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## Socioeconomic Impacts of Households' Vulnerability during COVID-19 Pandemic in South Africa: Application of Tobit and Probit Models

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### Abstract

Coronavirus is a public health issue with socioeconomic and livelihood dimensions. The World Health Organization declared the current novel coronavirus disease (COVID-19) epidemic a public health emergency of international concern on January 30, 2020, and a global pandemic on March 11, 2020. The South African government has implemented different strategies, ranging from total lockdown in certain locations and provision of palliatives in some provinces across the country. This study, therefore, investigated the correlates of vulnerability and responsiveness to the adverse impacts of COVID-19 in South Africa. The study utilized primary data collected among 477 respondents. Descriptive statistical tools, Tobit and Probit regression models, were used to analyze the data. The study found different levels of vulnerability (low, medium, and high) and responsiveness among households, including stocking up of food items, remote working, reliance on palliatives, and social grant provision, among others. Some of the correlates of responsiveness to the COVID-19 pandemic include being employed, the type of community, and the income of respondents. The study, therefore, recommends increased investments in welfare programmes (safety nets, palliative measures and economic stimulus packages) as well as capacity building of households through education to reduce vulnerability.

**Keywords:** Coronavirus; Determinants; Responsiveness; Vulnerability; South Africa.

### 1. Introduction

The novel Corona Virus Disease 2019 (COVID-19) is a pandemic with serious public health and economic dimensions [1, 2]. The COVID-19 virus, which was discovered in late 2019 in Wuhan, China, had spread across all countries [3]. As of May 2021, a total of 165,772,430 confirmed cases of COVID-19, including 3,437,545 deaths, had been recorded globally [4]. The pandemic has resulted in several mitigation strategies, including lockdown restrictions, palliatives, and social grants, among others. However, the lockdown restrictions resulted in significant welfare and economic losses for households and the government, respectively [5-8]. This is evident in the slowdown of production activities, tourism, taxes, and food insecurity due to the lockdown restrictions [9-11].

South Africa accounted for the highest number of confirmed cases in Africa. Specifically, a total of 1,654,551 cases resulting in 55,293 fatalities have been confirmed in South Africa [4]. This implies that the country bears a greater burden of COVID-19 relative to any other African country. In an attempt to mitigate the adverse impacts of COVID-19 on the economy, the South African government allocated about US\$ 160 million to assist vulnerable businesses, about US\$ 8.4

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billion to the unemployment insurance fund, and provided tax subsidies for at least 75,000 small and medium enterprises with a turnover of less than US\$2.7 million, among other relevant fiscal and monetary policies [12].

COVID-19 is a threat multiplier as it worsened the weak economic indices since the South African economy was already witnessing negative growth. The unemployment rate increased from 27.3 percent in the first quarter to 29.1 percent in the third quarter of 2019 [13]. There are reports in the literature that the pandemic would have reversed the welfare gains recorded in 2019 when poverty incidence decreased to 49.2 percent from the 55.5 percent that was recorded in 2015 [14]. The pandemic affected the aviation and tourism sectors of the economy as the lockdown restricted travel, resulting in underemployment and unemployment in extreme cases [3]. An estimated 50 percent of the population is engaged in the informal sector, hence the high dependence on physical interactions that were constrained by the lockdown [15].

A few studies have been published on COVID-19 responsiveness in South Africa [16–18]. Kollamparambil & Oyenubi [16] investigated the extent and determinants of COVID-19 vaccination hesitancy in South Africa. Cooper et al. [18] analyzed the behavioral response to the COVID-19 pandemic in South Africa. However, the previous attempts did not investigate socioeconomic factors affecting the vulnerability to adverse impacts and responsiveness to COVID-19 in South Africa. This study attempts to fill this identified gap in research. This study investigated the socioeconomic determinants of vulnerability and responsiveness to COVID-19 in South Africa. Therefore, the insights from this study will assist policymakers in implementing appropriate interventions against the pandemic.

## 2. Literature Review

Economies around the globe have unique socioeconomic structures that depict the relationship between the diverse range of forces that determine economic growth and development, for example, employment and the impacts of disasters [19]. COVID-19 is one such disaster that has radically changed economic structures and processes, challenging the relevance and effectiveness of economic planning processes [1]. Since the outbreak, COVID-19 has spread rapidly to almost all countries in the world. The World Health Organization declared COVID-19 a public health emergency of international concern on the 30<sup>th</sup> of January, 2020, and thereafter pronounced it a global pandemic on the 11<sup>th</sup> of March, 2020.

The COVID-19 pandemic is a health disaster that has global health impacts coupled with socio-economic disruptions and losses of livelihoods [20]. The COVID-19 pandemic resulted in a considerable decline in economic activities in the global economy because of restriction measures put in place to reduce the contagion [21]. According to an early forecast by the International Monetary Fund [22], the global economy would contract by about 3 percent in 2020. However, in its June 2020 update, the International Monetary Fund [23] revised the forecast to a 4.9 percent contraction in 2020. The following reasons were cited for the updated forecast:

- Greater persistence in social distancing activities;
- Lower activity during lockdowns;
- Steeper decline in productivity amongst firms, which are open for business; and
- Greater uncertainty.

South Africa's economy suffered a significant contraction during the 2<sup>nd</sup> quarter of 2020, when the country operated under widespread lockdown restrictions in response to COVID-19. Gross domestic product (GDP) fell by just over 16% between the first and second quarters of 2020, giving an annualized growth rate of -51 percent, which dwarfed the annualized slowdown of 6.1% recorded in the first quarter of 2009 during the global financial crisis [24]. There has been an increase in the unemployment rate, consequently decreasing purchasing power and impacting effective demand for adequate food and other basic needs [25]. From both the demand and supply perspectives, the lockdown resulted in a massive decline across a lot of industries. The effect was widespread across industries, but most felt in the service sectors (e.g., restaurants, entertainment, tourism, travel, hotels, etc.). The lockdown birthed major impacts on employment, production, and demand, and these impacts spilled over into the macro-economy [7]. In the agricultural sector, restrictions on movement have disrupted the food systems by causing home and foreign price hikes in South Africa and having a far-reaching impact on individuals' and households' ability to access food [26]. The economic implications are wide-ranging and uncertain, with different effects on the labour markets, production supply chains, financial markets, and the world economy. The negative economic effects may vary by the stringency of the social distancing measures (e.g., lockdowns and related policies), their length of implementation, and the degree of compliance across economies.

## 3. Data and Models

Primary data was collected among South Africans using a Computer-Aided Personal Interviewing tool. This study was conducted in all the provinces of South Africa between April and October 2020. Although questionnaires from the Western Cape province were excluded from the analysis because only a few people (less than five) completed the questionnaire out of a total of over 477 received. The data collected include information on socioeconomic characteristics,

level of awareness of COVID-19, vulnerability, and responsiveness, among others. We model the linear regression as;

$$FW_i = \beta_0 + \beta_1 X_i + \varepsilon_i \quad (1)$$

where  $FW_i$  is the effect of financial wellbeing during coronavirus pandemic (categorical order variable);  $X_i$  are the covariates which included age (years), marital status (categorical variable), education, income, household size, province, and log of monthly income. This study used Probit regression model to analyse the factors influencing responsiveness to COVID-19 contagion mitigation measures. Age of respondents, employment status and location of respondents were found to be significant.

The Tobit regression model was used to analyse the determinants of vulnerability to the adverse impacts of COVID-19 among respondents in the study area. Age and being unemployed were found to be significant.

## 4. Results and Discussion

### 4.1. Socioeconomic Characteristics of Respondents

This section profiles the COVID-19 responsiveness against socioeconomic characteristics of the respondents such as age, sex, marital status, monthly income, location and COVID-19 spread mitigation measures. Table 1 presents the summary statistics of the dataset.

**Table 1. Profile of COVID-19 Responsiveness Against Socioeconomic Characteristics of Respondents**

Variable	Responsive	Non-responsive	Total
<b>Age (years)</b>			
<30	240 (61.70)	149 (38.30)	389 (81.56)
30-39	19 (43.18)	25 (56.82)	44 (9.22)
40-49	9 (28.13)	23 (71.88)	32 (6.71)
≥50	4 (33.33)	8 (66.67)	12 (2.52)
<b>Sex</b>			
Female	117 (55.71)	93 (44.29)	210 (44.03)
Male	155 (58.05)	112 (41.95)	267 (55.97)
<b>Marital Status</b>			
Married	23 (34.85)	43 (65.15)	66 (13.84)
Non married	249 (60.58)	162 (39.42)	411 (86.16)
<b>Monthly Income (Rands)</b>			
<3,000	196 (63.02)	115 (36.98)	311 (65.20)
3,000-5,999	31 (52.54)	28 (47.46)	59 (12.37)
6,000-8,999	14 (58.33)	10 (41.67)	24 (5.03)
>9,000	31 (37.35)	52 (62.65)	83 (17.40)
<b>Location</b>			
Urban/Peri-urban	57 (40.71)	83 (59.29)	140 (29.35)
Rural	215 (63.80)	122 (36.20)	337 (70.65)
<b>COVID-19 Awareness</b>			
No	8 (57.14)	6 (42.86)	14 (3.13)
Yes	264 (55.35)	199 (41.72)	463 (97.06)

Sixty-two percent of the respondents below 30 years old responded to the COVID-19 spread mitigation measure by stocking their houses with food items before the lockdown orders were put in place. On the other hand, 71 percent of the respondents between 40-49 years of age had the highest proportion of those who had no response to the COVID-19 spread mitigation measure. This might be because the study area has a large, young, and economically active population below 30 years old. This is consistent with the earlier findings of [27]. Generally, at older ages of the population, the response level was observed to decline, with respondents aged 40 years and above recording the lowest response level in both response categories. The results presented in Table 1 revealed that males accounted for the majority of the respondents in the study area. Male respondents have a higher response level in both response categories relative to their female counterparts. In terms of marital status, the majority of the respondents were not married. This may be because most respondents are under 30 years of age, therefore most of the respondents may not have married.

The majority of the respondents earned monthly income below R3000, and they have the highest level of responsiveness to the COVID-19 contagion mitigation measure. This could be because low-income earners tend to allocate a larger part of their income to the purchase of food items. Respondents who earned above R9000 monthly had higher non-responsiveness, and this could be linked to the fact that at higher income levels, individuals tend to place priority on luxuries relative to necessities such as food items [28].

A larger number of the respondents are aware of the COVID-19 pandemic incidence in the study area. However, a lot of the respondents did not stock up their homes with food items as a response to the lockdown orders [1]. This could be due to the short lockdown notice and financial hardship faced by low-income earners, who make up the largest number of respondents in the study area.

#### 4.2. Vulnerability to the Adverse Impact of COVID-19 Pandemic

The results presented in Table 2 revealed that 16 percent of the respondents were not vulnerable, 76 percent were moderately vulnerable while 8 percent were highly vulnerable. Based on the results, most of the respondents who are younger than 30 years were either moderately vulnerable (95%) or highly vulnerable (11%) to the adverse impact of COVID-19. This might be because most of the respondents who are younger than 30 years are single, either unemployed or in school. In fact, the majority of the respondents who were unemployed were vulnerable, as they had moderate (84%) and high vulnerability (16%). In terms of location, respondents that are based in rural areas (75%) and urban areas (76%) are mostly moderately vulnerable. This is consistent with the earlier reports of Ngarava [8], which highlighted the vulnerability of rural youth, poor people, and migrant and seasonal workers to the adverse impacts of COVID-19. This study found that respondents who were earning at least R9,000 had moderate vulnerability without falling into the high vulnerability category. Conversely, the majority of the households earning less than R3000 per month had moderate vulnerability (77%) to adverse COVID-19. This implies that respondents who are employed and earn at least 9000 rands per month are less vulnerable to adverse COVID-19 impacts.

**Table 2. Vulnerability profile of respondents**

	Non-vulnerable	Moderately vulnerable	Highly vulnerable	Total
<b>Age (years)</b>				
<30	61	293	35	389
30-39	7	32	5	44
40-49	6	26	0	32
≥ 50	1	10	1	12
<b>Sex</b>				
Female	37	154	19	210
Male	38	207	22	267
<b>Marital Status</b>				
Single	60	311	36	407
Married	13	49	4	66
Separated	1	1	0	2
Widowed	1	0	1	2
<b>Monthly Income (Rands: 100 Rands = 5.84 USD)</b>				
< 3000	29	237	35	301
3000- 5999	15	48	6	69
6000- 8999	5	19	0	24
>9000	26	57	0	83
<b>Location</b>				
Urban/ Peri-urban	22	107	11	140
Rural	53	254	30	377
<b>Employment Status</b>				
Employed	75	150	0	225
Unemployed	0	211	41	252

#### 4.3. Factors Influencing Vulnerability of Respondents to the Adverse Impact of COVID-19 Pandemic

The results presented in Table 3 revealed that age and being unemployed are the factors influencing vulnerability to the adverse impact of COVID-19. A positive and statistically significant relationship exists between age and vulnerability

to COVID-19. In fact, a unit increase in age will increase vulnerability by 0.79 percent. This might be due to the higher burden and high susceptibility to COVID-19 among elderly people [29]. The study also found a positive relationship between being unemployed and vulnerability to COVID-19. This might be due to the limited income available to unemployed individuals to procure necessary preventive items and stock food in situations of lockdown. Therefore, individuals that are unemployed have a 13.92 percent increase in vulnerability to the COVID-19 pandemic relative to their employed counterparts.

**Table 3. Determinants of Vulnerability to Adverse Impact of COVID-19 (Data Analysis, 2021)**

Variables	Coefficient (Standard error)	Marginal Effect
Age	0.0068** (0.0034)	0.0079
Sex	0.0142 (0.0310)	0.0142
Married	-0.0276 (0.0743)	-0.0275
Education	-0.0091 (0.0113)	-0.0091
Household size	-0.0043 (0.0058)	-0.0042
Monthly Income	-0.0004 (0.0002)	-0.0001
<b>Primary Occupation</b>		
Unemployed	0.3940** (0.0810)	0.3920
Public/Civil Service	-0.0008 (0.1021)	-0.0008
Student	-0.0962 (0.1304)	-0.0962
Private Sector/Artisans	0.1076 (0.1104)	0.1076
Traders	-0.0111 (0.1722)	-0.0011
Location (rural)	0.1459 (0.0246)	0.0146
Constant	0.0584	
R <sup>2</sup>	0.3273	

Standard errors in parentheses; \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

#### 4.4. The Correlates of Responsiveness to COVID-19 Pandemic

The results presented in Table 4 revealed a positive and statistically significant relationship between age and responsiveness to COVID-19 contagion mitigation measures. A unit increase in the age of respondents will lead to a less than 1% responsiveness to COVID-19 contagion mitigation measures. This implies that older respondents would respond more to the mitigation measure as COVID-19 has been proven to have more adverse effects on older persons and persons with other underlying disease conditions [30].

**Table 4. COVID-19 responsiveness and adverse effect on financial wellbeing**

Variables	Adverse effect on financial wellbeing	
	(1) Pooled OLS	(2) Probit
Municipality support system	-0.0751 (0.113)	-0.297 (0.385)
Provision of reliefs	0.00621 (0.0241)	0.0295 (0.0834)
Community healthcare	0.0147 (0.0148)	0.0535 (0.0527)
Index of price, income & expense	0.294** (0.115)	0.952** (0.396)
Age	0.00671* (0.00392)	0.0235 (0.0145)
Sex	0.0541 (0.0401)	0.200 (0.141)
<b>Family structure Ref: Single</b>		
Married	-0.195** (0.0856)	-0.698** (0.302)
Widow	-0.424 (0.308)	-1.321 (0.989)
Divorced	0.0171 (0.360)	

Education Ref: No schooling		
Primary	-0.860 (0.534)	
Secondary	-0.0878 (0.345)	-0.199 (0.236)
Diploma	-0.0270 (0.353)	-0.00580 (0.368)
Bachelor	-0.0800 (0.345)	-0.168 (0.219)
Postgraduate	-0.0480 (0.346)	
Household size	0.00630 (0.00750)	0.0248 (0.0280)
Occupation	-0.0202 (0.0132)	-0.0683 (0.0453)
Province Ref: Western Cape		
Eastern Cape	0.481 (0.357)	
Northern Cape	0.316 (0.303)	0.988 (0.979)
Free State	0.00337 (0.360)	0.0445 (1.136)
KwaZulu-Natal	0.281 (0.299)	0.884 (0.965)
North West	0.287 (0.306)	0.883 (0.991)
Gauteng	0.529 (0.511)	
Mpumalanga	0.235 (0.342)	0.727 (1.093)
Limpopo	0.525 (0.514)	
Constant	0.375 (0.474)	-0.653 (1.070)
Observations	449	438
R-squared	0.066	

Standard errors in parentheses; \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Being employed is significant at 5% and has a positive relationship with responsiveness to COVID-19 contagion mitigation measures. This implies that employed respondents have a higher likelihood to respond to the COVID-19 mitigation measure by stocking up their houses with food items in readiness for the lockdown orders (See Figure 1). This corroborates the earlier reports of Mogaji [31].

The location of the respondent is also significant at 1% and has a negative relationship with responsiveness to COVID-19 contagion mitigation measures. Living in a rural area decreases the livelihood of a respondent being responsive by 13.5%. Rural dwellers can source food items from their gardens and farms and might not need to stock up their homes with food items.

*Robustness check:* Figure 2 depicts the family structure, which shows that separated and divorced people are less affected by the COVID-19 pandemic than married people and single people. Interestingly, the single has a more negative effect on the coronavirus as compared to other family structures.

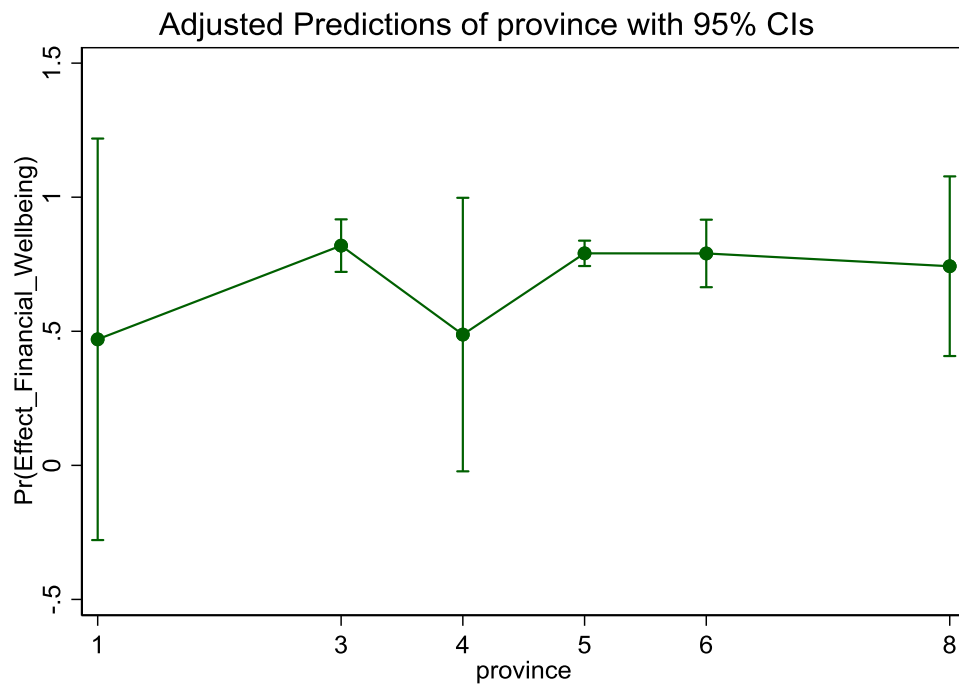


Figure 1. Provinces and adverse effect of COVID-19

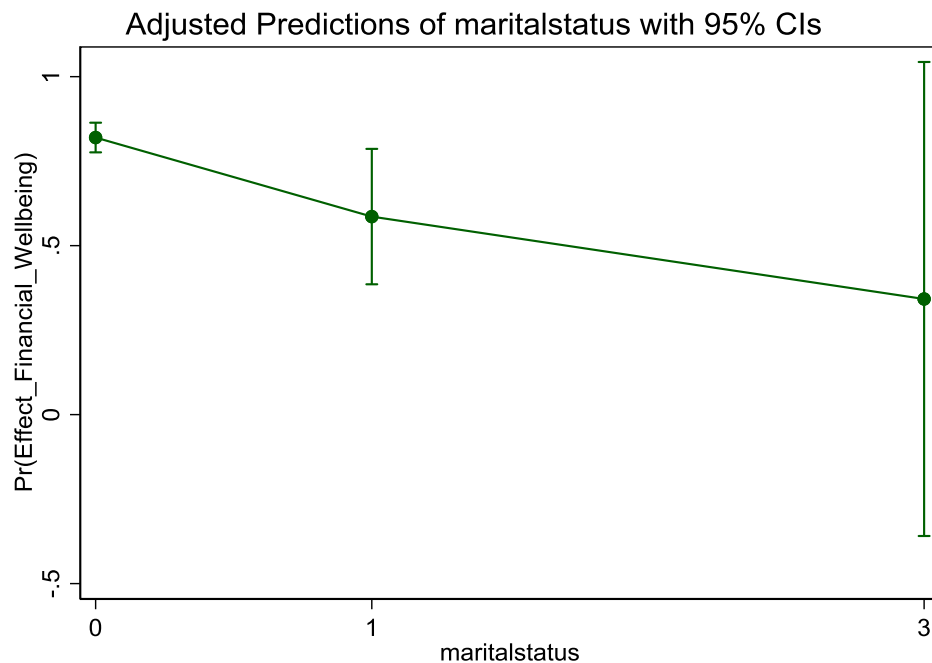


Figure 2. Family structure (or marital status)

## 5. Conclusion and Recommendations

This study was conducted to analyze the factors influencing responsiveness and vulnerability to the adverse impacts of COVID-19. The study utilized valid data from 477 respondents for its analysis. In addition, descriptive statistical tools, probit, tobit, and multiple linear regression models were used to analyze relevant data. The study found that most of the respondents were aware of the COVID-19 pandemic. However, fewer respondents were responsive to the pandemic and the associated lockdown measures. Therefore, this study proves that the high level of awareness of COVID-19 among the respondents does not necessarily mean they have the capacity and support to respond appropriately and mitigate the adverse impacts of the pandemic. The results of the Probit Regression model revealed that age, living in rural areas, and being employed are the factors affecting the responsiveness of households to the COVID-19 pandemic. Similarly, age and employment status determine the level of vulnerability to the adverse impacts of the COVID-19 pandemic.

Emanating from the study findings, there should be increased investments in welfare programmes (safety nets, palliatives and economic stimulus packages) as well as capacity building of households through education to reduce



vulnerability. Government and relevant stakeholders should also prioritize rural communities in the development of appropriate COVID-19 mitigation strategies.

This study has a few limitations that could be potentially addressed in future studies. The study did not consider the effects of other factors such as access to health care, household size, family structure, sector of employment, and remittances on the responsiveness and vulnerability to the adverse effects of COVID-19. In addition, the study did not analyze the roles of specific government- or private sector-led interventions targeted at improving the responsiveness of South Africans. This would have provided insights into the impacts of such interventions on responsiveness among the respondents.

## 6. Declarations

### 6.1. Author Contributions

Conceptualization, I.B.O.; methodology, I.B.O., A.O.O., and O.A.A.; formal analysis, A.O.O. and O.A.A.; resources, I.B.O.; writing—original draft preparation, I.B.O., A.O.O., and O.A.A.; writing—review and editing, I.B.O. and A.O.O. All authors have read and agreed to the published version of the manuscript.

### 6.2. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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The authors received no financial support for the research, authorship, and/or publication of this article.

### 6.4. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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