

COVID-19 and adolescent girls' mental health in Uganda: A panel data analysis

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The COVID-19 pandemic and associated mitigating measures are expected to aggravate the mental health challenges of adolescents. Poor mental health among young people is of concern in itself but is also known to affect long-term outcomes. Given the global burden of the pandemic, it is particularly concerning that limited empirical evidence currently exists for young women, especially in low- and middle-income countries (LMICs), where the pandemic serves as an additional psychosocial stressor for the already challenging lives that most young women in low-resource contexts experience. This article adds to the existing evidence base by drawing on 3 rounds of panel data (2019–2021) to assess changes in adolescent mental health among 468 young women aged 13–19 years residing in rural to semi-urban villages in Uganda before and during the pandemic. Using fixed effects models, we find increases in symptoms of moderate-to-severe depression as measured by both the Patient Health Questionnaire-8 during the pandemic and accompanying lockdown measures. We also find that adolescent girls who faced a higher COVID-19 burden exhibit stronger declines in mental health. Our findings shed light on the impacts of the pandemic on young women's mental health in an LMIC context, and suggest the need for age-, gender-, and vulnerability-targeted policies that ensure that the pandemic does not undo current progress toward a more gender equitable world.

Keywords: Mental health, COVID-19, Uganda, Adolescents, Depression, Psychological distress

1. Introduction

SARS-CoV-2 is a virus that spreads between humans through coughing, sneezing, and surfaces that are potentially contaminated [1]. On March 11, 2020, the World Health Organization declared SARS-CoV-2 as a pandemic, which by October 1, 2020, had already affected 34 million globally with an estimated death toll of 1 million worldwide [2]. In order to prevent the spread of the virus, strict public health measures were taken, which included social distancing, face masks, travel restrictions, and school closures [3]. While these preventive measures helped minimize the spread of the virus, they also resulted in negative economic and health consequences, which can serve as triggers for poor mental health conditions [4]. For example, analysis conducted during the initial phase of the COVID-19 outbreak in China shows moderate-to-severe psychological impacts in more than half of the study respondents [5].

A demographic of particular concern in mental health discourse are young people, given that the majority of

mental health issues experienced during adulthood begin in adolescence [6]. Adolescence is a life stage rife with heightened psychosocial vulnerability, which, if not managed or treated aptly, can have severe short- and long-term consequences [7–9]. Moreover, mental health conditions and associated behavioral disorders are the leading causes of years lived with disability and years of life lost due to premature mortality in adolescents [7, 10]. Thus, unsurprisingly, mental health disorders among adolescents have increasingly moved to the center stage of global public health and development policy issues in the last few decades, most notably in their inclusion in the Sustainable Development Agenda through Sustainable Development Goal (SDG) target 3.4, which aims to “promote mental health and well-being.” Moreover, good mental health is an essential factor in improving women's voice and agency [11], integral mechanisms through which the core goal of SDG 5—“Achieve gender equality and empower all women and girls”—can be attained [12, 13].

The unprecedented disruptions to social and community networks, in-person learning, economic and recreational activities, and access to health care due to the COVID-19 pandemic and associated mitigating measures pose unparalleled threats to the mental health of adolescents globally [14, 15]. Given the emotional gravity of COVID-19, many posit that mental health disorders among adolescents will exacerbate, putting millions of young people at risk of mental health deterioration. The anticipated negative effects of COVID-19 on adolescent

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mental well-being could even be more telling for adolescent girls and young women in low- and middle-income countries (LMICs), who, layered on top of the drastic physical, emotional, and social changes they experience during adolescence, contend with high levels of exposure to poverty, abuse, or violence [4]. The pandemic, coupled with the preexisting socioeconomic challenges that most young women in LMICs face, can make adolescent girls extremely vulnerable to mental health problems and their accompanying short- and long-term implications.

This study aims to contribute to a nascent literature on the influence of COVID-19 on the mental health of young women living in low-resource contexts. We use 3 rounds of panel data collected prior to and during the COVID-19 pandemic (2019–2021) on 468, initially 13- to 19-year-old young women residing in urban and peri-urban areas of Kampala, Uganda.¹ Using validated measures of mental health, including the Patient Health Questionnaire-8 (PHQ-8) and General Health Questionnaire-12 (GHQ-12), we assess the changes in mental health among these young women before and during the pandemic. We hypothesize that the COVID-19 pandemic led to declines in mental health.

We also explore how young women perceived and actual burden of the COVID-19 pandemic affects their mental health. While there exists a growing literature on the COVID-19 pandemic's role in exacerbating psychological functioning such as suicidal thoughts [16] and lower life satisfaction [17], it is not clear how perceptions about a pandemic (measured in this analysis as an index of perceived impact on the community) can affect young women's overall mental health. Literature relevant in this space focuses on either the impacts of containment policies on older women's mental health [18] or looks at how fear of COVID-19 among individuals can evolve into a range of adverse mental health outcomes [19]. These include psychological distress [20], post-traumatic stress symptoms [21], moderate-to-severe depressive symptoms [22–25], and anxiety [26, 27]. We also compare this to the actual COVID-19 burden, measured as an index of the self-reported impact of the pandemic on the adolescent girl and her household. Since these questions were asked in the middle of the pandemic and lockdowns, our hypothesis is that higher levels of actual and perceived COVID-19 burden should be associated with worse mental health outcomes.

Our analysis contributes to literature in a number of important ways. First, it adds to a growing literature on COVID-19 and mental health among adolescents and young adults [28], where evidence for LMICs is still limited, particularly among adolescents [29, 30]. For instance, out of the 116 studies investigating the impacts of the pandemic on mental health of children and youth reviewed by Samji et al. [14], only 8 used data from an LMIC (3 of which are from African countries). Second, it is

1. While the age range for respondents selected for the ongoing study was between 13 and 19 years at baseline, respondents were between 15 and 21 years at the time of this survey. We thus refer to them both as adolescents and young women.

one of only a few studies to go beyond cross-sectional analysis, improving our ability to uncover a causal relationship [14]. Third, this study is among the first indicating the importance of perceived and actual burden of COVID-19 as a critical mechanism through which COVID-19 may have affected mental health. Lastly, it is the first article that we are aware of that looks at mental health among young women in Uganda. Matovu et al. [30] also looks at mental health during the COVID-19 pandemic in Uganda but focuses on the effects of COVID-19 lockdowns on young men's mental health and other socioeconomic outcomes.

2. COVID-19 and mental health in Uganda

2.1. Lockdowns, infections, and impact on economy

The first case of COVID-19 infection in Uganda was reported on March 21, 2020, rapidly triggering a robust preventative government response. Among the 33 preventative interventions implemented in response to the pandemic, schools and institutions of higher learning were closed, social gatherings were halted, travel restrictions were instituted, and curfews were instituted in the entire country, including a 3-month-long nation-wide home confinement [30].

The Government of Uganda declared COVID-19 a national emergency on January 30, 2020, and instituted several institutional arrangements aimed at controlling the spread of the disease. As of December 2, 2021, Uganda had a total of 127,618 confirmed cases of COVID-19 and 3,252 deaths [31]. While pivotal to containing the spread of the virus, the measures adopted in the country (**Figure 1**) also resulted in severe disruptions to the daily life of the Ugandan population, with unintended consequences. Early evidence found a decline in access to key health services and increase in adverse outcomes, including the prevalence of gender-based violence (GBV) [15]. The

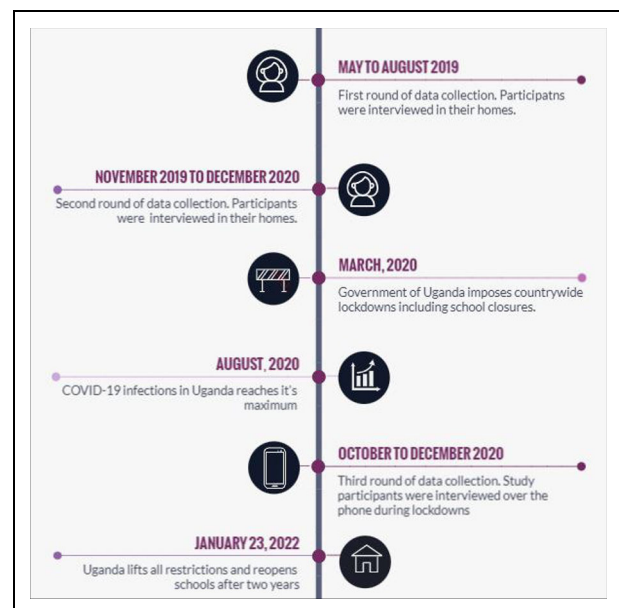


Figure 1. Timeline of data collection and COVID-19 events in Uganda. Source: Author's own figure. Dates from Ministry of Health, Uganda.

lockdown also had a severe negative impact on household earnings and access to food, both due to transport restrictions and sudden food price increases. While this was partially mitigated by a food distribution program rolled out by the Government of Uganda early in the pandemic, the strategy had a slow impact, leaving the majority of households vulnerable to food insecurity [32]. Uganda's real gross domestic product grew at less than half the rate recorded in 2019, likely as a result of the COVID-19 pandemic and indirect effects of the measures that were undertaken to prevent the spread of the virus [33].

2.2. Mental health in Uganda

Prior to the pandemic, Uganda ranked among the 6 top countries in Africa with the highest prevalence of depressive disorders [34], and mental health care funding and provision were described as largely inadequate [35]. Given the socioeconomic difficulties that the Ugandan population face to meet their daily basic needs, it is likely that the onset of COVID-19 and its associated restrictions have had a particularly severe negative effect in Uganda [36].

This concern is particularly heightened among adolescents. While adolescents are also susceptible to COVID-19 infection, infection is less likely to progress to severe disease than in older adults [37]. Instead, adolescents are more likely to suffer from indirect consequences of COVID-19 [37]. Part of this is due to prolonged school closures, which had a negative effect on the mental health and cognitive development of adolescents globally [38]. In Uganda, the adverse effects of school closures are expected to be disproportionately severe, as closures prevented students from returning to school for almost 2 years [39]. When looking at adolescent girls in particular, COVID-19 has been linked to mental health problems, including disorders, stress, anxiety, and fear in Uganda [40].

Adolescent mental health is vital in the context of Uganda given the social, economic, and political challenges affecting people including adolescent boys and girls [41]. The country is ranked among the highest African countries in terms of having a population with high levels of mental illness amid inadequate mental health support services and care [42]. During lockdowns, economic pressure, social isolation, fear, and stress have been found to result in increased GBV around the world [43]. With 34% of Ugandan women being married before the age of 18 [44], the COVID-19 home confinements may also have placed young women at heightened risk of GBV in Uganda, with further consequences on their mental health status.

3. Methods

3.1. Data source

The present analysis uses longitudinal data from 3 rounds of an ongoing study with adolescent girls aged 13–19 years at baseline (2019), covering 6 urban and 2 peri-urban subdistricts located in the central region of Kampala, Uganda. As outlined in **Figure 1**, the first round of data was collected in 2019, between May and August, when participants were interviewed in their homes. The

same girls were interviewed again for a second round of data collection, which took place between November 2019 and February 2020, ending just before the onset of COVID-19. This was followed by the third round of data collection that took place during the COVID-19 pandemic between October and December 2020. The third round of data collection was conducted virtually to avoid potential risk of COVID-19 infection.

In 2019, all young women between the target age of 13–19 years old living within a 0.5 km radius from BRAC Uganda's "Empowerment and Livelihood for Adolescents" (ELA) clubs, who provided informed assent/consent, were listed and screened for symptoms of depression. These clubs were used as a way to delineate communities and served the basis of an ongoing cluster randomized control trial which is explained in detail by Baird et al. [45]. The selection of participants was based on the 8-item PHQ-8 depression scale: a diagnostic tool to screen for current depression [46]. In this study, we restrict our analysis to balanced panel of 468 young women² who belong to the control group of the original experimental study.³

3.2. Measures

All 3 rounds of the survey contained detailed information on key demographic characteristics alongside validated measures capturing aspects of mental health. Additionally, COVID-19 specific measures were collected in the third round of data collection. We now describe the precise measures in detail.

3.2.1. Dependent variable: PHQ-8 and GHQ-12

Our primary outcome of interest is the mental health status of the adolescent girl, which we measure in 2 ways, both aimed at capturing symptoms of psychological distress. The first is the total score (from 0 to 24, with higher values indicating worse mental health) on the PHQ-8, which is measured with a set of 8 questions and is a widely used and validated depression instrument that assesses the prevalence and severity of depressive symptoms in clinical and general settings, including in LMICs [46]. In addition, we utilize the GHQ-12 (from 0 to 36, again with higher values indicating worse mental health), which is another widely used—including in LMIC contexts—and reliable 12-item self-assessment screening tool to aid clinical diagnosis of mood disorders such as anxiety and depression [47]. We choose to use the continuous score to capture the full distribution of the measure as opposed to specifying a binary cutoff.

2. This is out of an original sample of 652 adolescent girls and suggests an attrition rate of 20%. Analysis of attrition suggest that across most observable characteristics those surveyed look the same as those lost to follow-up, except for being more likely to find adolescent girls who are younger, and slightly lower levels of psychological distress. Findings should be interpreted with this in mind.

3. We focus on the control group only to avoid potential interactions between COVID-19 and the ongoing interventions. Analysis of the impact of the interventions will be part of future analysis.

Table 1. Variable descriptions and summary statistics (mean and standard deviation, $N = 468$)

Variable Name	Definition of Variable	Round 1	Round 2	Round 3
PHQ-8	A composite score to measure depression from a set of 8 questions. The index score ranges from 0 to 24 with higher values meaning more depression [46]	13.14 (2.93)	8.05 (4.77)	9.14 (5.11)
GHQ-12	A composite score to measure anxiety from a set of 12 questions. The index score ranges from 0 to 36 with higher values meaning more anxiety [47]	6.92 (2.92)	4.85 (3.17)	4.79 (3.17)
Perceived COVID-19 burden	An aggregate index that was made from a combination of questions relating to perceived impact of COVID-19 and lockdowns on jobs lost, food insecurity, violence, and so on in the community. The score ranges from 1 to 17 with higher values meaning more perceived burden. For details, see Appendix. For comparison purposes, we use a standardized measure of this score in our regressions	NA	NA	11.54 (2.40)
Actual COVID-19 burden	An aggregate index that was made from a combination of questions relating to the impact of COVID-19 and lockdowns on personal level outcomes like getting angrier, arguing more often, being more stressed, and so on. The score ranges from 2 to 12 with higher values meaning more actual burden. For details, see Appendix. For comparison purposes, we use a standardized measure of this score in our regressions	NA	NA	8.28 (1.83)
Age	Age is a continuous variable that ranges from 13 to 19 (at Round 1)	16.80 (2.02)	17.09 (2.08)	17.88 (2.11)
Education	Education is a dummy variable that takes the value of 1 if the respondent has completed at least secondary school level of education or higher and 0 otherwise	0.23 (0.42)	0.25 (0.43)	0.26 (0.44)
Never married	A dummy variable indicating whether the respondent has been married or not (1—never been married, 0—otherwise)	0.85 (0.35)	0.85 (0.35)	0.82 (0.37)

Means and standard deviations (in brackets) for all variables used in our estimating equation. GHQ-12 = General Health Questionnaire-12; NA = not applicable; PHQ-8 = Patient Health Questionnaire-8.

3.2.2. Main independent variables: Perceived and actual COVID-19 burden

Round 3 data collection involved a COVID-19 experiences section that was adapted from the Evidence-based Measures of Empowerment for Research on Gender Equity COVID-19 module Center on Gender Equity and Health [48] and Baird et al. [49]. This section assessed community level awareness of the containment efforts to control the spread of the COVID-19 virus as well as the perceived effect of COVID-19 on the community as a whole by asking “yes” or “no” questions (e.g., due to the COVID-19 pandemic, people are unable to bank or get cash for daily expenses; more people are becoming very anxious or depressed; there is more violence among people in the community, families cannot afford to buy enough food to eat, etc.). We summed the number of affirmative answers to create an aggregate measure of “Perceived COVID Burden.” The COVID-19 experiences survey also assessed the impact COVID-19 may have had in the personal life of the adolescent girl and her household by asking a series of “yes” or “no” questions (e.g., are you getting angry more quickly, arguing more often, etc.) as well as Likert-scale type questions (e.g., “do you agree, partially agree, or disagree with the statement that COVID-19 has increased the

stress in your household,” etc.). We summed these questions to create an aggregate measure of “Actual COVID Burden.” See Appendix A for the full set of questions used to create both the perceived and actual COVID-19 burden indices.

3.2.3. Covariates

We include the age of the respondent, her educational attainment, and marital status as covariates in our estimating model. These variables are known to be associated with both awareness and state of mental health in Uganda [50]. Our models also control for all time-invariant covariates. **Table 1** provides the definitions of the variables included in the regression models used in this study along with means across all 3 rounds of data collection. At baseline (Round 1), respondents' average age is 17 years, about 23% of respondent had completed at least secondary school level of education or higher and about 85% of respondents have never been married.

3.3. Data analysis

All statistical analysis was conducted using Stata 17.0. To analyze how symptoms of psychosocial distress have changed over time among our study population, we combine 3

rounds of data and employ a fixed effects regression approach. The regression equation takes the following form:

$$Y_{itc} = \alpha_i + \beta T_i + X_{itc} + Z_i + \varepsilon_{itc}. \quad (1)$$

In the equation above, Y_{itc} is a measure of individual i 's PHQ-8 or GHQ-12 scores at time t in cluster c , T_i is a dummy variable that captures time. The coefficient β will measure the change in PHQ-8 and GHQ-12 scores over time as T_i switches from 0 to 1, X_{itc} represents the set of time-variant covariates listed above for individual i at time t in cluster c . Z_i and ε_{itc} are individual level fixed effects and standard errors clustered at the level of ELA club, respectively. The individual fixed effects control for all observable and unobservable time-invariant differences across individuals.

We choose to estimate Equation 1 by first analyzing changes in our main outcomes from Round 1 to Round 2 and then again for examining changes in outcomes from Round 2 to Round 3. We take this approach because we hypothesize that from Round 1 to Round 2 both the PHQ-8 and GHQ-12 scores should substantially decrease due to the design of the study. Specifically, since at baseline we only enroll adolescent girls showing symptoms of moderate-to-severe depression (scoring ≥ 10 on the PHQ-8), we anticipate significant remission by Round 2, consistent with other studies [48]. We then treat the data in Round 2 as the steady state, and in the absence of any negative (or positive) shocks hypothesize, controlling for relevant covariates, that rates should remain stable. From Round 2 to Round 3, given the onset of the COVID-19 pandemic, we hypothesize significant declines in mental health in our sample of young women.

To further explore how experiences during COVID-19 pandemic are associated with psychological distress, we investigate how perceived and actual experiences with COVID-19 are associated with symptoms of psychological distress. To this end, we estimate the following equation:

$$Y_i + \alpha_i + \beta \text{CovidBurden}_i + Z_i + X_{i1} + \varepsilon_{ic}, \quad (2)$$

where Y_i is a measure of individual i 's PHQ-8 or GHQ-12 scores in Round 3 (or change between Round 2 and Round 3 in an alternative estimation), CovidBurden_i measures the scores on perceived and actual COVID-19 burden for individual i , β measures the association between the outcome Y_i and CovidBurden_i , Z_i are ELA club level fixed effects that control for all ELA club level observable and unobservable variables that are fixed over time like sub-district level norms, geographical location of the sub-district, and so on, X_i is a rich set of covariates from baseline of data collection which includes individual and household characteristics of the respondent that are associated with depression and psychological distress. These include age (continuous), marital status (indicator for never married), indicator for qualified secondary school or higher, county of the total number of close friends the respondent have, an index of household's likelihood of falling below the poverty line as measured by the Poverty Probability Index,⁴ and an indicator if the respondent has been

involved in any paid work activity in the last 12 months. Finally, ε_{ic} are standard errors clustered at the ELA club level.

4. Results

4.1. Changes in mental health prior to COVID-19

Table 2 shows results from estimating regression Equation 1 for changes in PHQ-8 and GHQ-12 scores from Round 1 to Round 2. For each outcome, columns correspond to an unadjusted regression (Columns 1 and 4), an adjusted regression that controls for individual level time-variant covariates (Columns 2 and 5), and finally results for a regression that controls for both time-variant covariates and individual level fixed effects (Columns 3 and 6).

Table 2 shows a clear reduction (improvements) in PHQ-8 and GHQ-12 scores across all 3 versions of the model from Round 1 (May to August 2019) to Round 2 (November 2019 to February 2020) which ended just before the start of the COVID-19 pandemic. These improvements in PHQ-8 and GHQ-12 are not only significant at the 1% level but also considerably large in magnitude with an average improvement of 40% for the PHQ-8 and 30% for the GHQ-12, respectively, with consistent effect sizes across specifications. As noted above, we recruited a sample that all exhibited symptoms of moderate-to-severe depression at Round 1 and based on existing literature anticipated levels of remission in this range [51]. These findings also show a sharp age trend, with older individuals scoring higher on both the PHQ-8 and the GHQ-12.

4.2. Changes in mental health during COVID-19

Table 3 follows the same structure as **Table 2**, but focuses on changes from Round 2 to Round 3. A reminder that data collection in Round 3 was done during COVID-19 lockdown. In the absence of the pandemic, we hypothesized that these measures should stay stable over time. Our findings suggest increases in symptoms of depression of around 10% from Round 2 to Round 3 for the PHQ-8, with no significant movement on the GHQ-12.

4.3. Associating burden of COVID-19 with mental health

While the above findings suggest there may have been small declines in mental health as a result of the COVID-19 pandemic, it is not conclusive given different findings for the PHQ-8 and the GHQ-12. But, these average effects may mask important heterogeneity based on exposure to the pandemic. **Table 4**, Panel A, further explores the association between symptoms of psychological distress with perceived and actual COVID-19 burden. As a reminder, perceived COVID-19 burden includes the adolescent woman's reported presence of containment efforts in her community to control the spread of the COVID-19 virus, as well as her perceived effect of COVID-19 on the community as whole. Actual COVID-19 burden measures the impact of COVID-19 on the participant and her household (see Appendix A for all items included in the construction of perceived and

4. povertyindex.org/country/Uganda.

Table 2. Change in depression and psychological distress from Round 1 (June to August 2019) to Round 2 (November 2019 to February 2020)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	PHQ-8	PHQ-8	PHQ-8	GHQ-12	GHQ-12	GHQ-12
=1 if Round 2	-5.090*** (0.374)	-5.167*** (0.374)	-5.285*** (0.382)	-2.075*** (0.279)	-2.128*** (0.284)	-2.238*** (0.298)
Age		0.292*** (0.056)	0.697 (0.480)		0.196*** (0.062)	0.545** (0.259)
Never married		-1.063* (0.535)	-0.541 (1.117)		-0.444 (0.329)	0.095 (0.498)
Qualified secondary school or higher		-0.488 (0.313)	-0.245 (0.793)		-0.214 (0.253)	0.485 (0.751)
Observations	936	936	936	936	936	936
Adjusted R^2	0.292	0.317	0.351	0.103	0.120	0.254
Controls	No	Yes	Yes	No	Yes	Yes
Individual FE	No	No	Yes	No	No	Yes
Mean in Round 1			13.15			6.925
Mean in Round 2			8.060			4.850

Column (1) estimates an unadjusted version of Equation 1, Column (2) controls for time-variant covariates, and Column (3) controls for both time-variant covariates and individual level fixed effects. Robust standard errors clustered at the ELA club level. FE = fixed effects; GHQ-12 = General Health Questionnaire-12; PHQ-8 = Patient Health Questionnaire-8.

Stars denote statistical significance: *** $P < 0.01$, ** $P < 0.05$, * $P < 0.10$.

Table 3. Change in depression and psychological distress scores from Round 2 (November 2019 to February 2020) to Round 3 (August 2020 to December 2020)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	PHQ-8	PHQ-8	PHQ-8	GHQ-12	GHQ-12	GHQ-12
=1 if Round 3	1.083*** (0.336)	0.674** (0.326)	0.717* (0.408)	-0.060 (0.284)	-0.279 (0.281)	-0.349 (0.297)
Age		0.506*** (0.087)	0.465 (0.324)		0.266*** (0.056)	0.354* (0.189)
Never married		-0.580 (0.530)	0.398 (0.532)		-0.415 (0.348)	0.047 (0.422)
Qualified secondary school or higher		-0.731** (0.344)	0.659 (0.904)		-0.261 (0.238)	0.696 (0.532)
Observations	936	936	936	936	936	936
Adjusted R^2	0.011	0.056	0.343	-0.001	0.031	0.323
Controls	No	Yes	Yes	No	Yes	Yes
Individual FE	No	No	Yes	No	No	Yes
Mean in Round 2			8.060			4.850
Mean in Round 3			9.143			4.791

Column (1) estimates an unadjusted version of Equation 1, Column (2) controls for time-variant covariates, and Column (3) controls for both time-variant covariates and individual level fixed effects. Standard errors clustered at the ELA club level. FE = fixed effects; GHQ-12 = General Health Questionnaire-12; PHQ-8 = Patient Health Questionnaire-8.

Stars denote statistical significance: *** $P < 0.01$, ** $P < 0.05$, * $P < 0.10$.

Table 4. Associations between COVID-19 burden and mental health during the pandemic**Panel A: Continuous Measures (PHQ-8 and GHQ-12)**

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	PHQ-8	PHQ-8	PHQ-8	GHQ-12	GHQ-12	GHQ-12
Perceived COVID-19 burden	0.920*** (0.236)		0.686*** (0.251)	0.657*** (0.138)		0.673*** (0.148)
Actual COVID-19 burden		1.218*** (0.234)	1.131*** (0.250)		0.340 (0.155)	0.253* (0.153)
Tests of equality (<i>P</i> values)						
Perceived CB = Actual CB			0.260			0.080
Observations	449	449	449	449	449	449
Adjusted <i>R</i> ²	0.044	0.069	0.087	0.054	0.022	0.105

Panel B: Difference Measures (Change in PHQ-8 and GHQ-12 from Round 2 to Round 3)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Change in PHQ-8 (R3 – R2)			Change in GHQ-12 (R3 – R2)		
Perceived COVID-19 burden	0.096 (0.242)		0.083 (0.258)	0.076 (0.162)		0.184 (0.181)
Actual COVID-19 burden		0.502 (0.276)	0.722** (0.283)		−0.102 (0.171)	−0.055 (0.171)
Tests of equality (<i>P</i> values)						
Perceived CB = Actual CB			0.137			0.398
Observations	449	449	449	449	449	449
Adjusted <i>R</i> ²	0.001	0.009	0.043	0.008	0.008	0.072

Panel A: Column (1) estimates Equation 2 with perceived COVID-19 burden as an independent variable, Column (2) estimates Equation 2 for actual COVID-19 burden as an independent variable, Column (3) estimates Equation 2 with both. All models control for baseline covariates including age, an indicator for qualified secondary school or higher, an indicator for being never married, number of close friends the respondent have, an index of household's likelihood of falling below the poverty line, and whether the respondent has taken up any paid work in the last 12 months. All regressions control for subdistrict level fixed effects with robust clustered standard errors.

Panel B: Outcome of interest is the change in PHQ-8 and GHQ-12 scores from Round 2 to Round 3. Column (1) estimates Equation 2 with perceived COVID-19 burden as an independent variable, Column (2) estimates Equation 2 for actual COVID-19 burden as an independent variable, Column (3) estimates Equation 2 with both. All models control for baseline covariates including age, an indicator for qualified secondary school or higher, an indicator for being never married, number of close friends the respondent have, an index of household's likelihood of falling below the poverty line, and whether the respondent has taken up any paid work in the last 12 months. All regressions control for subdistrict level fixed effects with robust clustered standard errors. CB = Covid burden; GHQ-12 = General Health Questionnaire-12; PHQ-8 = Patient Health Questionnaire-8.

Stars denote statistical significance: ****P* < 0.01, ***P* < 0.05, **P* < 0.10.

actual COVID-19 burden). Both of these scores are measured on a continuous scale with higher values indicating a greater burden and standardized with a mean of 0 and standard deviation of 1. Column (1) of **Table 4**, Panel A, shows results from estimating Equation 2 for perceived COVID-19 burden, Column (2) does the same for actual COVID-19 burden and Column (3) estimates Equation 2 with both measures.

Findings suggest that a 1 standard deviation increase in perceived COVID-19 burden is associated with a 0.920

increase in the PHQ-8 score (**Table 4**, Column 1). Therefore, going from 1 to 17 on the scale, a 3 standard deviation increase, would lead to an increase of 2.760 on the PHQ-8 score. Similarly, a 1 standard deviation increase in actual COVID-19 burden is associated with 1.218 points increase in the PHQ-8 score (**Table 4**, Column 2) which is an increase of 1.83 points on a 12-point actual COVID-19 burden scale. We observe a similar pattern for psychological distress measured by GHQ-12. Another interesting aspect of our results is the magnitude of these

coefficients. In Column (3), for PHQ-8, both perceived and actual COVID-19 burden are associated with weaker mental health, but the magnitude of the actual COVID-19 burden coefficient suggests that this type of burden may take a much bigger toll on mental health, compared to perceptions about how COVID-19 may have affected the community.

In Panel B of **Table 4**, we compare changes in symptoms of psychological distress from Round 2 to Round 3 with perceived and actual COVID-19 burden. We find a significant positive association of actual COVID-19 burden with changes in PHQ-8 scores. This suggests that actual COVID-19 burden is associated with larger increases in symptoms of psychological distress. We find no significant association with changes in the GHQ-12.

5. Conclusion and discussion

The present study adds to the evidence base on how mental health may have been affected during the COVID-19 pandemic. Overall, our results suggest that mental health among adolescent girls in Uganda as measured by the PHQ-8 has worsened during the pandemic, confirming our hypothesis that the pandemic and associated mitigating measures adversely impacted the mental health of young women. Our findings are in line with available evidence that mental health among young people has significantly deteriorated due to the pandemic and control measures [14, 49–54]. The current study is one of the few studies to focus on young women in LMICs and complements findings of older women in LMICs [18, 55].

That said, when we look at the GHQ-12, we find no significant change in mental health during the COVID-19 pandemic. We speculate that this discrepancy in findings is related to differences in how these 2 measures capture symptoms of psychological distress. The PHQ-8 focuses on how the individual has been feeling over the past 2 weeks, while the GHQ-12 asks how their feelings over the past 2 weeks compare to “usual.” Given that the survey took place 6–9 months into the pandemic, it is likely that “usual” was already a world where the COVID-19 pandemic was taking place. Thus, it is perhaps not surprising that we see impacts on the PHQ-8 and not on the GHQ-12, and we believe the findings on the PHQ-8 are a better reflection of the change in mental health as a result of the COVID-19 pandemic. While not a focus of this article, this finding points to the importance of being careful about measurement when looking at mental health, particularly during times of crisis such as a pandemic.

Our findings further unpack the role of the pandemic in increasing symptoms of psychological distress for young women by highlighting the role of perceived and actual burden of COVID-19. Both of these measures are significantly associated with worse mental health, with actual burden of COVID-19 also associated with stronger

declines in mental health. These findings are similar to Bau et al. [18], who find worse mental health among women in areas with more COVID-19-related containment measures. In addition, this finding also complements studies that explore the role of mindfulness in mediating the relationship between fear of COVID-19 and mental health [22]. Belen [22] argues that fear of the pandemic, as measured by perceived threat of contracting the virus or dying from it, is positively correlated with mental health problems such as anxiety and depression. While our analysis does not explore mitigating measures for improved mental health during the pandemic, our findings on the association between perceived and actual burden of COVID-19 and mental health aligns with that from Belen [22]. Future analysis could tease out the fear of disease versus the economic impact to further assess the relative association of each of these on mental health.

This study contributes to the nascent evidence base on the effects of COVID-19 on adolescent girls' mental health in LMICs. Moreover, it is one of the few studies to date that incorporates panel data, allowing us to go beyond simple cross-sectional correlations [14, 18]. The use of panel data allows us to control for time-invariant covariates and is better suited in uncovering dynamic relationships [56]. That said, the current study has a number of important limitations. First, while our models allow us to control for both observable and unobservable time-invariant characteristics and observable time-varying factors that are not accounted for. Second, since by design we start off with a purposefully selected sample with symptoms of moderate-to-severe depression from urban and peri-urban areas, findings are not necessarily generalizable to the broader population of adolescent girls in Uganda. Third, data collection that took place during the pandemic was done over the phone, as opposed to in person. This change of survey modality could have impacted measurement. Lastly, it needs to be recognized that our measures of perceived COVID-19 burden and actual COVID-19 burden come from self-reported questions and therefore may be subject to response bias, which might affect the generalizability of our findings.

Given the importance of adolescent mental health for future well-being [6–9], it is important to understand the potential ramifications of the COVID-19 pandemic. For young women in LMICs, in particular, given broader concerns about school dropout, teenage pregnancy, and increased exposure to GBV, addressing underlying mental health issues is going to be essential as part of gender equitable post pandemic recovery. Tailored age- and gender-based policies that both tackle mental health directly but also target associated vulnerabilities will be vital to ensure that progress toward SDG-5 remains on track [57].

Appendix A: Construction of perceived and actual COVID burden

We present the survey module we used to construct our actual and perceived COVID burden in this appendix. The survey module presented here lists all sets of questions that were used to create both perceived and actual COVID burden.

COVID-19 – Perceived & Actual COVID Burden	
<p><i>Note: Q1-2 are adapted from the EMERGE COVID-19 and Gender Survey Questions (Center on Gender Equity & Health, 2020). Q3-5 are adapted from Baird, S., Malachowska, A. and Jones, N. (2020) Covid-19 phone survey (round 1). Adult female module. London: Gender and Adolescence: Global Evidence.</i></p>	
Perceived COVID Burden	
1 In your community, how many households do you think have been affected by infection from Corona (the virus causing COVID19), with someone in the household becoming sick? <i>Read answer options aloud unless otherwise specified</i>	Many, including my own..... 1 Many, but not my own..... 2 Some..... 3 Few..... 4 None..... 5 (Do not read aloud) Refused..... -97 (Do not read aloud) Don't know..... -99
2 In your community, which of the following has increased since the start of the Corona pandemic and the social containment efforts to control the spread of the virus (e.g., lockdowns, curfews, etc.)? [1= Yes, 0= No, -97=Refused, -99=DK]	
a. Many people have lost their jobs or their ability to earn wages, and some have lost their business.	[]
b. People are unable to bank or get cash for daily expenses	[]
c. Families cannot afford to buy enough food to eat	[]
d. Many schools have closed, and the children are unable to continue their studies at home	[]
e. There is more violence against children (such as spanking or hitting) in the household	[]
f. There is more violence or other abuse towards women from their husbands or from other family members including in-laws	[]
g. There is more violence or mistreatment from police against people who are out on the streets during social containment	[]
h. People are drinking more and/or using drugs more	[]
i. More people are becoming very anxious or depressed	[]
j. There is more violence among people in the community	[]
k. There are more young women getting pregnant	[]
l. More people are unable to get medical care for health needs that are not related to COVID-19	[]
Actual COVID Burden	
3 Do you agree, partially agree or disagree with the following statement: the Corona situation has increased the stress in my household	Agree..... 1 Partially agree..... 2 Disagree..... 0 Refused to answer..... -97 Don't know..... -99
4 Did your household lose all, most, some, or none of your income as a result of this public health situation?	All..... 1 Most..... 2 Some..... 3 None..... 4 Refused to answer..... -97 Don't know..... -99
4 Which of the following describes how you are coping and responding to Corona? Are you...? [1= Yes, 0= No, -97=Refused, -99=DK]	
a) Getting angry more quickly	[]
b) Arguing more often	[]
c) Talking more often about problems with your family to find solutions	[]
d) Helping household members more with chores or other tasks	[]
e) Fearing and worrying about your own health and the health of your loved ones	[]

Figure A1. Perceived and actual burden of COVID-19 module.

Appendix B: Attrition

In Round 1 we started off with a sample of 637 adolescent girls, of these 542 were successfully reached for interview in Round 2 and 516 of the overall 637 adolescent girl were interviewed over telephone in Round 3. We run an attrition analysis to look at characteristics of adolescent girls that predict attrition. To do this, we estimate the following equation:

$$\text{Attrition} = \alpha_i + \beta X_{ic} + Z_i + \epsilon_{ic},$$

where attrition is a dummy variable that takes the value of 1 if the respondent was not available in a subsequent round and 0 otherwise, X_{ic} is a set of girl specific

characteristics which include PHQ-8 score, GHQ-12 score, age, level of educational attainment, and if the respondent has ever been married, Z_i are subdistrict level fixed effects, and ϵ_{ic} are standard errors clustered at the ELA club level. Column (1) in **Table B1** reports estimates from Equation 1 for attrition that occurred from Round 1 to Round 2 whereas Column 2 does the same for attrition that occurred from Round 2 to Round 3. For Round 1 to Round 2, we see less educated and older girls were more likely to attrit. For Round 2 to Round 3, girls with less education and higher psychological distress are significantly more likely to attrit.

Table B1. Attrition

Variables	(1)	(2)
	Attrition (R1 to R2)	Attrition (R1 to R3)
PHQ-8 score	0.004 (0.004)	0.001 (0.004)
GHQ-12 score	0.005 (0.005)	0.011** (0.005)
Age	0.022*** (0.008)	0.005 (0.009)
Qualified secondary school or higher	-0.083*** (0.023)	-0.073*** (0.017)
Never married	0.025 (0.044)	0.048 (0.037)
Observations	637	542
Adjusted R^2	0.050	0.062

Independent variables include PHQ-8 and GHQ-12 score, age, an indicator for qualified secondary school or higher, and an indicator for being never married. All regressions control for sub-district level fixed effects with robust standard errors clustered at the ELA club level. GHQ-12 = General Health Questionnaire-12; PHQ-8 = Patient Health Questionnaire-8.

Stars denote statistical significance: *** $P < 0.01$, ** $P < 0.05$, * $P < 0.10$.

Data accessibility statement

Data will be made available on request.

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Competing interests

The authors declare that they have no competing interests.

Ethical considerations

Ethical approval was obtained from School of Public Health, Makerere University (Protocol 552), the Uganda National Council for Science and Technology (HS318ES), and the George Washington University Committee on Human Research Institutional Review Board (180580). Written informed assent and consent (as appropriate) was obtained from the participants. Confidentiality of data was maintained throughout the study period.

Author contributions

Performed analysis and interpreted data for this work: DUS.

Oversaw critical revisions of the manuscript: DUS, BA. Conceptualized the study: SB, DUS, CDA.

Provided significant critical revisions: SB.

Contributed to the overall writing of the manuscript: DUS, BA, CDA, CN, SB.

Read and approved the manuscript: All authors.

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