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COVID-19 Infection Risk and Socioeconomic Disparities in Non-Communicable Disease Patients: Evidence from Rural Sierra Leone

Amira Ben Salah[1]*, Youssef Trabelsi[1]

[1]Department of Social and Preventive Medicine, Faculty of Medicine, University of Tunis El Manar, Tunis, Tunisia.

***E-mail** ✉ amira.bensalah@outlook.com

Abstract

Non-communicable diseases (NCDs) are emerging as a major contributor to death and illness in Sierra Leone. Despite this, there is limited understanding of how NCD patients in Sierra Leone experience both direct COVID-19 exposure and the indirect consequences of the pandemic on socioeconomic determinants of health. We performed a cross-sectional telephone survey among adults (≥ 18 years) with hypertension, diabetes, or heart failure receiving care at the NCD clinic of Koidu Government Hospital (KGH) in rural Sierra Leone. We collected information on patient demographics, COVID-19 knowledge, and adherence to infection prevention measures. Wealth quintiles were assigned using an asset-based index to approximate national representation, and social vulnerability indicators were stratified by clinical program and wealth category. Among 400 participants, 80.5% were aged 40–69 years, and 46.1% were male. Over 90% were aware that wearing masks, maintaining physical distance, isolating from infected individuals, and avoiding handshakes were effective for COVID-19 prevention. Yet, only 27.3% had access to adequate handwashing facilities, 25.5% had attended crowded gatherings in the prior two weeks, and just 5.8% consistently used masks. Compared to national wealth distribution, 33.0% of participants were in the richest quintile, 34.8% in the second-richest, and 32.2% in the combined bottom three quintiles. Socioeconomic vulnerability was widespread with clear disparities across wealth levels. Within the 30 days prior to the survey, nearly 60% of individuals in the poorest-middle categories faced at least one barrier to essential health services, 87.4% resorted to at least one emergency coping strategy for food, housing, or health care, and 98.4% reported food-related worry. Corresponding figures for the richest quintile were 32.3%, 39.5%, and 81.6%.Patients demonstrated good awareness of COVID-19 preventive practices; however, there were notable gaps between knowledge and actual behaviors. Despite being wealthier than the national average, NCD patients still experienced high levels of socioeconomic vulnerability, highlighting the persistent issue of absolute poverty in Sierra Leone. Wealth-related inequities in access to essential resources remain a significant concern among this population.

Keywords: COVID-19, Non-communicable disease, Death and illness, Socioeconomic disparities

Introduction

NCDs account for 71% of deaths globally [1]. Individuals with pre-existing NCDs face a dual burden during the COVID-19 pandemic: a heightened risk of severe outcomes, including hospitalization and death from COVID-19 [2, 3], and susceptibility to indirect impacts such as disruption of health services, limited access to medications, and challenges in securing social determinants of health [4, 5]. Interruptions in chronic disease care can result in complications and increased mortality [6], while insufficient access to food and safe housing can hinder disease management [7, 8].

In Sierra Leone, NCDs are an increasingly significant source of death and disability. DALYs lost to NCDs and injuries rose from 18% in 1990 to 28% in 2017, and by 2017, NCDs accounted for one-third of all deaths [9]. As one of the world's poorest nations [10], access to government-funded NCD care is limited, leaving patients

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with restricted treatment options—a situation likely worsened by the COVID-19 pandemic [4]. Sierra Leone's population was estimated at 8,420,641 in 2021 [11]. Between March 2020 and March 2023, 7,760 COVID-19 cases and 125 deaths were reported [12], though these numbers likely underestimate the true burden due to diagnostic and reporting limitations. The pandemic has affected management of acute and chronic conditions, including declines in hospital visits and TB diagnoses [13, 14]. Lockdowns and COVID-19 impacts have led to reduced income, food insecurity, and heightened anxiety [15]. While other settings have studied social vulnerability and pandemic experiences among NCD patients [16–18], no research has addressed these issues in Sierra Leone. This study aims to characterize the direct and indirect effects of COVID-19 on NCD patients, with attention to exposure risks and socioeconomic vulnerability.

Materials and Methods

Study setting

The study was conducted at KGH in Kono District, a rural area with one public secondary hospital, 90 primary health facilities, and around 500,000 residents [19]. In 2018, Partners In Health, in collaboration with the Sierra Leone Ministry of Health and Sanitation, established one of the country's first outpatient NCD clinics at KGH. Initially operating one day per week, the clinic expanded due to demand. Over four years, more than 5,000 patients with NCDs, including hypertension, heart disease, liver disease, diabetes, and stroke, have been enrolled.

Study population

Participants were adults (≥ 18 years) with hypertension, diabetes, or heart failure receiving treatment at KGH. Patients lacking a phone number were excluded. Paper-based registers were used to create a sampling frame, generating three groups of random line numbers corresponding to each clinical program. For each selected line, staff extracted the next eligible patient's contact information. To account for anticipated non-response, 300 line numbers per program were initially sampled to achieve at least 167 respondents per group. Patients in multiple programs were assigned hierarchically (hypertension, heart failure, diabetes) until the sample criteria were met. Deceased patients were replaced by the next eligible individual in the register.

Random sampling was imperfect in practice: (a) hypertension patients were selected randomly but called by line order, favoring earlier enrollees; (b) the first 300 diabetes patients were called sequentially rather than randomly; (c) all heart failure patients with listed phone numbers were contacted. Additionally, the sample overrepresented older individuals compared to the general population.

Data collection

Because COVID-19 restrictions prevented in-person interviews, we gathered information through telephone surveys. The questionnaire was developed jointly with the PIH Cross-Site COVID-19 Cohort Technical Working Group, which oversees COVID-related cohort studies across eight PIH sites worldwide. Adapted for the Sierra Leone context, the instrument contained 11 modules: (1) participant demographics; (2) self-reported COVID-19 symptoms; (3) reported risk factors for COVID-19 and testing history; (4) food security in the previous 30 days, measured with four items from the Household Food Insecurity Access Scale (HFIAS), including a three-item subset validated as the Household Hunger Scale (HHS) [20]; (5) infection prevention practices, covering household adoption of selected measures, access to handwashing facilities, and household crowding; (6) access to healthcare and essential services; (7) depressive symptoms assessed via PHQ-2 [21]; (8) anxiety symptoms assessed via GAD-2 [22]; (9) medication adherence using a three-item validated self-report measure [23]; (10) COVID-19 knowledge adapted from Banda *et al*. [24]; and (11) household assets to determine wealth levels [25] and exposure to income shocks [26].

Data collection took place between March and December 2021. Hypertensive participants were interviewed from March to August, heart failure patients from March to November, and diabetic patients from May to December. Data collectors received two days of training covering study objectives, ethical considerations, respectful engagement, and practical questionnaire administration via role-play. Each selected participant was contacted up to five times on separate days before being classified as a non-respondent. Participants who consented verbally over the phone completed surveys lasting 17–20 minutes. Questionnaires were read aloud in Krio, with responses recorded in English through the CommCare platform. Data were uploaded to the cloud after each survey, and

every participant was assigned a unique ID code to preserve confidentiality.

Data analysis

For descriptive purposes, continuous demographic variables were summarized using medians and interquartile ranges (IQRs), while categorical variables were presented as counts and percentages, stratified by clinical program. Comparisons between programs employed Pearson's chi-square test or linear regression models, depending on the variable type.

A condensed asset-based wealth index was generated following the methodology of Chakraborty *et al*. [25]. Nine items from the Sierra Leone DHS [27] were selected based on the product of the first principal component score and the variable's standard deviation, prioritizing those with the largest absolute product values. Principal component analysis was then performed using 2019 DHS data to calculate an abbreviated wealth score and establish quintile thresholds. Agreement with the full DHS wealth index was evaluated using Cohen's kappa (0.63) and percent agreement (70.5%), consistent with prior reports [25]. Because the lower three wealth quintiles were underrepresented, they were merged into a single "poor-middle" group, producing a three-level wealth variable: poor-middle, richer, and richest.

COVID-19-compatible symptoms were defined as self-reported fever with cough, or loss of taste or smell, occurring since March 2020. Adequate handwashing access required a dedicated location with daily availability of soap or detergent over the past month. Household crowding was calculated as household members divided by sleeping rooms. COVID-19 knowledge was evaluated using 16 true/false items, with each participant's overall score computed as the percentage of correct responses. Household implementation of infection prevention measures was summarized by the proportion of households practicing each measure. COVID-19 symptoms, testing, and risk factors were reported for the overall population and stratified into three periods: March 18–April 20, 2021; May 1–October 25, 2021; and October 26–December 13, 2021 (no surveys occurred between April 20 and May 1). Only data from the last period were used to report COVID-19 knowledge and prevention practices, because early survey rounds showed implausibly low variation, prompting retraining of data collectors in late October.

Indicators of social vulnerability—including household hunger, access to essential services, use of emergency coping strategies, medication adherence, and mental health—were analyzed overall and by clinical program. Hunger, access to services, coping strategies, and adherence referred to the previous 30 days, while mental health reflected the past two weeks. Associations between wealth and socioeconomic or COVID-related factors were examined using logistic regression for binary outcomes and linear regression for continuous outcomes, treating wealth as a continuous ordinal variable. Factors significantly associated with wealth ($p < 0.05$) were visualized in equiplots.

All statistical analyses were conducted using STATA 15.1 [28], employing complete case analysis.

Ethical considerations

Approval for this research was secured from the Sierra Leone Ethics and Scientific Review Committee, as well as the PIH Sierra Leone Research Review Committee. Prior to participation, all respondents provided verbal informed consent. Data were collected via the CommCare platform and stored on a secure cloud system, with analyses conducted using anonymized datasets to ensure participant confidentiality.

Results and Discussion

From the 5,089 patients enrolled in the hypertensive, diabetic, and heart failure programs at Koidu Government Hospital's NCD clinic as of March 18, 2021, 671 patients were selected for contact. Of these, 400 were successfully interviewed, representing an overall response rate of 59.6% **(Figure 1).** Response rates varied by clinical program: heart failure patients achieved 79.5% (93/117), hypertensive patients 65.0% (165/254), and diabetic patients 47.3% (142/300). Median interview dates were June 2021 for hypertensive patients, October 2021 for heart failure patients, and November 2021 for diabetic patients **(Table 1).** The majority of respondents were aged 40–69 years (80.5%), and 46.1% were male. Compared to national wealth distribution, 33.0% were classified in the richest quintile, 34.8% in the second-richest, and 32.2% within the combined bottom three poor-middle quintiles. Gender distribution was comparable across programs; however, survey date, age, and wealth quintiles differed significantly ($p < 0.05$).

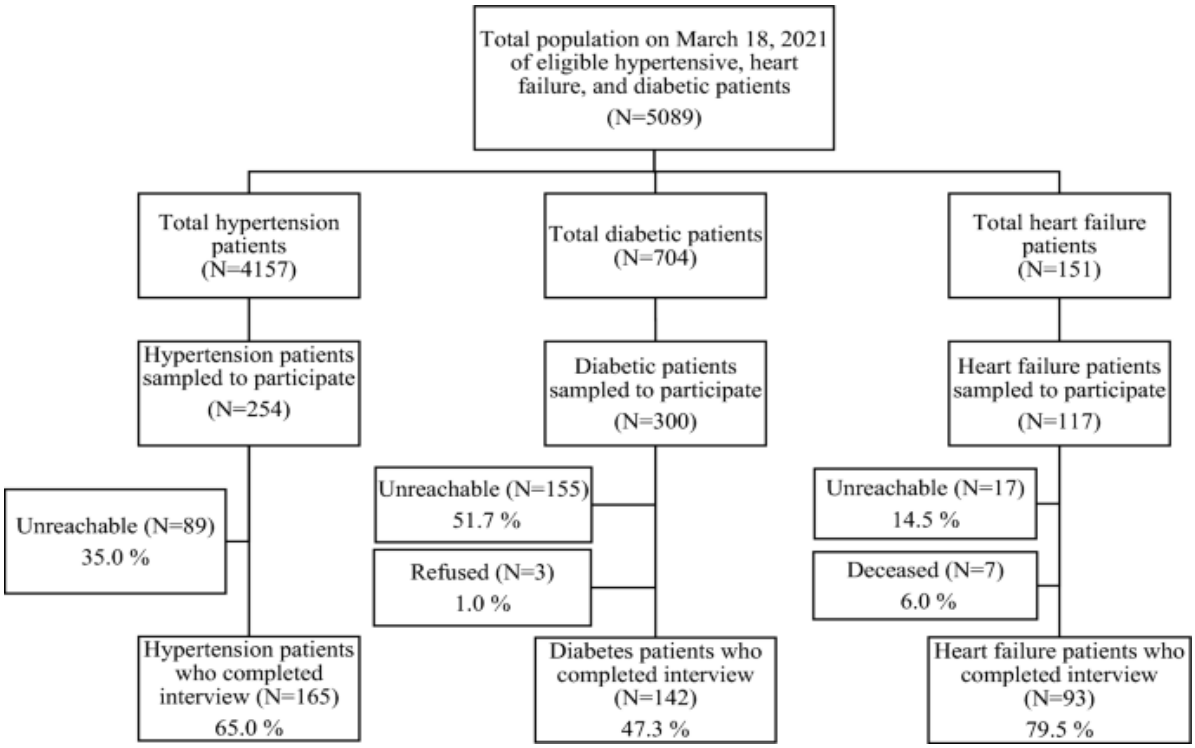

Figure 1. Patient selection flowchart

Table 1. Demographic characteristics of study population (N = 400)

Characteristic	Heart Failure (N=93)	Diabetes (N=142)	Hypertension (N=165)	Total (N=400)	p-value
Interview date, Median (IQR)	10/29/2021 (10/13/2021–11/16/2021)	11/30/2021 (9/5/2021–12/8/2021)	6/4/2021 (3/25/2021–7/19/2021)	9/5/2021 (7/6/2021–11/19/2021)	<0.001
Sex (N=399)					0.340
Male	38 (41.3%)	72 (50.7%)	74 (44.8%)	184 (46.1%)	
Female	54 (58.7%)	70 (49.3%)	91 (55.2%)	215 (53.9%)	
Age category (years) (N=393)					<0.001
18–39	11 (12.2%)	27 (19.6%)	14 (8.5%)	52 (13.2%)	
40–49	19 (21.1%)	38 (27.5%)	53 (32.1%)	110 (28.0%)	
50–59	18 (20.0%)	38 (27.5%)	70 (42.4%)	126 (32.1%)	
60–69	32 (35.6%)	28 (20.3%)	20 (12.1%)	80 (20.4%)	
≥70	10 (11.1%)	7 (5.1%)	8 (4.8%)	25 (6.4%)	
Wealth quintile[a] (N=394)					<0.001
Poorest	11 (12.1%)	4 (2.9%)	8 (4.8%)	23 (5.8%)	
Poorer	10 (11.0%)	9 (6.5%)	29 (17.6%)	48 (12.2%)	
Middle	11 (12.1%)	12 (8.7%)	33 (20.0%)	56 (14.2%)	
Richer	22 (24.2%)	55 (39.9%)	60 (36.4%)	137 (34.8%)	
Richest	37 (40.7%)	58 (42.0%)	35 (21.2%)	130 (33.0%)	

aWealth quintiles defined using an abbreviated asset-based index

Nearly one-fifth (19.5%) of participants reported symptoms consistent with COVID-19, while 20.6% reported having undergone testing **(Table 2).** The proportion of patients reporting compatible symptoms rose from 1.3% in those interviewed before May 1, 2021, to 38.1% after October 25, 2021. Testing followed a

similar trend. Among tested individuals, 3.7% reported positive results, all occurring after October 25, 2021. Regarding exposure in the preceding two weeks, 25.5% attended festivals or large gatherings, 23.8% visited healthcare facilities, and 17.3% traveled outside Kono District. Exposure to all risk factors, except known or suspected COVID-19 contact, increased over time. Only 27.3% had access to adequate handwashing facilities, and 43.7% lived in crowded households. Mask usage was reported as always or more than half the time by 52.1%, while 23.7% never wore a mask. Peak adherence was observed among participants interviewed between May 1 and October 25, 2021, with 81.6% reporting consistent mask use.

Table 2. COVID-related symptoms, testing, and risk factors (N = 400)

Characteristic	Period 3: October 26–December 13, 2021 (N=147)	Period 2: May 1–October 25, 2021 (N=176)	Period 1: March 18–April 20, 2021 (N=77)	Total (N=400)
Clinical program				
Diabetes	90 (61.2%)	52 (29.5%)	0 (0.0%)	142 (35.5%)
Heart failure	57 (38.8%)	34 (19.3%)	2 (2.6%)	93 (23.3%)
Hypertension	0 (0.0%)	90 (51.1%)	75 (97.4%)	165 (41.3%)
COVID-19 compatible symptoms (since March 2020)				
Any COVID-19 compatible symptoms (fever and cough, or loss of taste or smell)	56 (38.1%)	21 (11.9%)	1 (1.3%)	78 (19.5%)
Required medical attention, hospitalization, or missed work/school among those with symptoms (N=78)	56 (38.1%)	21 (11.9%)	0 (0.0%)	77 (19.3%)
COVID-19 testing (since March 2020)				
Ever received COVID-19 test (N=398)	54 (36.7%)	22 (12.6%)	6 (7.9%)	82 (20.6%)
Positive COVID-19 test (N=82)	3 (5.6%)	0 (0.0%)	0 (0.0%)	3 (3.7%)
In the last 2 weeks has the patient…				
Attended a festival or mass gathering	83 (56.5%)	19 (10.8%)	0 (0.0%)	102 (25.5%)
Visited a health facility (N=399)	73 (50.0%)	17 (9.7%)	5 (6.5%)	95 (23.8%)
Traveled outside Kono district	56 (38.1%)	12 (6.8%)	1 (1.3%)	69 (17.3%)
Visited a traditional healer (N=398)	7 (4.8%)	5 (2.9%)	1 (1.3%)	13 (3.3%)
Had contact with a confirmed/suspected case or person with COVID-related symptoms	2 (1.4%)	5 (2.8%)	1 (1.3%)	8 (2.0%)
Traveled internationally	7 (4.8%)	0 (0.0%)	0 (0.0%)	7 (1.8%)
Infection prevention				
Access to adequate handwashing facilities (N=373)	17 (12.3%)	25 (15.6%)	60 (80.0%)	102 (27.3%)
Household crowding (>2 people per sleeping room) (N=359)	89 (69.5%)	40 (25.3%)	28 (38.4%)	157 (43.7%)
Frequency of wearing a face mask when leaving home (N=397)				
Always	1 (0.7%)	15 (8.6%)	7 (9.2%)	23 (5.8%)
More than half the time	14 (9.5%)	127 (73.0%)	43 (56.6%)	184 (46.3%)

About half the time	33 (22.4%)	4 (2.3%)	1 (1.3%)	38 (9.6%)
Less than half the time	46 (31.3%)	12 (6.9%)	0 (0.0%)	58 (14.6%)
Never	53 (36.1%)	16 (9.2%)	25 (32.9%)	94 (23.7%)
COVID-19 knowledge score, Median (IQR)[a] (N=147)	10.0 (7.0–12.0)			

aData shown only for October 26–December 13, 2021, due to low quality in earlier periods

Among the 147 patients surveyed after October 25, 2021, over 90% correctly identified masks, social distancing, avoiding handshakes, and isolation of positive cases as effective preventive measures. More than 75% understood that transmission occurs via respiratory droplets and that unfiltered water, wild animals, or blood do not spread infection. Less than half of respondents recognized that contaminated surfaces, asymptomatic individuals, or non-febrile cases can transmit the virus; fewer than 50% were aware that COVID-19 does not always cause severe illness, there is no definitive cure, older adults are at higher risk, or children are generally less susceptible. Only 9% knew that patients with pre-existing conditions are at elevated risk for severe outcomes **(Figure 2).**

Household measures reported to reduce COVID-19 spread showed that 91% avoided crowded places, and 27% avoided markets. Over half maintained physical distance, refrained from handshakes, and avoided touching their face. Only 36% reported household mask use, 34% reported handwashing, and fewer than 20% implemented measures such as limiting outings, covering mouth/nose, or using hand sanitizer **(Figure 3).**

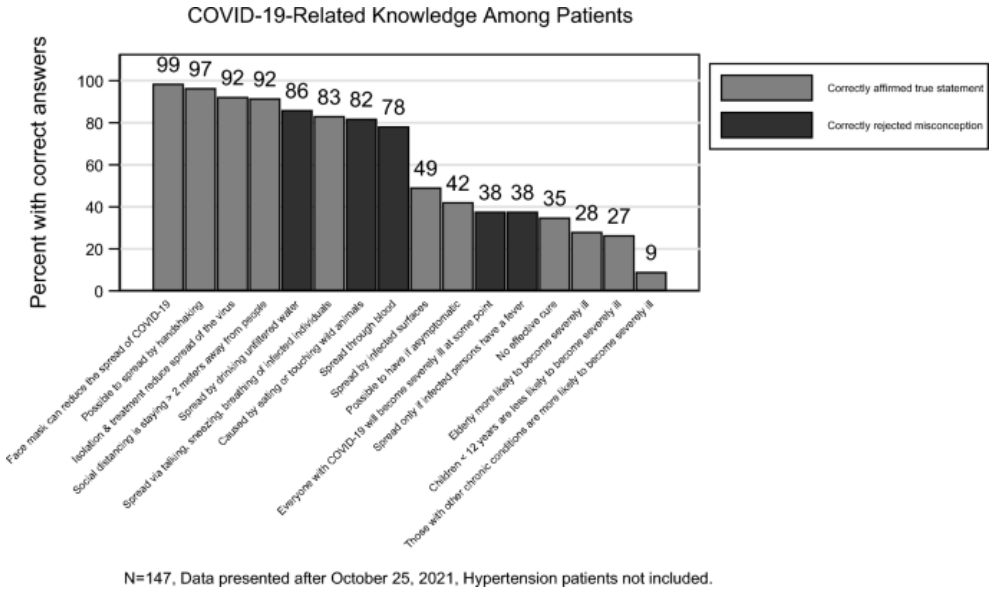

Figure 2. COVID-related knowledge among patients (N = 147)

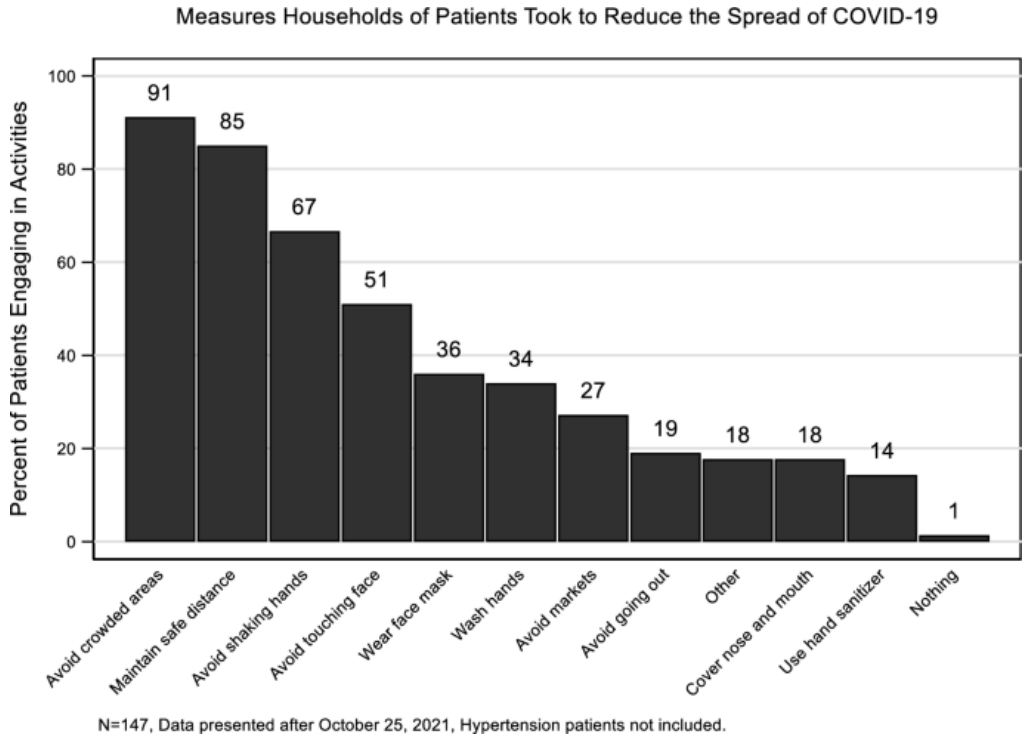

Figure 3. Household infection prevention practices (N = 147)

Looking at social vulnerability over the 30 days prior to the survey, 91.0% worried at least once about adequate food, 78.0% reported moderate household hunger, 47.5% faced at least one barrier to healthcare access, and 61.2% used one or more emergency coping mechanisms for food, housing, or healthcare. The most frequently cited obstacles to healthcare were transportation limitations and insufficient funds, whereas lack of services and fear of COVID-19 were infrequently mentioned (1.8–2.7%). Overall, 71.8% had at least one prescribed medication, with diabetic and heart failure patients reporting higher rates (99.3% and 100%, respectively) than hypertensive patients (32.1%). Among those prescribed medication, the median adherence score was 80 [IQR: 76.7–90.0]. Anxiety screening was positive in 1.8% of patients, and depression was detected in 6.5%, with the highest prevalence among heart failure patients (19.4%). Patients with positive mental health screens were referred to the Mental Health Unit.

Table 3. Social vulnerability of study population (N = 400)

Characteristic	Heart Failure (N=93)	Diabetes (N=142)	Hypertension (N=165)	Overall (N=400)
In the past 30 days, did your household ever worry about having enough food…				
Never	18 (19.4%)	16 (11.3%)	2 (1.2%)	36 (9.0%)
Rarely (once or twice)	37 (39.8%)	93 (65.5%)	140 (84.8%)	270 (67.5%)
Sometimes (3–10 times)	38 (40.9%)	33 (23.2%)	23 (13.9%)	94 (23.5%)
Often	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Household hunger score				
Little to no hunger	44 (47.3%)	43 (30.3%)	1 (0.6%)	88 (22.0%)
Moderate hunger	49 (52.7%)	99 (69.7%)	164 (99.4%)	312 (78.0%)
Essential services: in the past 30 days, were you ever unable to…				
Attend scheduled health appointments[a]	31 (33.3%)	40 (28.2%)	78 (47.3%)	149 (37.3%)

Access health care for unscheduled or urgent needs[b]	34 (36.6%)	50 (35.2%)	68 (41.2%)	152 (38.0%)
Obtain medication[c]	22 (23.7%)	34 (23.9%)	54 (32.7%)	110 (27.5%)
Experienced at least one barrier to accessing health care	48 (51.6%)	61 (43.0%)	81 (49.1%)	190 (47.5%)
Children unable to attend school (N=388)	9 (10.5%)	3 (2.2%)	13 (7.9%)	25 (6.4%)
Emergency coping: In the last 30 days, did your household use any of the following strategies to pay for food, housing, or health care?				
Sold assets (N=397)	61 (65.6%)	61 (43.9%)	2 (1.2%)	124 (31.2%)
Borrowed from family or friends (N=397)	24 (25.8%)	36 (25.9%)	98 (59.4%)	158 (39.8%)
Borrowed from someone else (N=396)	8 (8.7%)	15 (10.8%)	95 (57.6%)	118 (29.8%)
Used at least one emergency coping mechanism (N=397)	65 (69.9%)	78 (56.1%)	100 (60.6%)	243 (61.2%)
Medication adherence				
Patient prescribed at least one medicine	93 (100.0%)	141 (99.3%)	53 (32.1%)	287 (71.8%)
Medication adherence scale (N=283), Median (IQR)	77.8 (71.1–92.2)	80.0 (77.8–90.0)	90.0 (80.0–90.0)	80.0 (76.7–90.0)
Mental health				
Positive screen for anxiety (GAD ≥3)	3 (3.2%)	4 (2.8%)	0 (0.0%)	7 (1.8%)
Positive screen for depression (PHQ ≥3)	18 (19.4%)	8 (5.6%)	0 (0.0%)	26 (6.5%)

a117 (78.5%) of participants identified lack of transport as a barrier to accessing healthcare, 23 (15.4%) cited financial constraints, 5 (3.4%) reported service cancellations or closures, and 4 (2.7%) mentioned fear of COVID-19.

b96 (63.2%) reported transportation difficulties, 40 (26.3%) indicated insufficient funds, 12 (7.9%) cited service unavailability, and 4 (2.6%) referenced fear of COVID-19.

c74 (67.3%) noted transport challenges, 19 (17.3%) reported financial barriers, 15 (13.6%) indicated services were canceled or closed, and 2 (1.8%) cited COVID-19-related fear.

When examining the relationship between wealth and both socioeconomic and COVID-related factors, significant associations were observed. Wealth strongly correlated with food security, access to essential services, use of emergency coping strategies, and mask usage, with the poor-middle group showing the highest vulnerability and the richest group the lowest (**Figure 4**). Similarly, both having a prescribed medication and adherence to medication regimens were significantly associated with wealth; the poor-middle group reported lower medication use than richer and richest groups.

Individuals in higher wealth categories were more likely to undergo COVID-19 testing and participate in activities with potential exposure risk, such as attending festivals or mass gatherings, visiting healthcare facilities, or traveling outside the district or internationally. The greatest disparities between the poor-middle and richest groups were observed in: use of at least one emergency coping strategy (87.4% vs. 39.5%), experiencing at least one barrier to healthcare (59.1% vs. 32.3%), worrying about food (38.6% vs. 15.4%), ever having a COVID-19 test (11.9% vs. 38.5%), attending mass gatherings (19.7% vs. 42.3%), visiting health facilities (15.9% vs. 36.2%), and domestic travel (8.7% vs. 36.9%). Depression, anxiety, COVID-related symptoms, infection prevention practices, and selling assets as an emergency coping mechanism were not significantly associated with wealth.

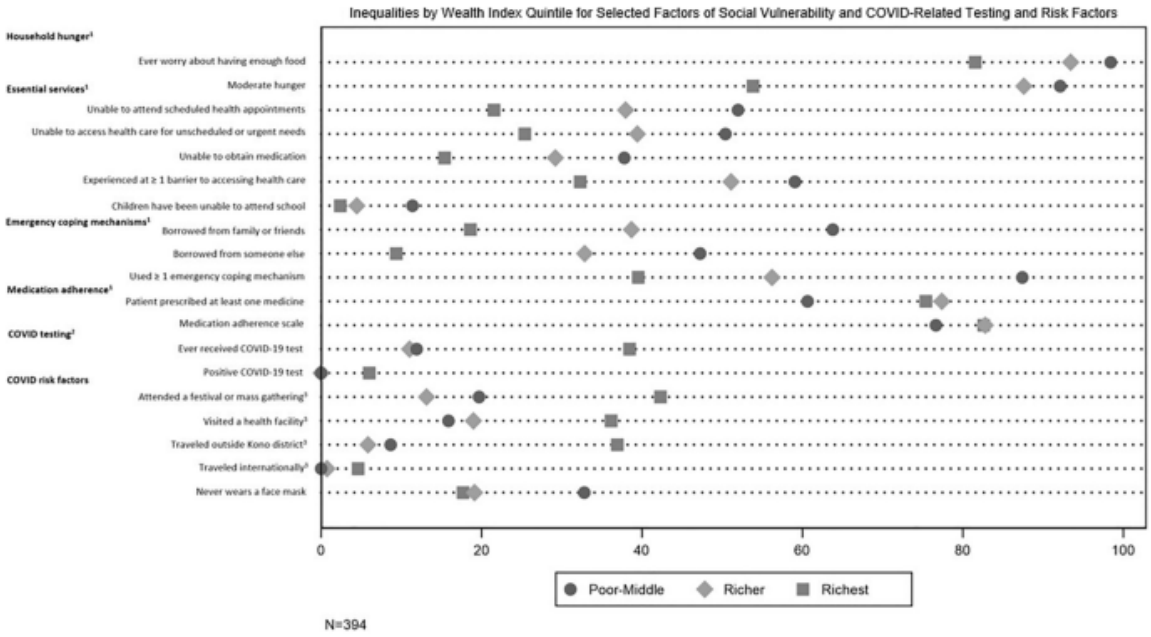

Figure 4. Social vulnerabilities, COVID-19 testing, and risk factors by wealth quintiles (N = 394). Only outcomes showing significant differences across wealth categories are displayed.

In this cross-sectional telephone survey among NCD patients in Sierra Leone, we found that participants faced substantial COVID-19 exposure risks and high levels of social vulnerability. Although only a small proportion of patients reported a positive COVID-19 test (3.7%), the prevalence of COVID-19-like symptoms and exposure to potential risk factors rose as the pandemic progressed. Encouragingly, COVID-19 testing increased over time, likely reflecting greater public awareness, the development of national strategies, and improved diagnostic capacity in Sierra Leone.

Overall, patients demonstrated solid knowledge regarding COVID-19 transmission and preventive measures, but their understanding of disease severity and outcomes was limited, which may partly explain suboptimal adherence to preventive behaviors. Compared to previous studies [29], knowledge about prevention appears to have improved, potentially due to the time elapsed since the global pandemic declaration. Following the 2014–2016 Ebola outbreak, Sierra Leone invested heavily in national infection-prevention and control (IPC) campaigns [30], which may have contributed to its high preparedness rating for COVID-19 at the pandemic's onset [31]. Community health workers (CHWs) remain central to IPC education [32]. Their prior Ebola experience and additional COVID-19 training likely enhanced their ability to educate communities about preventive measures. However, CHWs generally have low health literacy, which may limit their ability to communicate accurate information regarding COVID-19 severity and treatment.

For patients with NCDs, improving awareness of their heightened risk for severe COVID-19 could motivate greater adoption of protective behaviors or vaccination. While our survey did not capture vaccination data, only 17.3% of the general Sierra Leonean population is fully vaccinated [31], and no targeted policies exist for NCD patients, including those attending our clinic.

We also identified notable gaps between patients' knowledge of COVID-19 preventive measures and their actual practices. For instance, while patients widely recognized that mask-wearing and hand hygiene were effective strategies against COVID-19, their reported adherence to these behaviors was substantially lower. These observations are consistent with findings from other studies in sub-Saharan Africa [33], and poverty may partly explain this low compliance [34]. Previous research has highlighted that limited access to handwashing supplies—including soap, running water, or functional handwashing stations—poses a barrier to preventive practices in low-income settings [29]. Although we did not directly evaluate whether

insufficient use of preventive strategies was linked to economic or behavioral factors, we support the idea of an interconnection: financial resources can influence access to information and education, which in turn affects behavior. Moreover, other psychological or behavioral factors may contribute to this "knowledge-behavior gap," including perceptions that COVID-19 poses minimal risk, waning motivation, declining community engagement with prevention measures [35], or rational adaptation in response to a decrease in cases in Sierra Leone.

Discrepancies were also evident in self-reported household adherence. While many respondents indicated that their households avoided crowded areas, handshakes, and maintained social distancing, more than a quarter reported attending mass gatherings in the preceding two weeks. These inconsistencies may reflect data limitations, such as social desirability bias, communication difficulties between data collectors and patients due to low educational levels, or insufficient training and experience of survey staff. Alternatively, these discrepancies could indicate that, despite households' efforts to reduce COVID-19 exposure, practical necessities—such as attending health services or earning a living—limited full adherence to social isolation measures. Ultimately, while the data suggest a combination of behavioral, economic, and psychological drivers for non-adherence to preventive measures, our study cannot disentangle the individual contributions of these factors. Future qualitative studies may better elucidate how these elements influence decision-making.

Although our sample was relatively wealthier than the national average, likely reflecting the telephone-based nature of data collection, our NCD patients still faced high levels of socioeconomic vulnerability. This included limited access to food and healthcare, challenges with medication adherence, reliance on emergency coping mechanisms for basic needs, and frequent engagement in behaviors increasing COVID-19 risk. Such vulnerability reflects the broader context of absolute poverty in Sierra Leone, where 60% of the population lives below the global poverty threshold [36]. The COVID-19 pandemic further reduced per capita GDP by 4% [37], disrupting employment, farm supply chains, and food accessibility, and contributing to daily stress and heightened social vulnerability [14, 38]. For individuals with chronic conditions, these poverty-related challenges amplify the risk of hospitalization, disability, and mortality [39]. Economic barriers may explain the surprisingly low proportion of hypertension patients reporting being prescribed medication, despite nearly all program participants requiring ongoing pharmacologic management. Although some patients receive lifestyle-focused guidance, many who reported no prescriptions likely face poverty-related obstacles preventing regular access to their medications.

Our results, along with interventions implemented during the pandemic to sustain care for NCD patients, suggest potential strategies for strengthening future pandemic preparedness and resilient health systems. During COVID-19, PIH introduced a home-based care program delivering healthcare, medications, and food packages to the most vulnerable or disabled NCD patients. This program supported 200 families, providing medication every 1–3 months depending on disease severity and household accessibility. Our findings indicate that such initiatives should be expanded and reinforced to reach a larger proportion of NCD patients. Coupled with continuous patient education for chronic disease management, creation of safe facility spaces to reduce nosocomial infection, routine vulnerability assessments, sustainable supply chains, and community health worker–led home care models, these strategies can support continuity of care for NCD patients in resource-limited settings, especially during future health crises.

Our study has several limitations. First, although we aimed to randomly sample NCD patients, the selection process was not fully implemented, and only patients with telephone access were included, resulting in a wealthier and non-representative sample. Additionally, findings may not generalize to other districts, given PIH's extensive support, including free NCD care. Second, self-reported telephone data may be subject to social desirability or recall biases, particularly in a population with limited education and high respect for health workers as authority figures. Third, the inexperience of data collectors likely contributed to lower-quality data early in the study. Retraining and exclusion of low-quality data after October 25, 2021, mitigated some issues, but since all hypertension patients were interviewed during the early phase, it is impossible to determine whether observed differences reflect genuine clinical disparities, data collection issues, or temporal variations in pandemic experiences.

Conclusion

Despite these limitations, this study provides the first evidence on social vulnerability and COVID-19–related outcomes among NCD patients in Sierra Leone. Patients demonstrated strong awareness of preventive measures; however, knowledge alone did not always translate into protective behaviors, leaving them regularly exposed to COVID-19 risks. Socioeconomic vulnerability was pronounced overall and particularly high among poorer NCD patients. Sierra Leone, and similar low-income countries, should prioritize health policies that ensure equitable access to care, regardless of health threats. Given the significant socioeconomic vulnerabilities identified, additional targeted economic support for NCD patients is warranted.

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