Title: Internal migration and mental health: exploring selection and outcomes in a South African cohort

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Abstract

Introduction

Migration is an important social determinant of health since it precipitates changes in the physical environment and affects individual socioeconomic and lifestyle circumstances, yet investigations of migration effects on mental health are sparse in low- and middle-income countries.

Methods

This paper uses data from Waves 2 and 3 of the Migrant Health Follow-Up Study, a young adult cohort composed of internal migrants and residents of the Agincourt study site in rural northeast South Africa. Using the 10-item Center for Epidemiological Studies Depression Scale (CES-D), we explore the likelihood of experiencing depressive symptoms over time by migrant status. We employ logistic regression analysis to investigate whether migrants are positively selected on mental health, and we fit ordinal logit regression models to analyse categorised CES-D scores as a function of migration status, sociodemographic and health characteristics, accounting for temporal sequence.

Results

In Wave 2, 47% of the cohort were resident within the Agincourt study site and 53% had migrated (n=2967). We observe lower average CES-D scores among migrants compared to Agincourt residents at both survey timepoints ($p<0.001$). However, we do not find evidence of a selection effect on depressive symptoms among those newly migrating between Wave 2 and 3 (n=1393). In analyses of the CES-D outcome, the influence of migration status on depressive symptoms is reduced with the inclusion of controls. Being consistently employed is associated with lower CES-D scores ($p<0.01$), while a diagnosis of a chronic condition and lower levels of social support are associated with higher CES-D scores ($p<0.001$).

Conclusion

Migration and its associated dislocation often raise concerns around potential negative mental health impacts; however, we find that being a migrant is associated with a lower likelihood of depressive symptoms. Recognition of the role of migration can improve our understanding of interrelationships between social and mental health outcomes.

1. Introduction

Rising global mental disorders have underscored the importance of understanding the social determinants of mental health (Arias et al., 2022; Lund et al., 2018). In the recent Global Burden of Diseases study, mental disorders were among the leading contributors to the world's disease burden, with depressive disorders being the most prevalent (COVID-19 Mental Disorders Collaborators, 2021; GBD 2019 Mental Disorders Collaborators, 2022). Worldwide, the prevalence of depressive disorders in 2019 was estimated at 279.6 million cases (increasing from 170.8 million cases in 1990), with variations by age, gender and region observed (GBD 2019 Mental Disorders Collaborators, 2022). While improvements in access to mental health treatments and quality of care are central to reducing the global burden of mental disorders, a multisectoral approach, including action to address the social determinants of mental ill-health is emerging as a key consideration for 21st century health policy (Lund et al., 2018; World Health Organization, 2022).

The socioeconomic context and physical environment play a central role in mental health and well-being outcomes (World Health Organization and Calouste Gulbenkian Foundation, 2014). These relationships have been described under the social determinants of health framework, and include demographic characteristics such as age and gender, economic factors such as education and employment, living conditions and social capital (Lund et al., 2018; Wilkinson and Marmot, 2003; World Health Organization and Calouste Gulbenkian Foundation, 2014). Migration is an important social determinant of health (Davies et al., 2006; Marmot et al., 2012) since it affects changes in the physical environment, typically necessitates severing and re-establishing community and neighbourhood-level ties, and impacts on individual socioeconomic and lifestyle factors. While the relationship between migration and health may be favourable for certain outcomes, migration has been associated with risks for health conditions (including infectious and communicable disease)

through altered exposures, changes in health-related behaviours, stress as a result of relocation, and interrupted access to health care (Abubakar et al., 2018; Nauman et al., 2016). The relationship between migration and mental health is made more complex by the fact that geographic mobility is understood as a highly selective process - migrants are rarely a simple representation of an origin population. “Migration differentials” along several characteristics such as age, gender, occupation and family status have long been noted in the literature (Thomas, 1938). Accumulated evidence for health selection along the dimension of physical health has been codified into the notion of the “healthy migrant effect”. While a simple migrant/non-migrant health differential (favouring migrants) is often observed, sorting out chronology and the competing contribution of the migratory process itself versus destination living circumstances is more challenging, especially when those undertaking migration may already differ substantially before they move (Nauman et al., 2016).

Studies exploring factors and processes linking migration to health have generally focused on physical health outcomes including mortality (Aldridge et al., 2018), fertility (Kulu, 2005), infectious and non-communicable disease outcomes (Abubakar et al., 2018) with fewer studies having explored the migration and mental health relationship. In addition, investigations of migration effects on mental health have commonly focused on international migration prompted by economic and political drivers, or due to forced displacement (Abubakar et al., 2018; Bhugra, 2004; Lindert et al., 2009). International geographic mobility, although diverse, has been associated with worsening mental health outcomes including increased stress, depression and anxiety (International Organization for Migration, 2020; James et al., 2022).

Evidence on the internal migration and mental health relationship is less well established, although internal migration, involving intra-country moves, occurs at a much greater scale than international

migration (Bell and Muhidin, 2009). A limited number of studies have explored mental health effects of internal migration within low- and middle-income countries (LMIC) in the context of rural to urban movement and urbanisation - in which migrants are typically seen as making moves to places of greater density, heterogeneity, and complexity. These studies have yielded mixed findings, however. Some find internal migration to be associated with improved mental health (Nauman et al., 2015; Zhang et al., 2022) while other studies find no relationship (Anglewicz et al., 2017), or mental health deterioration in the form of depressive symptoms or psychological stress after migration (Chen, 2011; Harpham, 1994; Lu, 2010b). Important dimensions affecting this relationship are gender (women have been found to exhibit worse mental health outcomes associated with migration (Anglewicz et al., 2018; Lu, 2010a)), socioeconomic status and living conditions, and social support (Harpham, 1994). Findings showing improved mental health following a move are often interpreted as an adaptation or acculturation effect (Urquia and Gagnon, 2011); conversely, increased exposure to stressful work, living, and social conditions may also plausibly explain deteriorations in mental health status among migrants (Zaami, 2022). In relation to health status preceding migration, empirical evidence of migrant selectivity along the lines of mental health has been quite sparse, especially in LMIC and transition economy contexts. A few studies conducted in Asia have noted either no direct effect of depressive symptoms on migration (Lu, 2010a) or poorer mental health (Nauman et al., 2015) associated with the propensity to migrate.

The relationship between internal migration and mental health has rarely been explicitly tested in sub-Saharan Africa, where risk factors for health conditions are often exacerbated by poverty and inequality. South Africa represents an appropriate setting for the study of migration and mental health, and the South African experience is likely to be informative for countries at earlier stages of health transition. South Africa is characterised by pervasive health and social inequalities (Lund and Cois, 2018) with a high burden of infectious disease (HIV/TB), non-communicable disease and

injuries (Achoki et al., 2022). In addition, levels of internal migration in South Africa are high, having evolved as a consequence of apartheid, into contemporary, routinized, and prevalent patterns of rural-urban and circular migration (Collinson et al., 2006; Hosegood et al., 2005; Posel, 2020). Men and women from rural origin areas move in search of employment which is often insecure and/or informal. The negative mental health consequences of migration, in conjunction with apartheid, have been acknowledged (Dommisse, 1986; Hickson and Kriegler, 1991; World Health Organization, 1977), but we still have a limited understanding of how contemporary migration under the legacy of apartheid affects mental health today.

In the present study we take advantage of cohort survey data to hone our understanding of the relationship between migration and mental health in South Africa and to tease-out potentially confounding influences. We include indicators of personal sociodemographic characteristics and physical health as we examine depressive symptoms and internal migration. The Migrant Health Follow-Up Study (MHFUS) draws participants from the Agincourt Health and socio-Demographic Surveillance System (HDSS), a geographically defined observation platform in a low-resource environment in rural northeast South Africa. The MHFUS focuses directly on internal migration, much of which constitutes rural-urban movements. Since our study recruits from a rural community with many sociogeographic conditions in common, we are able to draw robust comparisons between movers and those who stay behind. Furthermore, longitudinal data allow for the exploration of health and social conditions pre-migration and post-migration, and the monitoring of changes over time (Anglewicz et al., 2018).

The objectives of this study are 1) to explore the likelihood of experiencing of depressive symptoms among migrants and Agincourt study site residents using data from two study waves of the MHFUS spanning the period 2019 – 2021; 2) to investigate whether migrants are positively selected on depressive symptoms (i.e.: exhibit fewer depressive symptoms prior to a move), as an extension of

the healthy migrant effect; and 3) to examine the relationship between migration and depressive symptoms controlling for sociodemographic and health factors.

2. Methods

2.1 Study population and sample

The MHFUS is a nested cohort study of the Agincourt HDSS platform. The Agincourt HDSS, established in 1992, maintains an ongoing enumeration of the full population of a 420 square kilometre area in the Mpumalanga Province in South Africa's rural northeast (Kahn et al., 2012). The MHFUS commenced in 2017 with the recruitment of individuals from a simple random sample of 3800 18- to 40-year-olds who were part of the Agincourt HDSS population at the time of the 2016 HDSS census. The HDSS population from which the MHFUS sample was drawn was defined by all individuals who were listed in the roster of each household (usually reported by the household head) in the 2016 annual enumeration of the 31 villages in the Agincourt HDSS. This roster includes current residents within the Agincourt study site, as well as those living in other locations across South Africa for most of the year but who maintain connections to the household. At MHFUS Wave 1, 56% of the sample were residents of the Agincourt study site, while 43% were living away from the study site (migrants). From enrolment the MHFUS has followed all participants, migrants and Agincourt study site residents, no matter their subsequent origin household attachment.

Wave 1 of data collection on the cohort took place in 2018 via in-person interviews. Waves 2 and 3 occurred via telephone interviews, between September 2019 and January 2020 and September 2020 to March 2021 respectively. We successfully recruited and interviewed 3092 respondents in Wave 1 and retained 95.9% of this cohort through Wave 3 (see Ginsburg et al., 2021 for details on initial participation, eligibility, and recruitment methods). In the present analysis, we use data from Waves 2 and 3 since we introduced measures on mental health for the first time in the Wave 2 survey and

collected these again in Wave 3. The analytic sample for this study includes participants who responded to both the Wave 2 and 3 interviews (n=2967).

2.2 Variables and measures

At each wave, core questions on residence history and migration, education, employment and health status (including chronic conditions and health service use) were asked. Questionnaires were administered using REDCap electronic data capture software (Harris et al., 2019; Harris et al., 2009).

We define a "migrant" as a participant who was living away from the Agincourt study site in any given wave of the study. Due to high prevalence of circular and temporary migration in this population, a participant's migration status may be classified as:

1) a *continuing migrant* if they lived outside of the Agincourt study site for consecutive waves;

2) a *new migrant* if they transitioned from residing within the Agincourt study site to residing outside of it for the first time between two waves;

3) a *return migrant* if they moved back from a migration destination to the Agincourt study site between two waves.

We introduced the 10-item Center for Epidemiological Studies Depression Scale (CES-D) depression screening tool in Wave 2 to determine the presence of depressive symptoms in the study population (Adams et al., 2020; Radloff, 1977). The scale was translated and back translated (into and from the local language, xi-Tsonga) and administered by a team of experienced and trained fieldworkers via telephone. The CES-D score is based on the sum of responses to 10 questions asking about the way a person may have felt or behaved during the past week. Responses were coded on an ordinal scale with values from 0 to 3, where 0 referred to a response of "rarely or none of the time" and 3 referred to a response of "all of the time". In accordance with the screening tool protocol, two

response categories, item 5 (I felt hopeful about the future) and item 8 (I was happy), were asked and then reverse coded. We present analyses using an ordinal CES-D score (with categories 0, 1 - 3, and 4+) because of the right-skewed distribution of CES-D scores in our data (see Figure 1). Given the large number of participants with CES-D scores of zero, we include zero scores as a distinct category (our reference category) to differentiate those whose cumulative responses place them at the extreme low end of the scale from those who are in ordered categories of higher scores. While CES-D scores in theory range from 0 to 30, the highest score observed in our sample is 23.

The analyses include sociodemographic variables (time varying where applicable): gender, age, education and employment status, measures of physical health (diagnosis of a chronic condition) and migration status variables. We further include in our analyses of depressive symptoms a measure of perceived social support using a scale adapted from Zimet et al. which is based on the sum of 11 items with scores ranging from 1 to 4 (Rothschild, 2019; Turner et al., 2010; Zimet et al., 1990). The relevant extract of the MHFUS questionnaire for Wave 2 is available in the appendix (note that the same set of questions were included in Wave 3).

2.3 Statistical Analysis

2.3.1 **Descriptive Analyses.** To meet our first objective (to describe the likelihood of experiencing depressive symptoms in the cohort), we examine the characteristics of the sample at Wave 2 and the frequency of depressive symptoms over time (at Wave 3) by migration status (using χ^2 and t-tests in bivariate analyses).

2.3.2 **Analyses of Migration Selection.** To achieve the second objective (investigating migration selection), we employ logistic regression analyses to estimate the probability of being a migrant away from the Agincourt study site as of Wave 3 (Hosmer Jr. et al., 2013). In Model 1 we contrast Wave 3 migrants with Wave 3 Agincourt study site

residents (based on the full analytic sample). In Model 2, we predict the probability of being a Wave 3 migrant conditional on being a Wave 2 Agincourt study site resident, contrasting new Wave 3 migrants with Wave 3 Agincourt study site residents. We include in these analyses the set of sociodemographic and health status variables measured at Wave 2 that may be associated with migration status at Wave 3, including Wave 2 CES-D scores.

2.3.3 **Analyses of Depressive Symptoms.** To pursue our third objective (examining the relationship between migration status and depressive symptoms), we fit a series of ordinal logit regression models where CES-D category at Wave 3 is the outcome variable (Allison and Christakis, 1994; Fullerton, 2009).

Covariates age, gender, education, social support and diagnosis of a chronic condition are included in the models at Wave 3 values, since these reflect characteristics or conditions determined prior to the CES-D measure captured at time of survey, and we want more proximal measures of these variables to relate to the outcome. For migration and employment status, which are neither time invariant nor cumulative over time, we derive a set of categories to account for a potential change between Wave 2 and Wave 3 on depressive symptoms. For the migration status predictors, we contrast (1) continuing Agincourt residents (those who were living in the study site in Wave 2 and Wave 3); (2) continuing migrants (those who were living in migrant destinations outside of the study site in Wave 2 and Wave 3); (3) new migrants (those who moved out of the study site between Wave 2 and Wave 3); and (4) return migrants (those who returned to living within the study site between Wave 2 and Wave 3)[1]. To explore a

[1] We explored controls in the models for duration that a migrant was living in the destination (migration experience) and we found no significant effect.

potential effect of change in employment status between Wave 2 and Wave 3 we contrast participants who were continuously employed in Wave 2 and Wave 3, with those who were continuously unemployed (or not in the labour force) in Wave 2 and Wave 3, with those who gained employment (shifted from unemployed to employed between Wave 2 and Wave 3), with those who lost employment between Wave 2 and Wave 3.

For the ordinal logit regression analyses, we progressively add sets of covariates to estimate three models. Model 1 reflects the effect of migration status (alone) on CES-D score since this is our exposure of interest. Model 2 adds predetermined sociodemographic characteristics age, gender and education. Model 3 includes controls for employment status and health and well-being characteristics (diagnosis of a chronic condition, social support and CES-D score at Wave 2 to control for a prior status along the scale of depressive symptoms). All models include controls for fieldworker effects acknowledging well-established evidence that some variation may exist between fieldworkers particularly on subjective survey questions (Cleary et al., 1981; McBee and Justice, 1977; Pollner, 1998).

This set of models is then reproduced with an alternative migration definition to incorporate a destination component. Here we contrast migrants who moved locally (to other destinations within the Mpumalanga Province but outside of the Agincourt study area), with those who moved to destinations in the mostly urban Gauteng Province, and those who moved to other provinces beyond Gauteng and Mpumalanga. We examined this alternative operationalisation of migration as destination to test for differences in depressive symptoms among urban dwellers or those further away from home.

In addition to the models presented, we explored a set of models using the dichotomous CES-D score with a cut-off of 12 employed for clinically significant depressive symptoms (in line with validation studies of the CES-D instrument in South African populations (Baron et al., 2017)). We also investigated models with alternative functional forms to account for the CES-D distribution. Results were broadly consistent with the current models, which we present as both parsimonious and substantively clearer. Statistical analyses were performed using STATA version 16.1 (StataCorp, 2022).[2]

3. Results

3.1 Descriptive results

Table 1 displays the characteristics of the cohort at the study's Wave 2 survey, by migration status. At the time of this interview, 47.2% of the cohort were resident within the Agincourt study site, and 52.8% of the cohort were living in destinations away from their origin households. Of the latter, 45.7% had migrated to destinations within the Gauteng Province, while 42% of migrants had moved to less distant locations within the Mpumalanga Province (within which the Agincourt study site is located). A larger proportion of Agincourt residents compared to migrants were under 25 years of age in Wave 2 (25.9% compared with 21.2% of migrants), while most migrants were aged between 25 and 35 years (59.5%). A larger proportion of migrants were men (57.7%). The majority of migrants had completed high school or attained a post-secondary school qualification (76.9%), and 61.5% of migrants were employed at the time of the interview in contrast with 27.8% of Agincourt study site residents. A significantly smaller proportion of migrants compared with Agincourt residents reported a chronic condition diagnosis in the second study wave (6.6% of migrants and 15.4% of Agincourt residents, $p<0.001$).

[2] We ran all statistical models making use of weights to adjust for sample loss. These results were consistent with those presented here.

<Insert Table 1>

At both study waves, we observe significantly lower average CES-D scores among migrants compared to Agincourt residents. Mean CES-D scores among migrants measured 1.64 in Wave 2 and 2.27 in Wave 3, while average scores among Agincourt residents were 2.22 in Wave 2 and 2.76 in Wave 3 (see Table 1 for Wave 2 characteristics). It is noteworthy that we find an almost equivalent increase in average CES-D scores between Wave 2 and Wave 3 for both groups (among Agincourt residents mean scores increased by 0.54, and among migrants by 0.63). Figure 1 depicts the distribution of categorised CES-D scores by migrant status for the two study waves (Wave 2 and Wave 3), highlighting the significant differences between migrants and Agincourt residents in terms of the 3-category CES-D variable used in analysis, while also underscoring the temporal shift.

3.2 Migration selection models

Table 2 presents the results of the logistic regression models with outcome migration status at Wave 3. Model 1 analyses the characteristics of Wave 3 migrants compared with Agincourt residents for the full analytic sample (n=2951) and Model 2 focuses on the determinants of undertaking a *new* migration among all those who were resident within the Agincourt study site in in Wave 2 (n=1393). In Model 1, Wave 2 CES-D score is significantly associated with migration status at Wave 3 ($\chi^2_{(2)}$ = 13.12, p<0.01). Those with CES-D scores between 1 and 3 have 23% lower odds of being a migrant at Wave 3 than those with CES-D scores of zero (p<0.01), while those with scores of 4 and above have 29% lower odds of having migrated. Those in the 25-30 age group have 1.26 times the odds of those in the youngest, 18–24-year age group of having moved away from the rural Agincourt study site by Wave 3 (p<0.05). Men have 1.37 times the odds of women of having moved from the study site by Wave 3 (p<0.001), and those with at least a high school certificate have 2.25 times the odds of those with less education of having migrated by Wave 3 (p<0.001). Employment status at Wave 2 is also

significantly associated with Wave 3 migration status (the group of employment status variables having a significant effect on the outcome, $\chi^2_{(2)} = 197.76$, $p<0.001$). Those who were employed or not in the labour force (not looking for work) have 3.59 and 1.79 times the odds of unemployed cohort members of being a migrant at Wave 3 ($p<0.001$). The odds of living outside of the study site at Wave 3 are 0.57 times lower among participants who reported having been diagnosed with a chronic condition by Wave 2, a notable deterrent, in contrast with participants with no such diagnosis ($p<0.001$).

In the restricted sample (Model 2, n=1393), CES-D scores are not significant in predicting a new migration between Wave 2 and Wave 3, although in this less-powered model the direction of effect remains the same as in Model 1. Men are 52% more likely to undertake a new migration compared with women ($p<0.05$). A new migration is 58% less likely among the oldest participants (36- to 44-year-olds) compared to participants aged 18-24 years ($p<0.05$). Education, employment and a chronic condition diagnosis are not significant determinants of a new migration in this time period.

<Insert Table 2>

3.3 Models of depressive symptoms (CES-D)

Table 3 turns to the follow-up assessment of CES-D, including predictions from a four-category operationalisation of migration and other prior characteristics. We employ ordinal logit regression analyses of categorised CES-D scores at Wave 3 with a sequentially more comprehensive models, successively including three sets of covariates. Beginning with migration status variables, our exposure of interest, Model 1 shows that in contrast with continuing Agincourt study site residents, continuing migrants between Waves 2 and 3 have 20% lower odds of manifesting higher CES-D categories ($p<0.01$).

Adding predetermined sociodemographic variables age, gender and education (Model 2), the significant association for continuing migrant status holds (OR=0.84, p<0.01) while having at least a high school completion is associated with 22% lower odds of increasing one's CES-D category (p<0.01). In Model 3, employment status change and measures of health and well-being are included. In contrast with the reference category of being continuously unemployed, being continuously employed between Waves 2 and 3 is associated with 27% lower odds of CES-D outcome (p<0.01). With the inclusion of employment status in the model, education status is no longer statistically significant (p=0.07), however the direction of association between completed schooling or tertiary education and lower CES-D scores holds (OR = 0.87)[3]. Having a higher score on social support is associated with lower odds of depressive symptoms (OR=0.97, p<0.001), while suffering from a chronic condition is associated with 1.54 times higher odds of reporting depressive symptoms (p<0.001). Controlling for Wave 2 CES-D scores, we observe some continuity in CES-D measures over time for participants with higher risk of depressive symptoms. Those with Wave 2 CES-D scores of 4 or higher have 1.26 times the odds of having higher CES-D scores in Wave 3 (p<0.05). In this final model, model fit (represented by the adjusted R^2 value) improves, although we note that this is modest. To illustrate these results, we contrast some predicted CES-D outcome categories based on Model 3. Holding all covariates at their reference categories, and using the mean score on social support, the probabilities of continuing migrants who were always employed being in CES-D categories 0, 1 - 3 and 4+ are 0.63, 0.25 and 0.12 respectively. Among continuing Agincourt residents who were always unemployed, these are 0.55, 0.29 and 0.16[4] respectively.

<Insert Table 3>

[3] We note a significant association between education and employment variables ($\chi^2_{(6)} = 71.17$, p<0.001) therefore with the inclusion of employment status in the model, the significance of education is reduced.
[4] There are modest changes in sample size across Models 1-3 in Tables 3 and 4. These are due to some missing values on independent variables.

A companion set of models for CES-D outcome, in which we substitute a more detailed indicator of migration destination for the migration status Wave 2 to Wave 3 variables, is displayed in Table 4. Model 1 shows an overall significant effect of migration destination variables on CES-D scores at Wave 3 ($\chi^2_{(3)} = 13.52$, $p<0.05$). Participants who migrated to other areas within the Mpumalanga Province, or those who moved to the more urbanised Gauteng Province both have 0.83 times the odds of being in being in higher CES-D category compared to those who remained in the area of origin ($p<0.05$). The odds of reporting more depressive symptoms were even less likely among participants who relocated to other provinces beyond the Agincourt study site (generally less geographically connected) (OR=0.63, $p<0.001$). This relationship holds once predetermined sociodemographic factors age, gender and education are included (Model 2). As with the prior set of models, the inclusion of employment status change and measures of health and well-being in Model 3 does reduce the magnitude of the "migration destination" coefficients. The coefficients in Model 3 are consistent with results reported in Table 3 indicating a significant relationship between continuous employment, social support and health status on CES-D categories. These more geographically nuanced models are broadly indicative of greater selectivity among migrants undertaking a move to more remote destinations.

<Insert Table 4>

4. Discussion

South Africa presents a complex setting in which intersecting economic, social and environmental conditions have the potential to greatly influence the country's mental health burden. This study seeks to extend our understanding of these dimensions, and in particular, redress the sparseness of evidence on internal migration and mental health in the country. Using cohort data for young adult population from two time points, the likelihood of experiencing depressive symptoms in the cohort is ascertained, and the migration and mental health relationship explored from two perspectives –

the first examining depressive symptoms as a determinant of migration and the second, investigating the relationship between migration status and depressive symptoms – accounting for temporal sequence.

Our study finds comparatively low likelihood of experiencing depressive symptoms, with average CES-D scores of 1.9 in this younger adult population. While the age ranges and samples are not directly comparable, these are in contrast with other studies based on South African adults where higher average CES-D scores of 5.8 (Kim et al., 2022) and 6.9 (in a nationally representative sample) (Myroniuk et al., 2022) were observed. Average scores differ cross-sectionally by migrant status, with Agincourt residents (at Wave 2 and 3) having higher average CES-D scores than migrants. Extant literature finds diverse patterns of association between migration and mental health. The Migration and Health in Malawi study, for example, finds no significant association between mental health status of migrants and non-migrants in the cohort following a move (Anglewicz et al., 2017), while an analysis based on national-level longitudinal data from the South African National Income Dynamics Study (NIDS) contrasting internal migrants and non-migrants at destinations, finds that the association differs at different survey time points (Ajaero et al., 2017). In line with our cross-sectional findings showing lower levels of depressive symptoms among migrants, a recent analysis of four waves of the NIDS data finds an improvement in mental health and emotional well-being following migration (Myroniuk et al., 2022). We observe a uniform increase in CES-D scores between Wave 2 and Wave 3 which is suggestive of a possible universal effect of the COVID-19 pandemic which overlapped with the interview at Wave 3 (see Ginsburg et al., 2022 for more details on the impact of COVID-19 on the cohort). This corresponds with findings from a systematic review of international literature identifying increases in depressive symptoms as a consequence of the COVID-19 pandemic (Vindegaard and Benros, 2020), and local studies noting an increased risk of depression during the COVID-19 pandemic period (de Kadt et al., 2021; Hunt et al., 2021). The shift in CES-D score from Wave 2 to Wave 3 adds credence to its validity in our MHFUS sample.

We hypothesise that migrants may be positively selected on mental as well as physical health, yet we do not find consistent evidence of positive (or negative) selection on depressive symptoms in our analysis. While no significant selection effect on depressive symptoms is observed among those initiating a new migration between the two time points analysed, having a CES-D score above zero is associated with lower odds of being a migrant at Wave 3 (having migrated between Wave 2 and Wave 3 or at an earlier time). This contrasts studies of internal migration that have associated migration with stress and psychological distress (Chen, 2011; Lu, 2010b) – migrants in this study, who are also more likely to be employed and have higher levels of education than those who do not move, have relatively low risk of depressive symptoms. It is noteworthy that Agincourt residents have a higher likelihood than migrants of suffering from a chronic condition, and the presence of chronic conditions strongly reduces the likelihood of migration. This adds support to the healthy migrant hypothesis which, commonly studied in relation to physical health (Anglewicz et al., 2017; Lu, 2008; Lu and Qin, 2014), has been less studied in relation to mental health.

Our analysis of depressive symptoms shows that being a continuing migrant over the analysis period is associated with lower categories of CES-D scores, although this relationship is no longer observed once employment status and health characteristics are introduced. Our results support trends observed in other studies of the socioeconomic determinants of mental health. We observe a positive association between educational attainment and mental well-being that has been observed in other South African studies (Hamad et al., 2008; Mungai and Bayat, 2019). Of greater significance is the association between continuous employment and lower CES-D scores in this young adult cohort. The link between lower socioeconomic status and increased depressive symptoms has been well established in the South African literature (Ardington and Case, 2010; Hamad et al., 2008; Lund and Cois, 2018). Migration, which is itself associated with education and employment, is likely to be an important variable interwoven along the causal pathway when examining the social determinants

of mental health. In furtherance of this effort to disentangle migratory behaviour and reported health conditions, a noteworthy contribution of our study is that it considers *change* in migration status and employment in relation to the CES-D outcome, thus adding evidence around temporal ordering that goes beyond cross-sectional associations and doing so for a particularly relevant migration setting and population. Our expanded analysis incorporating migrant's destination into our migration definition indicates that the distance travelled, or characteristics associated with the destination location, may be associated with CES-D scores. Regional variation in the prevalence of depressive symptoms have been observed in other South African studies, with differences posited to relate to levels of poverty or the co-existence of other morbidities (Craig et al., 2022; Cuadros et al., 2019; Mkhize and Hamann, 2022).

The connection between physical health and depressive symptoms is underscored in our models with higher CES-D scores among those reporting a diagnosis of a chronic condition. We further find that social support is associated with lower CES-D scores in the cohort which echoes findings from other studies on the importance of social networks in the context of migration and more broadly (Berkman and Krishna, 2014; Lu, 2010a). It is noteworthy that we do not find significant gender differences in our analysis of depressive symptoms, as have been observed in several studies of mental health in low-resource settings including South Africa where women have a higher prevalence of depressive symptoms than men (Ajaero et al., 2017; Das et al., 2012; Lu, 2010a; Mungai and Bayat, 2019). We have found important gender differentials in the migration and physical health relationship based on MHFUS data, and further qualitative research is planned to study women's mental and physical health and circumstances around migration.

Our study raises some important methodological considerations and potential limitations which are worthy of attention as this area of research develops. The questionnaire data and CES-D items were collected telephonically (using a translation of the English into xi-Tsonga). Research conducted in

high-income, English speaking countries using telephone surveys have found little difference between telephone as a medium for collecting mental health measures compared with face-to-face interviews (Aneshensel et al., 1982; Rohde et al., 1997; Ryan et al., 2013). Moreover, telephone interviews, as our work has shown, can be conducted with less demand for resources than in-person interviews, and at more frequent intervals for focussed assessments on particular subjective conditions. Undoubtedly, further research would be valuable to investigate the use of telephone surveys of mental health indicators in LMIC and transition contexts. We propose that it may be challenging for fieldworkers to establish a high degree of rapport over the phone, and therefore participants may underreport their symptoms of depression. This is likely to compound issues around language-translation and cultural explanations of mental health symptoms in LMICs and diverse cultural settings.

Our study, based on two time points, provides some insight into changes in mental health and corresponding migration trajectories. While in our selection models, regressors are predetermined, we note the possibility in our CES-D outcome models of reverse causality given the close correspondence in time between the collection of our mental health outcome measure and the other covariates in our model. We reason that most covariates and changes in status between Wave 2 and Wave 3 would have taken place in advance of the CES-D survey that uses a one-week reference point prior to the interview. Accumulating longitudinal data on this cohort through repeated assessments of mental health status and corresponding migration trajectories over time will deepen our understanding of this increasingly important migration-mental health relationship, particularly as the cohort ages and experiences further life cycle variation in socioeconomic conditions.

5. Conclusion

Migration and the stress associated with dislocation often raise concerns around potential negative mental health impacts. This perspective is not borne out in our analysis of internal migration in a South African rural origin young adult population. We find that in contrast to the prevailing narrative around the vulnerability of migrants, migrant status is associated with fewer depressive symptoms. Further, being employed, having social support and being in better physical health are protective against poor mental health. In South Africa, where internal migration in an important strategy to gaining access to the labour market, policy that is supportive of maintaining migrants' health, both physical and mental is warranted. Additional concern arises for those "left behind" in origin (often rural) communities. To the degree that such individuals are less able to migrate (due to physical and possibly mental health conditions) and in turn, less likely to be economically engaged, our results suggest increasing attention be placed on these persons' well-being. Our findings suggest that continued evidence on the role of migration – both positive and negative – can lead to a better understanding of the interrelationship between social and mental health outcomes.

List of abbreviations:

CES-D: 10-item Center for Epidemiological Studies Depression Scale

COVID-19: Coronavirus Disease 2019

HDSS: Health and Demographic Surveillance System

HIV: Human immunodeficiency virus

LMIC: Low- and middle-income country

MHFUS: Migrant Health Follow-up Study

NIDS: South African National Income Dynamics Study

NS: Not significant

OR: Odds ratio

TB: Tuberculosis

Declarations

Ethics approval and consent to participate:

The Migrant Health Follow-Up Study was reviewed and approved by the University of the Witwatersrand Human Research Ethics Committee (Medical) (clearance certificate numbers M170277 and M220160), and the Mpumalanga Provincial Health Research and Ethics Committee. Informed consent for participation in the study was received in writing from all participants who were interviewed face-to-face. Informed consent was obtained verbally in Wave 1 in instances where migrant participants were not within reach for a face-to-face interview, and for Waves 2 and 3 where all interviews were administered via telephone. All methods were carried out in accordance with relevant guidelines and regulations.

Data availability:

Data from the Migrant Health Follow-Up Study are available from the corresponding author on reasonable request. Agincourt Health and Demographic Surveillance Systems data are available through the SAPRIN URL <http://saprin.mrc.ac.za/>.

Competing interests:

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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Figures and Tables

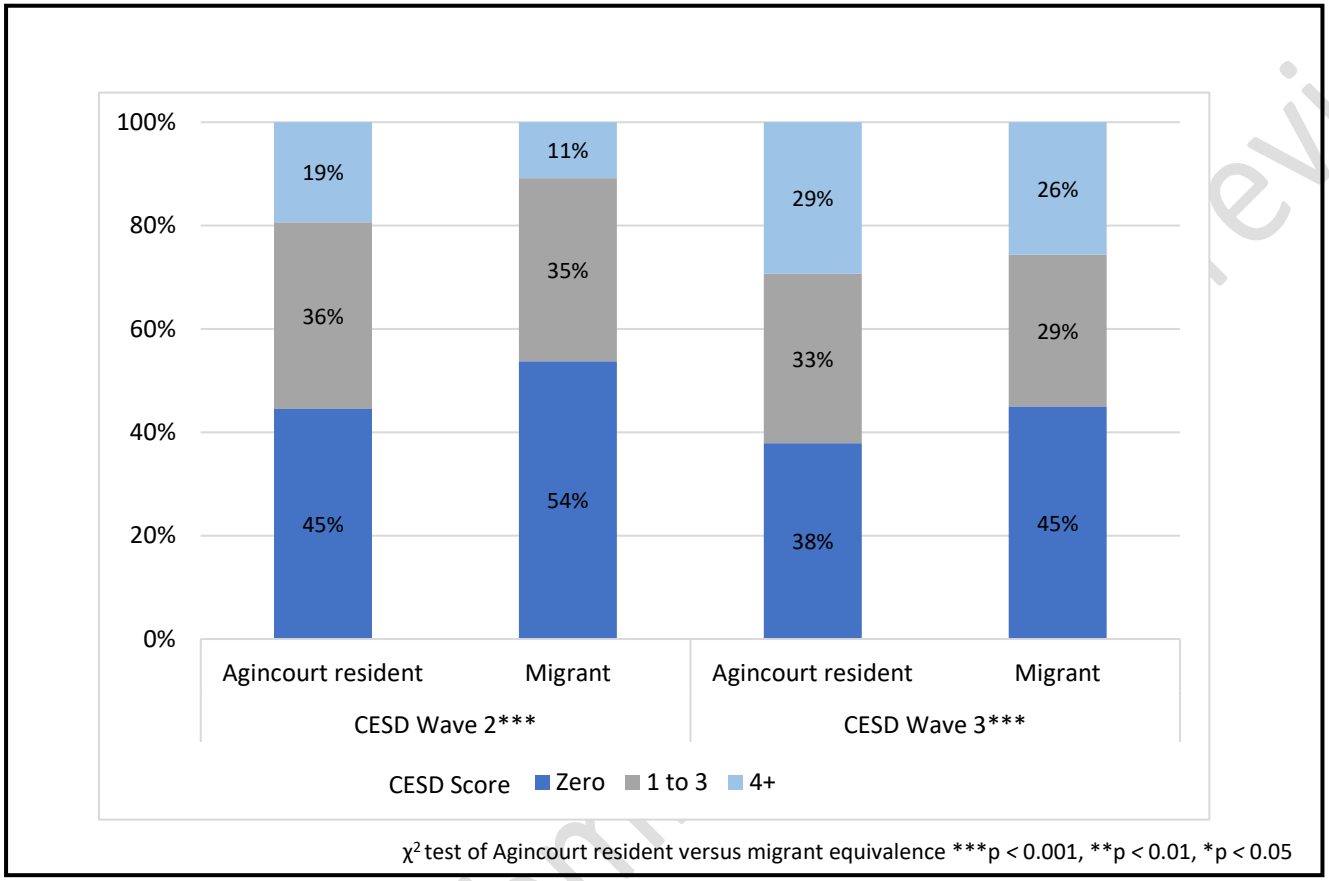

Figure 1: Distribution of CES-D score by migrant status Waves 2 and 3

Table 1: Characteristics of the MHFUS cohort at Wave 2

		Wave 2 cohort (n = 2967)		Agincourt resident (n = 1399, 47.2%)		Migrant (n = 1568, 52.8%)		p-value
		n	%	n	%	n	%	
Age Group	18-24	695	23.4%	362	25.9%	333	21.2%	p< 0.01
	25-30	1006	33.9%	431	30.8%	575	36.7%	
	31-35	696	23.5%	338	24.2%	358	22.8%	
	36-44	570	19.2%	268	19.2%	302	19.3%	
Gender	Men	1493	50.3%	589	42.1%	904	57.7%	p< 0.001
	Women	1474	49.7%	810	57.9%	664	42.3%	
Education Status	Primary school or lower	119	4.0%	91	6.5%	28	1.8%	p< 0.001
	High school incomplete	897	30.2%	566	40.5%	331	21.1%	
	Completed high school or post school	1945	65.6%	739	52.8%	1206	76.9%	
	Missing	6	0.2%	3	0.2%	3	0.2%	
Employment status	Not in labour force	348	11.7%	179	12.8%	169	10.8%	p< 0.001
	Unemployed	1259	42.4%	829	59.3%	430	27.4%	
	Employed	1353	45.6%	389	27.8%	964	61.5%	
	Missing	7	0.2%	2	0.1%	5	0.3%	
Chronic condition diagnosis	Yes	319	10.8%	215	15.4%	104	6.6%	p< 0.001
	No	2646	89.2%	1183	84.6%	1463	93.3%	
	Missing	2	0.1%	1	0.1%	1	0.1%	
Social support score	Mean (SD)	34.3 (7.0)		34.2 (7.1)		34.5 (6.8)		NS
	Min, Max	11, 44		11, 44		11, 44		
CES-D score	Mean (SD)	1.9 (2.7)		2.2 (3.0)		1.6(2.4)		p< 0.001
	Min, Max	0, 23		0, 23		0, 18		
Province of residence	Mpumalanga	2057	69.3%	1399	100%	658	42.0%	n/a
	Gauteng	717	24.2%	~	~	717	45.7%	
	Limpopo	93	3.1%	~	~	93	5.9%	
	North West	54	1.8%	~	~	54	3.4%	
	Other	46	1.6%	~	~	46	2.9%	

Table 2 Logistic regression models – outcome migrant status Wave 3

Reference category: Agincourt residents		Model 1: Migrants Wave 3		Model 2: New Migrants Wave 3	
		OR	95% CI	OR	95% CI
Age group	18-24 (Ref)	~	~	~	~
	25 - 30	1.26*	(1.01 1.57)	0.82	(0.53 1.25)
	31 - 35	1.08	(0.84 1.38)	0.56*	(0.34 0.92)
	36 - 44	1.16	(0.89 1.51)	0.42**	(0.24 0.77)
Gender	Men	1.37***	(1.17 1.62)	1.52*	(1.07 2.15)
	Women (Ref)	~	~	~	~
Education status Wave 2	Incomplete high school or lower (Ref)	~	~	~	~
	Completed high school or post school	2.25***	(1.90 2.66)	1.29	(0.91 1.84)
Employment status Wave 2	Unemployed (Ref)	~	~	~	~
	Employed	3.59***	(3.00 4.29)	1.42	(0.96 2.09)
	Unemployed not looking for work	1.79***	(1.38 2.34)	1.24	(0.73 2.11)
CES-D score Wave 2	0 (Ref)	~	~	~	~
	1 - 3	0.77**	(0.64 0.91)	0.88	(0.61 1.27)
	4+	0.71**	(0.56 0.90)	0.89	(0.56 1.42)
Chronic condition diagnosis Wave 2	Yes	0.57***	(0.43 0.75)	0.86	(0.49 1.53)
	No (Ref)	~	~	~	~
Constant		0.30***	(0.23 0.39)	0.13***	(0.08 0.21)
*** p < 0.001, ** p < 0.01, * p < 0.05		N observations 2951		N observations 1393	
		Pseudo R^2 = 0.1160		Pseudo R^2 = 0.0300	
		LR Chi ^{2} 474.10		LR Chi ^{2} 30.46	

Table 3: Ordinal logit regression models – outcome CES-D score Wave 3

		Model 1		**Model 2**		**Model 3**	
		OR	95% CI	OR	95% CI	OR	95% CI
Migrant status Wave 2 to Wave 3	Continuing Agincourt resident (Ref)	~	~	~	~	~	~
	Continuing migrant	0.80**	(0.69 0.92)	0.84**	(0.73 0.98)	0.98	(0.83 1.16)
	New migrant	0.78	(0.57 1.06)	0.78	(0.57 1.06)	0.86	(0.63 1.18)
	Return migrant	0.94	(0.71 1.24)	0.98	(0.74 1.30)	0.97	(0.72 1.29)
Age group	18-24 (Ref)	~	~	~	~	~	~
	25 - 30			0.94	(0.77 1.15)	0.96	(0.78 1.18)
	31 - 35			1.05	(0.85 1.30)	1.04	(0.83 1.30)
	36 - 44			0.85	(0.68 1.05)	0.80	(0.63 1.01)
Gender	Men	~	~	1.00	(0.87 1.15)	1.13	(0.98 1.32)
	Women (Ref)			~	~	~	~
Education status Wave 3	Incomplete high school or lower (Ref)	~	~	~	~	~	~
	Completed high school or post school			0.78**	(0.67 0.90)	0.87	(0.74 1.01)
Employment status Wave 2 to Wave 3	Always unemployed (Ref)	~	~	~	~	~	~
	Always employed					0.73**	(0.60 0.89)
	Gained employment					0.85	(0.66 1.10)
	Lost employment					0.96	(0.77 1.20)
Social support score Wave 3		~	~	~	~	0.97***	(0.96 0.98)
Chronic condition diagnosis Wave 3	Yes	~	~	~	~	1.54***	(1.25 1.90)
	No (Ref)					~	~
CES-D score Wave 2	0 (Ref)	~	~	~	~	~	~
	1 - 3					1.02	(0.87 1.19)
	4+					1.26*	(1.02 1.56)
*** p < 0.001, ** p < 0.01, * p < 0.05	Models control for fieldworker effects						
N observations		2964		2962		2935	
Pseudo R^2		0.0387		0.0413		0.0520	
LR Chi ^{2}		248.61		265.13		330.72	

Table 4: Ordinal logit regression models – outcomes CES-D score Wave 3, expanded migration status

		Model 1		Model 2		Model 3	
		OR	95% CI	OR	95% CI	OR	95% CI
Migrant Destination Wave 3	Agincourt study site (Ref)	~	~	~	~	~	~
	Other Mpumalanga	0.83*	(0.70 0.99)	0.86	(0.72 1.03)	1.00	(0.83 1.20)
	Gauteng	0.83*	(0.69 0.98)	0.87	(0.73 1.05)	1.02	(0.84 1.23)
	Beyond	0.63**	(0.47 0.84)	0.66**	(0.49 0.89)	0.75	(0.56 1.02)
Age group	18-24 (Ref)	~	~	~	~	~	~
	25 - 30			0.94	(0.77 1.14)	0.96	(0.78 1.18)
	31 - 35			1.05	(0.85 1.29)	1.04	(0.83 1.30)
	36 - 44			0.84	(0.68 1.05)	0.80	(0.63 1.01)
Gender	Men	~	~	1.00	(0.88 1.15)	1.14	(0.98 1.32)
	Women (Ref)			~	~	~	~
Education status Wave 3	Incomplete high school or lower (Ref)	~	~	~	~	~	~
	Completed high school or post school			0.78**	(0.67 0.90)	0.87	(0.74 1.01)
Employment status Wave 2 to Wave 3	Always unemployed (Ref)	~	~	~	~	~	~
	Always employed					0.73**	(0.60 0.89)
	Gained employment					0.84	(0.66 1.08)
	Lost employment					0.95	(0.76 1.18)
Social support score Wave 3		~	~	~	~	0.97***	(0.96 0.98)
Chronic condition diagnosis Wave 3	Yes	~	~	~	~	1.53***	(1.24 1.89)
	No (Ref)					~	~
CES-D score Wave 2	0 (Ref)	~	~	~	~	~	~
	1 - 3					1.02	(0.87 1.19)
	4+					1.25*	(1.02 1.55)
*** p < 0.001, ** p < 0.01, * p < 0.05	Models control for fieldworker effects						
N observations		2964		2962		2935	
Pseudo R^2		0.0393		0.0418		0.0525	
LR Chi ^{2}		251.98		268.25		338.80	

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