0
Access to water		
Yes	4,109	73.6
No	1,472	26.4
Household size		
1 – 4	2,648	47.4
5 – 6	1,850	33.1
7+	1,083	19.4
Household income		
Employment	2,474	44.3
Business	331	5.9
Government grants	2,290	41.0
Family	226	4.0
No income	124	2.2
Pension	133	2.4
Household members who received grants		
None	3,737	66.9
1	1,246	22.3
2+	598	10.7
Total	5,581	100

Abbreviation: ABET: Adult basic education and training.

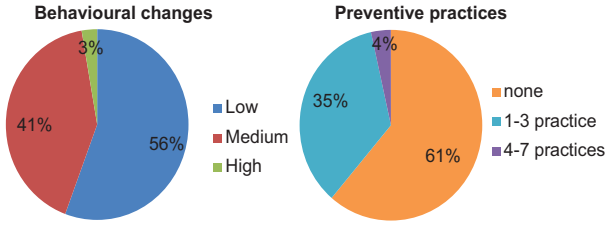

Figure 1. Measures of behavioral changes and levels of preventive practices among adolescents and young adults during the COVID-19 period in South Africa (2021)

3.3. Behavioral changes and adolescent background/household characteristics throughout the COVID-19 outbreak

Table 2 presents the distribution of adolescents' behavioral changes during the COVID-19 period, categorized by background and household characteristics. Bivariate analysis revealed that some individual and household-level factors were associated with behavioral changes among adolescents ($p < 0.001$) in South Africa. The data show that male (40.8%) and female (36.7%) adolescents aged 15 – 24 years experienced low behavioral changes in response to COVID-19. In contrast, only 3.3% of males and 4.1% of females had high behavioral changes during the pandemic. Our results also indicate that the association between gender and behavioral changes during the COVID-19 period is significant. Regarding ethnicity, adolescents from the Colored racial group constituted 2.8% of those with high behavioral changes during the COVID-19 period, while adolescents from the White and Asian/Indian racial groups had high behavior changes at 7% and 6.8%, respectively. The results show a significant association between racial diversity and behavioral changes related to COVID-19. In addition, the association between the province of residence and educational level during the COVID-19 period was also significant. For instance, adolescents who reported being in the ABET education group and having no schooling constituted 0% and 3% with high behavior changes, respectively, which was equally low among those with below the senior certificate (3%).

Table 2. Percentage distribution of COVID-19 behavioral changes among adolescents and young adults aged 15 – 24 by background/household characteristics in South Africa

Background characteristics	Behavioral changes (*n*=5581)			*p*-value
	Low	Medium	High	
	n (%)	*n* (%)	*n* (%)	
Gender				0.004*
Male	878 (40.8)	1,282 (55.9)	70 (3.3)	
Female	1,259 (36.7)	2,030 (59.2)	142 4.1)	
Ethnicity				0.09
African/Black	1,845 (38.2)	2,810 (58.1)	179 (3.7)	
Colored	179 (38.7)	271 (58.3)	13 (2.8)	
Asian/Indian	16 (36.4)	25 (56.8)	3 (6.8)	
White	97 (40.4)	126 (52.5)	17 (7.0)	
Province of residence				0.05*
Western Cape	154 (37.5)	242 (58.9)	15 (3.6)	
Eastern Cape	211 (38.6)	318 (58.2	17 (3.1)	
Northern Cape	120 (35.9)	207 (61.9)	7 (2.1)	
Free State	99 (29.5)	221 (65.9)	15 (4.5)	
KwaZulu-Natal	652 (39.8)	918 (56.0)	68 (4.2)	
North West	114 (34.3)	201 (60.5)	17 (5.1)	
Gauteng	326 (38.2)	490 (57.4)	37 (4.3)	
Mpumalanga	213 (39.9)	302 (56.5)	19 (3.6)	
Limpopo	248 41.5)	333 (55.7)	17 (2.8)	
Education level				0.001**
National certificate	19 (35.8)	31 (58.5)	3 (5.7)	
Senior certificate	825 (33.5)	1,521 (61.8)	116 (3.0)	
Below senior certificate	1,190 (43.1)	1,603 (55.6)	88 (3.0)	
ABET	6 (31.6)	13 (68.4)	0 (0.0)	
No schooling	97 (59.4)	64 (38.5)	5 (3.0)	
Household access to electricity				0.9^{ns}
Yes	2,031 (38.3)	3,065 (57.8)	202 (3.8)	
No	106 (37.5)	167 (59.0)	10 (3.5)	
Household access to water				0.004*
Yes	1,531 (37.3)	2,407 (58.6)	171 (4.2)	
No	606 (41.2)	825 (56.0)	41 (2.8)	
Household size				0.08
1 – 4	980 (37.0)	1,564 (59.0)	104 (3.9)	
5 – 6	748 (40.4)	1,027 (55.5)	75 (4.0)	
7+	409 (37.8)	641 (59.2)	33 (3.0)	
Household income				0.001**
Employment	840 (33.9)	1,521 (61.5)	113 (4.6)	
Business	112 (33.8)	201 (60.7)	18 (5.4)	
Government grants	973 (42.5)	1,255 (54.8)	62 (2.7)	
Family	89 (39.4)	124 (54.9)	13 (5.7)	
No income	57 (45.9)	62 (50.0)	5 (4.0)	
Pension	64 (48.1)	68 (51.1)	1 (0.7)	
Household members who received grants				0.35^{ns}
None	1,419 (37.9)	1,168 (58.0)	150 (4.0)	
1	479 (38.4)	719 (57.7)	48 (3.8)	
2+	239 (39.9)	345 (57.7)	14 (2.3)	

Notes: **p<0.01; *p<0.05; ns: Non-significant.
Abbreviation: ABET: Adult basic education and training.

Our study revealed that adolescents who reported to have come from households with no access to water and electricity had a low behavioral change during the COVID-19 period compared to those who had access to water and electricity (41.2% vs. 37.3%; $p < 0.04$). Household income and size were found to be associated with the chances of adopting new behaviors during the COVID-19 period, and only households that received grants were found not to be associated with adopting new measures of behaviors throughout the COVID-19 outbreak.

3.4. COVID-19 preventive measures among adolescents and young adults aged 15 – 24 by background/household characteristics in South Africa

Table 3 presents the percentage distribution of adolescents who adopted some level of preventive measures during COVID-19 in South Africa. Bivariate analysis revealed that some individual and household characteristics were associated with adolescent preventive measures adopted during the COVID-19 period ($p < 0.01$) in South Africa. From the three categories of preventive measures created for this study, 45% of adolescents, both male and female, adopted one to three preventive measures, while <5% of adolescents reported adopting more than four preventive measures during the pandemic. The findings also reveal a relationship between ethnicity and province of residence during the COVID-19 period. Adolescents from the Free State and Gauteng provinces adopted the highest number of preventive measures, with 9.2% and 6.2%, respectively.

Among the household-level factors, the study revealed that adolescents with no access to water had a higher chance of adopting one to three preventive measures compared to those who had access to water (52.2% vs. 47.9%; $p < 0.001$). Access to electricity and household size were found not

Table 3. COVID-19 percentage distribution of preventive measures among adolescents and young adults aged 15 – 24 by background/household characteristics in South Africa

Background characteristics	Preventive measures (*n*=5581)			
	None	1 – 3 practices	4 – 7+ practices	*p*-value
	n (%)	*n* (%)	*n* (%)	
Gender				0.03*
Male	979 (45.5)	1,084 (50.4)	87 (4.0)	
Female	1,590 (46.3)	1,655 (48.2)	186 (5.4)	
Ethnicity				0.001**
Africans/Black	2,138 (44.2)	2,453 (50.7)	243 (5.0)	
Colored	281 (60.7)	162 (34.9)	20 (4.3)	
Asian/Indian	23 (52.3)	20 (45.4)	1 (2.3)	
White	127 (52.9)	104 (43.3)	9 (3.7)	
Province of residence				0.001**
Western Cape	243 (59.1)	150 (36.5)	18 (4.4)	
Eastern Cape	252 (36.1)	271 (49.6)	23 (4.2)	
Northern Cape	221 (66.2)	105 (31.4)	8 (2.4)	
Free State	144 (42.9)	160 (47.8)	31 (9.2)	
KwaZulu-Natal	611 (37.3)	954 (58.2)	73 (4.5)	
North West	224 (67.5)	100 (30.1)	8 (2.4)	
Gauteng	397 (46.5)	403 (47.2)	53 (6.21)	
Mpumalanga	253 (47.4)	261 (48.9)	20 (3.7)	
Limpopo	224 (37.5)	335 (56.0)	39 (6.5)	
Education level				0.3^{ns}
National certificate	32 (60.4)	20 (37.7)	1 (91.9)	
Snr cert	1,152 (46.8)	1,189 (48.3)	121 (4.9)	
Below senior certificate	1,296 (44.9)	1,442 (50.0)	143 (4.9)	
ABET	7 (36.8)	12 (63.2)	0 (0.0)	
No schooling	82 (49.4)	76 (45.8)	8 (4.8)	
Household access to electricity				0.45^{ns}
Yes	2,449 (46.2)	2,591 (48.9)	258 (4.9)	
No	120 (42.4)	148 (52.3)	15 (5.3)	
Household access to water				0.01*
Yes	1,937 (47.1)	1,971 (47.9)	281 (4.9)	
No	632 (42.9)	768 (52.2)	72 (4.9)	
Household size				0.42^{ns}
1 – 4	1,234 (46.6)	1,280 (48.3)	134 (5.0)	
5 – 6	861 (46.5)	907 (49.0)	82 (4.4)	
7+	474 (43.8)	552 (50.9)	57 5.3)	
Household income				0.001**
Employment	1,275 (51.5)	1,087 (43.9)	112 (4.5)	
Business	147 (44.4)	175 (52.9)	9 (2.7)	
Government grants	962 (42.0)	1,207 (52.7)	121 (5.3)	
Family	68 (30.0)	138 (61.0)	20 (8.8)	
No income	49 (39.5)	70 (56.4)	5 (4.0)	
Pension	67 (50.4)	60 (45.1)	6 (4.5)	
Household members who received grants				0.01*
None	1,772 (47.4)	1,786 (47.8)	179 (4.8)	
1	558 (44.8)	628 950.4)	60 (4.8)	
2+	239 939.9)	325 (54.3)	34 (5.7)	

(Cont'd...)

Table 3. ***(Continued)***

Notes: **p<0.01; *p<0.05; ns: Non-significant.
Abbreviation: ABET: Adult basic education and training.

to be associated with the chance of adopting preventive measures during the COVID-19 outbreak.

3.5. Household and individual level determinants of COVID-19 behavioral and preventive measures during the COVID-19 period in South Africa

Utilizing multivariate binary logistic regression, we examined the impact of both individual and household-level factors on behavioral changes and preventive measures adopted by adolescents during the COVID-19 outbreak in South Africa. After controlling for the other covariates, we noticed that gender, ethnic affiliation, province of residence, education attainment, access to electricity, access to water, and household income increased the odds of behavioral changes during the COVID-19 period. Being female had a positive association with the chances of behavioral change. Adolescents from Colored and White racial groups (15 – 24 years) had lower odds of behavioral changes during the COVID-19 period; (adjusted odds ratio [AOR]: 0.84; 95% confidence interval [CI]: 0.66 – 1.08) and (AOR: 0.87; 95% CI: 0.65 – 1.16), respectively. Conversely, adolescents from the Asian/Indian ethnic group had increased chances of adopting new behavioral measures, although their odds did not differ significantly from those of the Colored and White ethnic groups.

In terms of province or residence, adolescents from the Northern Cape, Free State, and Gauteng provinces were associated with increased chances of adopting new behavioral measures during the COVID-19 period. However, adolescents residing in the Eastern Cape, KwaZulu-Natal, Gauteng, Mpumalanga, and Limpopo

had lower odds of adopting these measures: (AOR: 0.97; 95% CI: 0.73 – 1.73); (AOR: 0.94; 95% CI: 0.72 – 1.23); (AOR: 0.90; 95% CI: 0.69 – 1.19); (AOR: 0.89; 95% CI: 0.66 – 1.20); and (AOR: 0.89; 95% CI: 0.66 – 1.20), respectively. Furthermore, an association between educational level and behavioral changes was observed, with adolescents reported to have senior certificates, national certificates, and ABET having increased odds of behavioral changes during the COVID-19 period. Meanwhile, households with access to electricity, those with more than seven members, and households where at least one person received COVID-19 grants were also likely to adopt new behavioral measures during the COVID-19 period. Household income from government grants and pensions was associated with a positive change in behavior throughout the COVID-19 outbreak.

In analyzing the preventive measures adopted during the COVID-19 pandemic in South Africa, the full model, after controlling for various covariates, revealed that gender, ethnicity, and education level had no significant relationship with the adoption of preventive measures during the COVID-19 pandemic. Adolescent women from the Colored, Asian/Indian, and White racial groups (aged 15 – 24 years) had lower odds of adopting new preventive measures during the COVID-19 period: (AOR: 0.96; 95% CI: 0.69 – 1.22); (AOR: 0.91; 95% CI: 0.71 – 1.17); (AOR: 0.72; 95% CI: 0.39 – 1.31); and (AOR: 0.92; 95% CI: 0.69 – 1.22), respectively.

Furthermore, there were notable differences in the adoption of preventive measures across various provinces during the COVID-19 period in South Africa. Adolescents living in the Eastern Cape (AOR: 1.49; 95% CI: 1.12 – 1.99); Free State (AOR: 1.87; 95% CI: 1.35 – 2.58); Kwazulu-Natal (AOR: 2.04; 95% CI: 1.56 – 2.66); Gauteng (AOR: 1.54; 95% CI: 1.18 – 2.02); Mpumalanga (AOR: 1.38; 95% CI: 1.02 – 1.85); and Limpopo (AOR: 2.07; 95% CI: 1.54 – 2.79) were likely to adopt new preventive measures compared to adolescents living in the Western Cape, Northern Cape, and Northwest provinces. Regarding household characteristics, access to electricity, access to water, household income, and the number of household members who received grants were not associated with the adoption of preventive measures during COVID-19, although access to electricity, household income, and the number of individuals receiving grants had increased odds of adopting preventive measures during the pandemic (Table 4).

4. Discussion

This study's primary goal was to examine the influence of household characteristics on behavioral change and preventive measures adopted throughout the COVID-19 outbreak among adolescents in South Africa. The pandemic was a major global health crisis that impacted the social, economic, and development of many nations due to the shutdown of schools and the lockdown of many industries/factories (Carlitz & Makhura, 2021; Dorward *et al*., 2021; Eyawo *et al*., 2021). Most of the young population was largely affected by being dependent on their parents for guidance (Rich *et al*., 2022). Therefore, there is a need to further investigate the role of household-level factors on adolescents' behavior changes and preventive measures adopted during the pandemic. This study adds to the increasing body of research addressing the varied effects of the pandemic on the lives of teenagers in South Africa by demonstrating a relationship between behavioral changes, household features, and preventive actions taken to avert the virus and any other future pandemics.

Using cross-sectional survey data, bivariate analysis demonstrated that individual and household characteristics influenced the behaviors and preventive measures taken during the COVID-19 period in South Africa. The results of this study are in alignment with similar studies conducted in Nigeria and China (Gever *et al*., 2021; Ye *et al*., 2021), which also reported significant relationships between household factors and behavioral changes during the pandemic. This study investigated the influence of household characteristics on adolescents' health throughout the COVID-19 pandemic in South Africa. Two studies conducted in Kenya and Uganda in 2020 reported that about 23% and 15% of young individuals could not change their behaviors because of household conditions during the pandemic, highlighting the significance of household characteristics in shaping the behaviors of young individuals (Karp *et al*., 2021; Matovu *et al*., 2021). In addition, Gift *et al*. (2020) reported that access to water in households increased the change in behaviors and decreased the opportunities of being infected by coronavirus. Furthermore, Sengai *et al*. (2022) observed an increase in preventive measures among adolescents in Lesotho during the COVID-19 outbreak.

According to the literature, there is limited evidence on how household vulnerabilities affect adolescents' behavioral changes during the COVID-19 period in South Africa (Posel *et al*., 2021). Hence, the analysis of this research highlights the importance of our results in informing public health policy and programming, especially for young individuals who significantly depend on their parents for guidance during pandemics.

This study revealed that gender, ethnicity, province of residence, educational level, income, access to water and electricity, and household size were important factors

Table 4. Multivariate logistic regression analysis investigating the risk of background/household characteristics throughout the COVID-19 outbreak among adolescents and young adults (NIDS-CRAM 5, South Africa)

Background characteristics	Behavioral changes (*n*=5581)			Preventive measures (*n*=5581)		
	AOR	*p*-value	95% CI	AOR	*p*-value	95% CI
Gender						
Male	1			1		
Female	1.29	0.001**	(1.15 – 1.44)	0.96	0.492	(0.69 – 1.22)
Ethnicity						
African/Black	1			1		
Colored	0.84	0.191	(0.66 – 1.08)	0.91	0.48	(0.71 – 1.17)
Asian/Indian	1.04	0.9	(0.56 – 1.93)	0.72	0.284	(0.39 – 1.31)
White	0.87	0.349	(0.65 – 1.16)	0.92	0.553	(0.69 – 1.22)
Province						
Western Cape	1			1		
Eastern Cape	0.97	0.844	(0.73 – 1.73)	1.49	0.006**	(1.12 – 1.99)
Northern Cape	1.07	0.663	(0.79 – 1.43)	0.7	0.024*	(0.52 – 0.95)
Free State	1.3	0.109	(0.94 – 1.81)	1.87	0	(1.35 – 2.58)
KwaZulu-Natal	0.94	0.651	(0.72 – 1.23)	2.04	0	(1.56 – 2.66)
Northwest	1.67	0.36	(0.84 – 1.62)	0.62	0.006**	(0.44 – 0.87)
Gauteng	0.9	0.471	(0.69 – 1.19)	1.54	0.002**	(1.18 – 2.02)
Mpumalanga	0.89	0.452	(0.66 – 1.20)	1.38	0.034*	(1.02 – 1.85)
Limpopo	0.89	0.462	(0.66 – 1.20)	2.07	0***	(1.54 – 2.79)
Education level						
National cert	1			1		
Senior cert	1.33	0***	(1.19 – 1.49)	0.98	0.73	(0.88 – 1.09)
Below Snr cert	1.24	0.446	(0.70 – 2.18)	0.53	0.029*	(0.30 – 0.94)
ABET	1.32	0.547	(0.53 – 3.24)	1.1	0.831	(0.46 – 2.65)
No schooling	0.55	0***	(0.40 – 0.76)	0.74	0.063	(0.54 – 1.02)
Access to electricity						
Yes	1			1		
No	1.09	0.514	(0.85 – 1.39)	1.13	0.339	(0.88 – 1.44)
Access to water						
Yes	1			1		
No	0.91	0.167	(0.79 – 1.04)	0.99	0.963	(0.87 – 1.14)
Household size						
1 – 4	1			1		
5 – 6	0.9	0.118	(0.80 – 1.02)	0.93	0.225	(0.82 – 1.04)
7+	1.05	0.52	(0.89 – 1.23)	0.92	0.296	(0.79 – 1.07)
Household income						
Employment	1			1		
Business	1.09	0.476	(0.86 – 1.38)	1.12	0.327	(0.89 – 1.40)
Government grants	0.72	0***	(0.64 – 0.82)	1.33	0***	(1.18 – 1.50)
Family	0.83	0.2	(0.63 – 1.10)	2.31	0***	(1.75 – 3.05)
No income	0.68	0.041*	(0.47 – 0.98)	1.34	0.114	(0.93 – 1.91)
Pension	0.55	0.001**	(0.389 – 0.78)	1.02	0.925	(0.71 – 1.45)

(Cont'd...)

Table 4. ***(Continued)***

Background characteristics	Behavioral changes (*n*=5581)			Preventive measures (*n*=5581)		
	AOR	*p*-value	95% CI	AOR	*p*-value	95% CI
Household members who received grants						
None	1			1		
1	1.04	0.534	(0.91 – 1.19)	1.02	0.809	(0.89 – 1.16)
2+	0.96	0.661	(0.80 – 1.15)	1.17	0.086	(0.98 – 1.40)

Note: ***p<0.001; **p<0.01; *p<0.05.
Abbreviations: AOR: Adjusted odds ratio; CI: Confidence interval.

associated with behavioral changes among young people in South Africa during the COVID-19 pandemic. In addition, this study revealed that the number of household members who received COVID-19 grants did not affect adolescents' behavioral changes. One key reason for the resistance to behavioral change among some young people could be a lack of proper information about the COVID-19 pandemic, as adolescents without access to radio or TV did not receive the necessary information to make informed changes in their behavior.

Our study further revealed that gender, ethnicity, province of residence, access to water, household income, and the number of household members who received any form of COVID-19 grant were important factors in adopting any form of preventive measure during the pandemic. Furthermore, education level and household size were not associated with any form of preventive measure adopted among adolescents.

This study also found that the odds of behavioral changes during the COVID-19 period among adolescents were lower among the Colored and White racial groups. This suggests that an adolescent's ethnic background significantly influenced the extent to which they changed their behaviors throughout the period. In addition, the study revealed that being female had a positive association with behavioral changes, implying that females had increased odds of positive behavior change during the pandemic. This finding corroborates the results of other studies from Ghana, which reported that young women were more likely to change their behaviors during the COVID-19 pandemic (Asiamah *et al*., 2021). Adoption of new behavioral measures was lower among male youth, probably because they were less aware of the various behavioral guidelines provided by the Department of Health throughout the COVID-19 outbreak. Literature states that men perform poorly in analyses concerning hygiene measures. This may also be the reason why male youth would be less aware of different behavioral guidelines provided by the Department of Health (Manirambona *et al*., 2022).

There was a significant association between household access to electricity and behavior change during COVID-19 among young people in South Africa. A similar result was reported in a previous study (Gittings *et al*., 2021). This research implies that, to ensure that households have access to electricity during pandemics and are well informed about the harmful effects of the illness, the government should give priority to these vulnerable homes. Furthermore, adolescents from households with seven members or above had increased odds of changing behaviors during pandemics. This finding signifies the importance of acknowledging the importance of large families in determining health-seeking behaviors during pandemics among young people. Meeting the health needs of large families, such as during the COVID-19 pandemic, has the potential to increase the necessary preventive measures to be taken during pandemic crises. By continuing to pursue the positive health-seeking behaviors of large families during a pandemic, such as the COVID-19 pandemic, the government will create an opportunity to reduce the risks, trends, and factors that will inform targeted public health interventions among the youth.

The research employed the HBM to elucidate the reasons for the behavioral modifications and preventative actions taken by a subset of South African youth during the COVID-19 pandemic. This model was adopted because people are more likely to take preventative health-promoting measures when they think the advantages of doing so exceed the challenges or drawbacks of doing so (Campos-Mercade *et al*., 2021; Jones & Wallis, 2022). The paradigm presupposes that people acquire rational abilities to make decisions by means of communication or schooling.

It is pertinent for young people to understand the importance of adopting preventive measures during infectious disease outbreaks to avoid contracting the virus. Household factors play a pivotal role in this regard, as some youths mentioned that they could not adopt any measure of preventive mechanisms in South Africa, despite the benefits associated with it. This finding could be

linked to the fact that HBM emphasizes that people adopt preventive health promotion measures when they think the advantages outweigh the challenges. The adolescents must have found that the challenges were too great to change their behaviors. The findings showed that adolescents from households with access to water were less likely to adopt any form of preventive measure during the pandemic compared with those with no access to water. This is a surprising result for us because both national and global agencies advocated for regular handwashing during the COVID-19 pandemic. It could also be a result of how the questions related to water were framed. On the contrary, it could be that the respondents did not understand the question based on their level of education, as the interviews were conducted through telephone calls; hence, a better approach for the adolescents to understand the question and provide appropriate responses could be a face-to-face interview. This finding confirms the assumption of the HBM that youth's increased knowledge may contribute to their understanding of the benefits of adopting preventive measures during pandemics. It shows that when an individual has better knowledge of an intervention, such as the preventive measures rolled out to minimize the spread of the COVID-19 pandemic, they are more likely to accept such an intervention.

4.1. Limitations of the study

This study has certain limitations that should be taken into account. First, causal inferences are limited by the study's cross-sectional design. Second, because participants were asked to express their attitudes about preventative health-seeking behavior in the survey rather than in the current year, recall bias may have affected their responses. Third, the dataset lacked information on a few significant outcomes and independent variables, including a woman's sexual activity, religion, and number of children. As such, carrying out an exhaustive investigation on the impact of COVID-19 on South African households during the pandemic proved to be difficult. Despite its shortcomings, this is a study that offered insight into adolescents' changes in behaviors and precautionary measures adopted during the COVID-19 era in South Africa. To address the damaging effects of the pandemic on youth's health, the study will therefore inform adolescents' health programming during any pandemic such as COVID-19.

Despite the fact that the full impact of the COVID-19 pandemic on adolescents' health and well-being experiences is not fully investigated in South Africa, this study provides a mini understanding of the effects of household-level factors during the COVID-19 period on behavioral changes, as well as preventive measures adopted among adolescents aged 15 – 24 years in South Africa. The percentage of young people who did not change their behaviors positively or adopt any preventive measures during the COVID-19 period is of concern for improving their health and well-being in the country. The low percentage of adopting any form of preventive measure during the pandemic observed in this study could be due to the challenges faced by many households seeking the means of survival as there were total lockdown rules, which made many individuals from an impoverished household unable to attempt to improve their situation. The other reasons could be poverty, lack of access to their farmlands, and disruptions in the supply and provision of food (Tripathi *et al*., 2021).

The findings of this study have significant implications for a theoretical understanding of the individual and household-level factors associated with behavioral changes, as well as preventive measures adopted during the COVID-19 period among youths in South Africa. In addition, the findings draw attention to individual, and household-level disruptions and challenges adolescents encountered during the pandemic in South Africa. It has also helped to identify the vulnerability of household conditions that need to be supported and improved during the COVID-19 period and any other infectious outbreak in the future. This is to ensure that young people from vulnerable households are supported to make decisions that will improve their health and well-being. Hence, the findings from this study will guide health policymakers in designing health policies and interventions that address the unique health-care needs of young people and support households during pandemics to avert the future consequences of COVID-19 on adolescent health in the country.

5. Conclusion

The study revealed that the behavior changes and preventive measures taken by adolescents were influenced by household-level characteristics during the COVID-19 pandemic in South Africa. This is evident from the increased proportion of adolescents who neither changed their behavior nor adopted any preventive measures during the pandemic. The impact of the COVID-19 infection on household living conditions in many communities may have contributed to this lack of behavioral change and preventive action. The study also established that lack of access to basic amenities such as social grants, water, and electricity altered the positive behaviors of youths toward the pandemic, thereby limiting their understanding of the infection's severity. This resulted in many young individuals falling victim to the COVID-19 infection in South Africa due to limited knowledge of the symptoms of the infection. Future studies should explore how community factors such as poverty, media exposure, and education affect

preventive health-seeking behaviors during pandemics. In addition, studies should examine the impact of providing community support and addressing cultural norms related to infections in SSA countries. Therefore, to prevent the spread of infection in South Africa, policymakers should strive to address these household characteristics that have been undermining the lives of people during pandemics.

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Conflict of interest

The authors declare that they have no conflicts of interest.

Author contributions

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Ethics approval and consent to participate

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Consent for publication

Not applicable.

Availability of data

The study uses fully anonymized secondary data obtained from the South African National Income Dynamics CRAM Survey, which can be downloaded freely online at http://cramsurvey.org/.

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Appendix

Appendix A1. Ranking of how adolescents' behavior changed during COVID-19 in South Africa

In what ways has your behavior changed (week 1)?	In what ways has your behavior changed (week 2)?	In what ways has your behavior changed (week 3)?	In what ways has your behavior changed (week 4)?	In what ways has your behavior changed (week 5)?	In what ways has your behavior changed (week 6)?	In what ways has your behavior changed (week 7)?
Wash hands more; avoid close contact with others; avoid big groups; wear face masks; get a flu vaccine; eat garlic; stay home more; use sanitizer; regularly clean/ disinfect home/surfaces; social distancing; wear gloves; avoid going to crowded places; spend time in the sun; no, I'm not doing anything; eating healthy.	Avoid close contact with others; avoid big groups; wear face mask; get a flu vaccine; eat garlic; stay home more; use sanitizer; regular cleaning/disinfect home/surfaces; use gloves; cough into elbow; stop drinking; stop smoking; avoid going to crowded places, spend time the sun; no, I'm not doing anything; eating healthy.	Avoid big groups; wear face mask; get a flu vaccine; eat garlic; stay home more; use sanitizer; regularly clean/disinfect home/surfaces; social distancing; wear gloves; cough into elbow; stop drinking; stop smoking; avoid going to crowded places; spend time the sun; no, I'm not doing anything; eating healthy.	Wear face mask; get a flu vaccine; eat garlic; stay home more; use sanitizer; regularly clean/disinfect home/ surfaces; social distancing; wear gloves; cough into elbow; stop drinking; stop smoking; avoid going to crowded places; spend time the sun; no, I'm not doing anything; eating healthy.	Get a flu vaccine; eat garlic; stay home more; use sanitizer; regularly clean/ disinfect home/surfaces; social distancing; wear gloves; stop drinking; avoid going to crowded places; spend time in the sun.	Use sanitizer; regularly clean/ disinfect home/ surfaces; wear gloves; cough into elbow; stop drinking; avoid going to crowded places; spend time in the sun; eat healthy.	Wear gloves and avoid going to crowded places.

Appendix A2. Ranking of adolescents' preventive measures adopted during COVID-19 in South Africa

Why unlikely to get the coronavirus (week 1)?	Why unlikely to get the coronavirus (week 2)?	Why unlikely to get the coronavirus (week 3)?	Why unlikely to get the coronavirus (week 4)?	Why unlikely to get the coronavirus (week 5)?	Why unlikely to get the coronavirus (week 6)?
Haven't interacted with someone with the virus; I stay at home; I wash my hands; I wear a mask; I social distance away from others; I don't believe there is something like this; coronavirus only affects people who are old; I sanitize my hands.	I stay at home; I wash my hands; I wear a mask; I social distance from others; I don't believe there is something like this; coronavirus only affects people who are old; I sanitize my hands.	I wash my hands; I wear a mask; I social distance from others; I don't believe there is something like this; I sanitize my hands.	I wear a mask; I social distance from others; I don't believe there is something like this; I sanitize my hands.	I don't believe there is something like this; I sanitize my hands.	I sanitize my hands.

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