URBANICITY, SOCIAL CAPITAL, AND DEPRESSION IN OLDER ADULTS: AN ANALYSIS OF TWO AFRICAN COUNTRIES

by

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Abstract

Depression is a significant contributor to global morbidity and mortality and is the primary cause of disability worldwide. Older adults are an age group that may be more vulnerable to depression due to a higher prevalence of many known risk factors. Moreover, evidence also suggests that living in urban locations can increase the risk of depression and other mental illnesses. Thus, as the world's population continues to age and urbanize, the burden of depression could increase. However, very few studies on the links between urbanicity and depression in older adults have been conducted in low- and middle-income settings such as sub-Saharan Africa, despite its rapid urbanization and substantial increases in the size of its aging population.

Through quantitative analyses of secondary data from the Ghana and South Africa samples of the World Health Organization (WHO) Study on Global AGEing and Adult Health (SAGE), this dissertation therefore sought to explore the relationship between urbanicity and depression among older adults in an African context. The study specifically used multivariable logistic regression to examine the association between current urban residence and depression in Ghanaian and South African older adults as well as whether urbanicity of residence across the life course was associated with depression in these populations. It also assessed the influence of urbanicity on the relationship between depression and social capital—a purported protective factor—through structural equation modeling.

Results indicated that there was no significant association between urbanicity and depression based on current residence or life-course residence in either country. Additionally, urbanicity did not substantially modify the effects of social capital on

depression in either nation, but urban-rural differences in the level and composition of social capital were observed. Moreover, while trust was associated with a lower risk of depression in South Africa overall, sociability and trust were associated with an increased risk of depression in Ghana.

These findings provide some insight into the socio-contextual determinants of depression in Ghanaian and South African older adults and may help to inform decisions on the allocation of mental health resources as well as policies and interventions to address later-life depression in these populations.

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Table of Contents

List of Tables

List of Figures

Urbanicity, Social Capital, and Depression in Older Adults: A Critical Review of the Literature

Introduction

Urbanization is one of the defining transitions of recent history. The majority of the global population now lives in cities, and projections indicate that by the year 2030, the total urban population will reach 5 billion.[1] Notably, most of this shift is currently occurring in the global south, particularly the continents of Africa and Asia.[1] The urbanization process has a significant bearing on population health, and while the impacts to physical health are widely acknowledged, impacts to mental health are also important. A number of studies have demonstrated an association between urbanicity—or the degree to which an area is urban—and mental illness.[2-4] These studies have shown links between poor mental health outcomes and greater urbanicity as measured by the population size or density of cities both in cross-sectional and longitudinal data. Whereas the link between urbanicity and psychosis has been firmly established,[5,6] findings on depression are also suggestive but much more varied.[5] Nonetheless, depression is a condition that has considerable and increasing burden around the world, ranking as the primary cause of disability and affecting over 300 million people according to the World Health Organization (WHO).[7] Thus, a clearer understanding of how urbanicity relates to depression is needed in order to prevent and control this disorder and its adverse effects in the midst of urban growth.

Picking up where other research has left off, this dissertation confronts the question of how urbanicity affects depression but places it within two important contexts

that address notable gaps in the literature. One is the context of aging, which is another widespread phenomenon with profound impact that is shaping the global population. Countries around the world are witnessing a maturing of their age structures due to declines in fertility and increases in life expectancy,[8] and a growing number of older adults are consequently living in cities.[9] The aging population is therefore deserving of attention.

The second context in which this dissertation situates the urbanicity-depression question is in the geographic context of Africa, where relatively little research has been conducted on this topic, let alone on depression and mental health itself. Nonetheless, the continent is urbanizing rapidly and is on course to have the fastest urbanization rate in the world beginning in the next few years.[10] Despite the fact that Africa currently has the youngest population, it has also seen large gains in life expectancy and the size of the older adult population is also increasing more quickly than in high-income countries.[11] As a result of these demographic transitions, the African region is poised to experience major population shifts in the coming years, for which it must be prepared.

The papers that follow therefore all examine the question of urbanicity and depression in these two contexts, but each explores it in unique ways. The first attempts to determine whether such a link exists in the study populations. The second tackles this question not just from a static perspective but recognizes the importance of exposure over the life course for the health of older adults and individuals in general. Lastly, the third paper uses the concept of urbanicity to instead assess its influence on the relationship of depression with another well-known determinant, social capital. The critical review of the

literature below addresses key topics relevant to these research questions and will help to frame the papers that follow.

Urbanicity as a Determinant of Depression

Though some observations of an excess of mental disorders in urban areas date back to the mid 1800's,[12] concern over urban-rural differences in mental health grew as a result of observations of high rates of psychotic disorders in inner cities in the first half of the 1900's.[13] In particular, early work in Chicago by sociologists Faris and Dunham[14] that documented higher rates of schizophrenia in the core of the city with rates declining gradually towards the perimeter brought greater attention to this issue and spawned further investigations into urban-rural differences in mental disorders. Differences have also been demonstrated in studies of depression, with a similar trend of higher rates among people living in urban areas. For example, a meta-analysis estimated an adjusted odds ratio of 1.28 (95%CI: 1.13-1.44) for mood disorders including depression in urban compared to rural residents,[3] and additional studies have also been reported. A longitudinal study of all Swedish residents demonstrated a significant association between population density and incidence of depression, with adjusted hazard ratios for depression of 1.20 (95% CI 1.11-1.30) and 1.12 (95% CI 1.02-1.23) for women and men, respectively, comparing the most densely populated quintile to the least dense quintile.[4] A study of the 2002 Canadian Community Health Survey also found that participants living in the most rural areas had a significantly lower prevalence of depression than those living in urban areas within census metropolitan areas or agglomerations;[15] and a pooled meta-analysis of Canadian national surveys also confirmed an urban

preponderance of major depressive episodes.[16] Similar results supporting significantly higher rates of depression or depressive symptoms among urban dwellers have been found in a study of national survey data in Korea,[17] an analysis of diabetic patients in Taiwan,[18] and small study of young adults from a state in India.[19] Furthermore, a systematic review of urbanicity and mental illness in Europe identified that seven out of nine studies on mood disorders found some evidence of a higher likelihood in urban settings.[20]

Area-level analyses of data on US counties also demonstrated significantly fewer reported average days of poor mental health including stress, depression, and emotional issues in more rural areas of the US—though rates of suicide were higher, which the authors attribute to greater access to more deadly methods,[21] such as firearms or possibly agricultural pesticides. Additionally, studies have also demonstrated comparable associations when assessing prescribing outcomes. For example, individuals residing in urban areas of Northern Ireland received significantly more prescriptions for depression and anxiety medications than in rural areas after accounting for compositional effects,[22] and higher rates of prescriptions for antidepressants, antipsychotics, and anxiolytics were also found for urban areas of Scotland after controlling for area health and socioeconomic characteristic.[23] Medication prescriptions as an outcome, however, could be problematic since use of and access to treatment could vary by urban-rural location.

Identifying Causes of the Relationship between Urbanicity and Depression

Recent work on urbanicity and mental health has begun to look within urban areas and turn to neighborhoods to hone in on the aspects of urban settings that may contribute

to mental illness such as mood disorders.[5,24] This has emphasized both social causes as well as physical characteristics.

In terms of social causes, factors such as residential segregation, socioeconomic disadvantage, and crime have been considered.[24-27] Notions surrounding social disorder and disorganization as well as social stress and the concentration of these conditions in urban areas are thus suggested to promote mental illness.[2,13,26,28] When adjusting for stressful life events and other personal characteristics indicative of socioeconomic disadvantage that were more prevalent in urban areas, the association between area of residence and psychiatric morbidity did in fact reduce substantially in a study of British adults but remained significant.[29] And a study of a random sample of residents from the four biggest cities in the Netherlands did not find an association between the density of residences or the amount of green space and symptoms of anxiety and depression; but, neighborhood socioeconomic status was significantly and negatively associate with distress, suggesting that disadvantage was the more relevant factor.[30] The study did not include more rural areas of the country, however.

Other studies on area social characteristics have produced mixed results. In a Belgian study on the role of residential area characteristics in depression, unemployment rate was significantly associated with depression; but median area income was not and area-level variables only accounted for a small amount of depression complaints compared to personal risk factors such as unemployment, income, and marital status.[28] Similarly, Walters et al.[31] found that living in economically deprived areas was significantly associated with depression but this association was eliminated once individual measures of socioeconomic status were taken into account. However,

population density as a measure of urbanicity remained significantly associated with depression, suggesting that other unmeasured factors were behind this effect.

Other research has implicated the physical environment in the urbanicity-depression relationship and in urban mental health in general, including factors such as noise, lack of green space, pollution, and road traffic.[25] For example, the density of trees in areas of London was found to be significantly and negatively associated with the rate of prescription for antidepressants in the area.[32] Ambient sulfur dioxide levels were also associated with depressive symptoms in China, though nonlinearly, but this was independent of the urbanicity effect.[33] Additionally, exposure to artificial light at night affects melatonin production and has been shown in animal models to alter circadian rhythms and lead to depression-like behaviors.[27] Similar findings among people involved in shift work have also been observed.[27] Increased stress with urban settings may also have other biologic effects by altering brain structure and function and leading to mood dysregulation.[27] Research into epigenetic changes as a result of exposure to aspects of the urban environment is also emerging as a potential explanation for the link between urban environments and mental illness.[34]

Inconsistencies in the Urbanicity-Depression Relationship

Despite the existing evidence, Breslau et al.[35] call the shift to focus on mechanisms and characteristics of urban settings that are detrimental to mental health "premature," asserting that the relationship has not been established. Their study of survey data from US adolescents and adults did not find an association between urbanicity and depression in adolescents and demonstrated that adults in small

metropolitan and semi-rural areas had significantly elevated odds of depression compared to large metropolitan areas after adjustment for personal factors, while rural adults did not differ from those in the most urban locations. And another analysis of nationally representative data from the National Health Interview Survey found significantly higher rates of depression among rural compared to urban residents; however, significance was not maintained after controlling for health and other personal characteristics.[36] Moreover, a study of women in the Southern US found conflicting results, with 12-month and lifetime rates of major depressive disorder (MDD) significantly lower among rural African Americans than urban African Americans while 12-month rates were higher in rural non-Hispanic white women.[37]

In addition, two European multi-country studies likewise demonstrated mixed results, with some countries in the United Kingdom and Western Europe showing greater depression rates in city dwellers and others—particularly in Scandinavia—showing lower rates or no association.[2,38,39] Moreover, the introduction of an intermediate category between rural and urban did not produce consistent patterns in prevalence with urbanicity.[2] Some studies from Japan have also found no significant difference in depression likelihood between urban and rural residents.[40,41] Conversely, some studies from China and Taiwan have shown higher depression rates in rural areas, [33,42,43] and in a study of nine countries of the former Soviet Union, significantly higher rates of psychological distress were found in those who lived in smaller urban settlements or rural areas compared to those living in capital cities.[44] Shorter[12] even claims that the link between urbanicity and mental illness is now reversing in some locations, with rurality becoming risk-inducing.

Therefore, there does seem to be some variation in the association between depression and urbanicity, leading some to assert that claims of an association between urban living and depression or other mental illnesses are oversimplifications and in fact derive from fictionalized ideas of urban and rural life.[12,45,46]

Geographic Limitations of Urbanicity-Depression Studies

Several reasons could explain these inconsistencies. The most glaring relates to the different geographic contexts that these studies cover. Clearly no two countries—or cities for that matter—are the same, and cultural, political, economic, demographic, and environmental circumstances may shape each in different ways. Thus, it may not be possible to identify a consistent relationship in this regard because it may be highly dependent on context. For this reason, the meta-analysis by Peen et al.[3] specifically included only high-income countries to limit the variation across settings.

Although the existing studies represent a variety of contexts, the geographic coverage has still been limited. Overall, European countries have dominated the literature, but several studies have also been conducted in North America, and research in Asian settings is expanding. However, studies in the African region are largely absent. Only a few quantitative studies addressing the topic in Africa were identified, with one showing Ugandans born in urban areas reporting significantly more depressive symptoms in the past week compared to those born in rural areas in multivariable analysis.[47] The other collection of studies described by Wissing et al.[48] found higher rural rates of depression or no significant difference in South Africa, while another community-based study in a Nigerian state found higher prevalence of depression in rural compared to

urban areas,[49] though neither adjusted for other factors. In a few other descriptive studies that did not specifically address this research question but examined general depression correlates, Gureje et al.[50] demonstrated a significantly higher likelihood of lifetime and 12-month MDD in a regional study of Nigerian older adults but only before accounting for socioeconomic factors; in others mostly no significant urban-rural differences were found.[51-54] The lack of studies in African settings, which are becoming increasingly urbanized, is a noticeable shortcoming in the literature that needs to be better addressed to even begin to characterize how urbanicity may affect depression in this region.

Methodological Limitations

Issues in study quality have also been raised in relation to research on the effect of urbanicity on depression and mental illness.[3,45] One concern has been that of insufficient power as a potential explanation for nonsignificant findings; this was a motivating factor for both the multi-country meta-analysis by Peen et al.[3] and the Canadian meta-analysis by Wiens et al.,[16] which both demonstrated significant urban-rural disparities for mood and depressive disorders with higher levels in more urban environments. Another issue raised is the assessment of the outcome, particularly in initial studies that did not use standard definitions for distinct conditions, although later studies have all relied on validated measures.[5,45] However, these measures range from clinical diagnostic tools to scales of depressive symptoms or severity, which may also contribute to the wide range of results.[3] For example, although Abe et al.[40] found no urban-rural difference in depression when using a cutoff score to classify individuals as depressed from the Geriatric Depression Scale, urban residents had higher scores in general.

Perhaps more challenging is the assessment of urbanicity, which has typically been operationalized as a dichotomous variable (urban vs. rural) in research and commonly based on one measure.[55] For instance, in their review of studies on urbanicity and mental health in Europe, Penkalla et al.[20] noted that most studies used population density as a proxy measure for urbanicity. Classification based on population size has also been commonly used.[3,55] In other cases, official designations based on government or administrative categories are used, which often incorporate these and other characteristics and vary from country to country.[55] For instance, population density, land use, and paved land cover are components used to classify all US census areas into urbanized areas, urban clusters, or rural.[56] Rather than a binary distinction, a minority of studies have also used multiple categories or introduced intermediate levels of urbanicity based on these measures, such as the quintile approach for population density used by Sundquist et al.[4]

Urban-rural binary classifications and the use of single measures such as population density or size have been shown to be overly simplistic and insufficient in accounting for the nuanced nature of place characteristics.[55] Urbanicity is a multi-dimensional construct that would be better captured by multiple characteristics. Some scales have been developed and validated for measuring urbanicity,[57] and many of them have items covering similar elements. For example, a scale developed for a study in China by Jones-Smith and Popkin[58]—which was the only urbanicity scale judged in a systematic review to be high quality[57]—used a 12 item scale with a 10 point scaling system per item. The items were population density, economic activity, traditional

markets, modern markets, transportation infrastructure, sanitation, communications, housing, education, diversity, health infrastructure, and social services.

Despite recognition of the need for more complex and consistent measures of urbanicity,[57] this is often limited by feasibility or data availability, particularly if the data were not collected specifically to address the research question. Moreover, most studies apply definitions that are specific to the country or area and thus are not directly comparable across studies. However, given the wide variety of urban contexts globally, a standard measure may not apply across all situations and a relative approach may be more appropriate.[3] Nonetheless, the observed effects will depend on the degree of variation between categories, and a highly urbanized or a predominantly rural but transitioning country may not have enough variation to observe marked differences. Similarly, simple binary classifications that do not recognize gradations or distinctions between the two ends of the spectrum could also be too broad and varied to observe differences between them and result in a higher degree of misclassification.

Apart from the issue of which elements are used to define urbanicity is the issue of scale and level of spatial aggregation. Municipal boundaries are generally used in research, and while most studies have not compared different types of units, a study of urban-rural differences in community involvement among individuals diagnosed with serious mental disorders did find some changes in their results when urbanicity was redefined from a census block group measure to a county measure.[59] Thus, determining the relevant area for research questions may be important and influence the nature of the findings.

Another methodological concern is that although some longitudinal studies have been conducted, the overwhelming majority are cross-sectional in design.[45] This limits the ability to exclude self-selection of mentally ill (or non-ill) individuals into certain environments. Indeed, two predominant theoretical explanations in sociology arose out of the Chicago School to account for the observed urban predominance of mental illness: a causative model which came to be known as the 'breeder hypothesis' suggesting that urban areas breed psychosis; and a model of social selection commonly referred to as the 'drift hypothesis' that posits that individuals prone to or suffering from psychoses are attracted to urban areas or that their psychosis leads to their poor social conditions and may force them into deprived areas.[3,13] Support for the drift hypothesis has been observed to some degree in terms of schizophrenia but is generally limited and evidence seems to suggest that causation is operating in addition and perhaps to a greater extent.[13,26] Furthermore, a recent Finnish study did not observe any link between depressive symptoms and subsequent residential mobility or movement to areas of different population density, which also does not support selective movement due to depression.[60]

Limitations in Study Scope

Related to the previous issue is that beyond addressing the time dimension in study design, incorporating time throughout the assessment of exposure is also not commonly seen. Specifically, most studies have only used current residence as a measure of urbanicity. However, humans and society are dynamic and adaptive, and life course theory suggests that health effects develop over time,[61] and such a perspective may be applicable when it comes to understanding the impact of urbanicity on mental health.[5]

Early life exposures have been associated with the development of some mental illnesses, and at least two studies have found significant associations between urban birthplace and depressive disorder or depressive symptoms.[47,62] So, an empirical basis for vulnerable periods of exposure in this relationship is already emerging.

The notion of cumulative effects of exposure over time may also be relevant, as evidence of greater susceptibility to schizophrenia with increased length of urban living in childhood has been observed.[25] Only a couple of studies have adopted a similar approach to assess exposure to urbanicity as a more dynamic process in relation to depression, in other words treating individuals as urbanizing agents themselves. In a study of Thai adults, a dose-response relationship was in fact found for psychological distress and diagnosed depression, with lowest levels in the rural-rural group, followed by the rural-urban group, and finally the urban-urban group.[63] However, in a study by Kim et al.,[64] higher rates of depression were observed among recent rural-urban migrants in Korean older adults.

This also connects to a related area of research on the impact of migration on mental health, and studies of migration and depression in general have produced mixed results,[65] which may reflect the complexity and diversity of migrants and their conditions and motivations for moving. Rural-urban internal migration in particular has been shown to have negative consequences for depression and mental health in some studies. Evidence from China appears to suggest that this is the case;[66] and in longitudinal analyses from Indonesia, Lu[67,68] demonstrated that rural-urban migrants did have significantly more depressive symptoms than their rural non-migrant counterparts, but the effects varied across personal characteristics of migrants and were pronounced mostly

among those migrating for work, women, and those migrating without family. However, a follow-up study of workers and their relatives in India found that the prevalence of depressive symptoms was highest among the rural group but, among women it was lowest in the rural-urban migrant group while among men migrant and urban rates were similar.[69] In multivariate analyses, however, no significant differences were maintained.

Thus, there may be competing forces operating between cumulative exposure on the one hand and the migration experience on the other, which itself can sometimes be a destabilizing and disruptive process requiring adaptation over time or a liberating experience offering opportunities.[65,70] Studies of transitions between urban and rural areas also present challenges, particularly around selection and healthy—or unhealthy—migrant effects as well as return migration, which often involves those who may be in worse health condition.[70] These selective migration patterns can therefore mask or bias results. Thus, the effects of urbanicity of residence over the life course on depression are likely to be complex and require careful study to enhance understanding of the nuances.

Additional areas for increasing the scope of research on urbanicity in relation to depression and mental health as a whole include accounting for differential effects within segments of the population. Studies have generally not focused on understanding this relationship in the context of other determinants but typically treat other factors as control variables. Judd[45] notes the lack of attention to interactive mechanisms as a particular weakness of research in this area. Yet, as some of the studies discussed above indicate, effects may impact subgroups of people differently, including subpopulations based on gender, socioeconomic status, age, and others. For example, Cheng et al.[42] found that differences in depression prevalence between urban and rural communities in Taiwan

were mainly seen in young women; and Wang[71] found a significant decreased odds of major depressive episode in rural compared to urban Canadians overall after adjustment, but stratified analyses revealed that significant differences were limited to various segments of the population based on age, race, region, and immigrant status. Likewise, gender and age differences were demonstrated in the significance of the association between urbanicity and depression in the North Carolina sample of the Epidemiologic Catchment Area Program.[72]

This dissertation specifically focuses on the urbanicity-depression relationship within the older adult segment of the population, which may also represent a potentially vulnerable group. Not only do older adults often experience additional risk factors for depression,[73] but health effects of the neighborhood environment have been shown to increase with age, which may be a reflection of longer exposure.[74] Moreover, Melis et al.[75] found that the effects of neighborhood characteristics were stronger among older adults, as well as women, which they attribute to the fact that they spend more time within their communities and are more likely to be home-bound. Therefore, the larger context of urbanicity may also be important at this age.

Some research has focused on this population, such as the studies mentioned previously in Japan finding no urban-rural difference in depression[40,41] and studies in China that revealed higher likelihood of depressive symptoms among rural residents.[33,43] And in a study of British residents at least 75 years of age, those living in the most dense and lower-intermediate density areas had significantly higher adjusted odds of depression than those living in the least dense areas.[31] However, in a Swedish study of residents 85 years and older, no significant difference was found for depression between urban and

rural residents in regression models.[76] These mirror the diversity of results found in general studies.

Other research has also looked at biologic factors and found that genetic susceptibility may also interact with the environment. A recent Finnish study demonstrated that even though area of residence was not linked to depression, living in urban areas was associated with a decreased likelihood of depression in individuals with at least one T allele for the serotonin receptor 2A gene, but these individuals were also more prone to depression in remote rural areas while their depression rates were intermediate in suburban and rural areas.[77]

These differential effects also imply that the effects of other determinants of depression might differ by urbanicity. Apart from intrapersonal factors, interpersonal factors are also relevant to depression and are frequently discussed in relation to this topic. Namely, social connections have been suggested as potential important contributing factors to mental illness and are believed to vary by urbanicity.[78,79] Much of this discussion centers around changes in the distribution of social capital as a result of urbanization, but there is also reason to believe urbanicity could affect the nature of the association between social capital and depression. These potential relationships will be explored below after a review of the effects of social capital on depression.

Social Capital and Depression

Social bonds and interactions are considered an established protective factor for health outcomes including depression.[80] In fact, Turner[81] asserts that "…social investments (employment and friendships) are the best protection against depression."

Two main models have been proposed to connect social relationships to health outcomes such as depression—one which indicates that they have a direct impact on health, and another which asserts that they buffer the effects of stress on health.[80] Social support, and primarily perceptions of it, is believed to decrease the likelihood of depression by buffering against life stressors while social integration—in terms of the types of relationships and involvement in them—is suggested to operate more directly.[80] Explanations for how social relationships influence mental health include their function in coping, evaluations of situations, self-esteem as well as roles, identity, and purpose within society.[82,83]

While there are many aspects of social relationships assessed in the literature, the construct of social capital, which according to Putnam[84] represents "connections among individuals—social networks and the norms of reciprocity and trustworthiness that arise from them," is one way of collectively describing them. Elements of social capital including social participation, trust, neighborhood attachment, and sense of belonging have demonstrated negative associations with mental illnesses such as depression.[85,86] These may operate by promoting social support, reducing exposure to risks, increasing informal social control, or promoting collective efficacy and access to resources.[78] Additionally, larger network size and mixed network composition (i.e., both friends and family) have shown protective effects against depression while living alone was shown to be a risk factor.[87]

Social support in particular has been widely studied in relation to depression, and a recent systematic review and meta-analysis of 100 studies from Europe, North America, and Australia found that 90% of studies observed a significant negative association

between social support and depression.[88] Another systematic review of 51 studies published in the decade between 2004 and 2014 found that for emotional support, the vast majority of studies showed a significant negative association between perceived support and depression and studies of actual emotional support received also mostly supported a significant association.[87] For instrumental support—which consists of more concrete assistance completing tasks such as aid with transportation, finances or caretaking when sick—perceived support was also overwhelmingly confirmed as a protective factor against depression while received support findings were somewhat inconsistent across studies.[87] In terms of differences in support providers, most studies indicated that family support was relevant, and nearly three-quarters found support from friends to be as relevant as family support. Social support in the workplace was also linked to lower depression.[87]

The overall conclusions of the above review were that perceptions of support are more strongly associated with depression than more objective measures.[87] Berkman et al.[82] also conclude that views of the sufficiency of support are more important than the mere presence of it. Another recent review of studies on social capital in relation to common mental disorders including anxiety and depression, likewise concluded that cognitive social capital—which consists of attitudes and perceptions regarding social relations, such as trust, sense of belonging, and social support—was conclusively associated with a lower likelihood of these disorders.[86] However, structural social capital—which pertains to activity and interaction with members of social networks and other groups—did not demonstrate consistent associations with common mental disorders.

Studies on social capital and mental health at a contextual level have been limited and have had varied results.[85,86] But they are also suggestive, again particularly for cognitive forms of social capital[86] as well as collective efficacy[89] and some structural measures.[21,90]

Social Capital and Depression in the Context of Aging

Findings among older adults have been similar to general studies, and while a previous meta-analysis did not find poor social support to be a significant risk factor for depression in this age group,[91] a more recent analysis of reports a pooled odds ratio of 0.56 (95% CI: 0.55-0.57) for protective association of social support with depression.[88] Again, perceived support demonstrates more consistent associations with mental health than enacted support in older adults, as does emotional support compared to instrumental support.[92] More generally for social connections, measures that represent relationship quality have shown stronger effects than those assessing quantity,[93] and subjective feelings of social isolation are similarly significant and perhaps more important predictors of depression separate from objective measures.[94,95] Some studies report mixed effects for cognitive social capital on mental health in this age group,[96] and structural elements of social capital, such as engagement in social activities and network characteristics, have also been linked to fewer depressive symptoms in this age group.[97-101]

The nature of social connections in this demographic also appears to differ from younger populations. Specifically, older adults are believed to be at increased risk of lacking sufficient social support, which is an important factor that may partly explain

elevated rates of depression among them.[97] While Van Groenou et al.[102] assert that some older adults can sustain high levels of participation due to more available time, worsening health status in this age group can diminish activity,[102] and older adults have been found to have smaller network sizes and be more distant from their network connections.[103] Studies from various countries also indicate that their networks consist more of family members than friends,[103-105] and frequency of contact has been reported to decline with age in some cases[104] but increase in others.[103]

However, older adults have stronger links to their communities because of the greater amount of time spent there,[106] and interactions with neighbors are increased among them.[103] A significant observed association between depression and support from neighbors reported by Forsman et al.[96] for older Finnish adults is therefore not surprising. Yet, in a Japanese study Murayama[106] did not find direct effects of neighborhood cohesion on later-life depression, though it did moderate the effects of stress.

Studies on social networks and participation in older adults show that the method of interaction as well as the type of contact also makes a difference for depressive outcomes. In particular, greater face-to-face interaction significantly lowered depressive symptoms among US older adults but phone and mail interaction did not have an effect.[107] However, in their sex stratified analysis of Australians 45 years and older, Feng[108] found that phone contact significantly reduced depressive and anxiety symptoms among men but not women. In relation to the type of contact, while a study of American older adults 55 years and above demonstrated that feeling isolated from family and friends was significantly associated with more depressive symptoms, the significance was only driven by the friend component.[94] Moreover, among older adults in rural India, the

network size for and frequency of contact with only friends or neighbors—as opposed to children, relatives, or a confidant—had significant negative associations with depression in multivariate analyses;[109] and in the Teo et al.[107] analysis of US data, only interaction with friends significantly decreased future depressive symptoms among older adults under 70 years of age, whereas interactions with family was significant among those over 70. Thus, although older adult networks may be more family-centered, friendships appear to be especially relevant for mental health. Additionally, in relation to social support, spousal support showed more reliable effects on depression in older adults followed by friends according to the Gariepy et al.[88] systematic review, but effects of support from family including children were mixed.

In summary, subjective aspects of relationships appear more relevant to the mental health of individuals, both young and old, and the nature of social relationships as well as their effects in older adults differ based on the type of interaction and type of relationship. These variations may account for some inconsistencies in findings on social capital and depression.

Caveats for the Role of Social Relationships in Depression

A word of caution is that behaviors and network characteristics observed in studies also need to be viewed critically, as Green et al.[110] note that actions that on the surface appear maladaptive in relation to depressive and mood disorders may not be applicable or reflect the same phenomena within the context of aging. For example, withdrawal and avoidance is common among depressed individuals; however, older adults may decrease their activity and network connections as they become more

selective of their time and re-prioritize activities and relationships in favor of quality over quantity.[110] Additionally, while extreme dependence has also been observed in mood disorders and can represent an unhealthy attempt to constantly seek affirmation from others, very close ties are beneficial and often necessary in older adults.[110]

It also must be noted that in some cases, social connections can be detrimental for mental health. For example, relationship conflict or low relationship quality can have negative consequences.[111,112] And although religiosity has mostly positive benefits for mental health, religious attendance has sometimes been found to positively predict depression.[113] Participation in community activities can also be burdensome and increase the risk for conditions such as depression, particularly in low-income settings.[86]

Another issue is that—much like research on urbanicity and depression—while some studies on the role of social connections and depression have been prospective in nature, a large proportion have been cross-sectional, which limits the ability to make causal claims in many cases.[87] This is important because depression also has an impact on social relationships and activities,[82,114] which makes it difficult to separate out the effects of reverse causal relationships. For instance, analysis of the Whitehall cohort demonstrated that social support did lead to improved mental health, which also led to greater support later on.[112] In comparing the effects of social support on depression, the Gariepy et al.[88] review found that the strength of effects was weaker in longitudinal studies than in cross-sectional studies and they were less significant statistically. On the other hand, a review of studies on social relationships in older adults found that for most forms of social capital or support, the overall findings did not differ between cross-sectional and longitudinal studies; however, social integration measures were more

consistent in longitudinal studies but often did not demonstrate an effect in cross-sectional studies.[93] Schwarzbach and colleagues[93] suggest that this may imply that social activities have a stronger preventive role than a curative role when it comes to depression. Min et al.[113] appear to confirm this assumption in their analysis of Korean older adults where they found that, except for religious attendance, participation in social gatherings was significantly associated with a decrease in depressive symptoms during follow-up but only among those with low depressive symptom scores at the start of the study.

Additionally, issues of power, confounding, social selection, and variable definition are again relevant for social capital and depression relationships. For example, a US twin study of social capital and health outcomes found significant protective effects of some social capital measures on self-rated mental health and number of depressive symptoms but not for the classification of major depressive disorder itself; moreover, effects were only observed among fraternal and not identical twins.[115] The authors attribute this to potential unobserved genetic factors that might affect both how individuals interact socially and how they respond to stress in terms of psychological well-being; but they also note potential issues in the cross-sectional design, quality of different measures for the mental health outcomes, and inadequate power for the major depression classification due to small numbers of discrepant pairs in the twin design.

Lastly, context and culture matter. Most studies on social support and depression have failed to address the larger structures and context within which this support occurs; and many have also been limited to Western nations and thus may not be generalizable to other contexts.[116] However, research indicates that different forms of social support have

different utility across cultures and that culture affects the type of social support sought and received.[116] For example, individuals from collectivist Asian cultures are less likely to use and gain from explicit social support (i.e., revealing one's feelings or requesting help) and consequently report less instrumental and emotional support but instead benefit more from implicit support or the mere recognition of the presence of a larger group to which one belongs without necessarily utilizing them for assistance.[117]

Additionally, results of the Schwarzbach et al.[93] review of depression in late life concluded that the amount of interaction with contacts was a significant protective factor for depression in Eastern societies while it did not appear to have an association in studies from Western societies. Conversely, marital status was not associated with depression in older adults in Eastern cultures but it was in the West, which the authors attribute to a greater emphasis on the intimate partnership in Western cultures. Similar culture-specific findings were observed in a study comparing non-Hispanic white and Korean American older adults in which contact frequency with non-family members had a significant direct effect against depression among the Korean immigrants but no direct effects of social network measures in the non-Hispanic white sample.[118] And in a cross-country study of civil servants from England, Japan, and Finland, differing degrees of interaction with friends or family were noted among the countries, as well as differing relevance of these interaction with these social groups for mental health.[119]

Again, most of the work on social connections and depression has been conducted in the West and increasingly the East. Research on this subject among African populations is lacking. The systematic review of social support and depression by Gariepy et al.[88] was specifically limited to Western countries, and of the 39 studies

included in the review by Schwarzbach et al.,[93] only 3 were from Africa. Some African studies do exist, however. For example, a smaller study of adults over 60 in an area of Nigeria found that partner and family social support was negatively associated with depression and its severity as measured by the Geriatric Depression Scale, although support from friends was not. Social support also declined with age.[120] Additional studies of Nigerian older adults also documented significant inverse associations between depression and social participation and contact with network members,[53,121] and measures of community involvement were also significantly linked to mental health for older Nigerian men and women in another analysis.[122] These studies were limited to specific regions of the country.

In other African countries, a study of residents of a province of South Africa found that participation in certain types of community groups was associated with decreased suicidal ideation[123] while a study from a nationally representative survey did not find an association between depression and civic participation based on involvement in groups or organizations;[124] but less general trust at the individual-level and lower neighborhood social capital were significantly associated with higher depressive symptoms.[124] Among older adults in a senior facility in one South African city, larger size of the family network and activity outside the residence were also significant protective factors for mental distress.[125]

A population-based study of Ghanaian older adults using the data in the present study found that having someone to confide in significantly decreased the odds of the symptoms of depressed mood and anhedonia while loneliness significantly increased it; however frequent contact with social ties was also associated with increased odds of

these symptoms.[126] Thus, studies in Africa tend to demonstrate similar benefits—as well as some disadvantages—of social capital for depression and mental health, but additional research is needed that includes more representative studies to increase the evidence base.

Theory and Evidence Linking Urbanicity to Social Capital

Urbanization's effects on social connections have been proposed as possible mechanisms for the link between urbanicity and mental illness since it has been suggested that urbanization may disrupt social networks and existing social structures.[78,79] While theories about the changing nature of societies and social bonds as a result of industrialization date back to the 1800's in German philosophy and Émile Durkheim's work on anomie,[127] sociologist Louis Wirth is notable for popularizing the idea of alienation and a loss of community accompanying urbanization as interactions shifted from strong ties with core individuals to more fleeting and segmented contacts with a range of people in urban settings.[127,128] Harpham[129] and Wang[71] also discuss Leighton's sociocultural disintegration theory that points to the breakdown of families, restricted social networks, and more hostile environments in urban areas, which are hypothesized to disrupt psychological balance and lead to mental illness.

Empirical support for the notion of deteriorating social ties in urban areas has however been mixed, and again some criticize that such beliefs may be rooted more in romanticism and idealization of rustic life than in reality.[74] While urban residents have been observed to be more likely to live alone[128] and some studies have reported lower levels of social support among them,[29,40,44,64] other research has tended to show that network size, strength of ties, frequency of interaction with ties, and participation levels

in groups and activities do not differ significantly in urban compared to rural environments.[74,128,130,131] In fact, denser population could promote interaction[24] while desolation in rural areas could promote isolation.[130] Furthermore, in a small US-based study among individuals already suffering from mental illness, those residing in urban areas exhibited greater degrees of participation and possessed a stronger sense of community than those living in rural areas, which the authors attribute to higher observed levels of stigmatization of the mentally ill in rural areas.[59]

Rather than a deficit in social connectedness, there appears to be a change in the nature of social support and type of social ties in urban compared to rural areas. Using US data from the 1985 General Social Survey, White and Guest[127] found that urban residents had roughly the same number of family ties but more ties to non-family members, and their network members were more fragmented or less connected to each other. And in a longitudinal study from Finland, urban residents were observed to have significantly more social support from friends while rural residents had significantly more support from family, though some of this difference was explained by differences in socioeconomic status and employment.[132] Studies have also shown living in urban settings to be associated with a lack of familiarity with neighbors and lower social support from neighbors.[63,128] Another study indicated that more specific features of the local environment, namely disorder in the neighborhood, had a negative impact on social network size and this also interacted with urbanicity such that the effect was stronger in non-urban areas.[74]

At the scale of the community, literature on urban environments, neighborhood characteristics, and social and health outcomes suggest that social processes are

mechanisms behind links between neighborhood characteristics and outcomes, and these draw on theories of collective efficacy and social control.[133] Researchers argue that deprivation, disorganization, and increased mobility in urban areas obstruct social cohesiveness on an aggregate level and reduce sense of control and community capacity to mobilize resources in pursuit of common objectives.[27] Empirical evidence has supported lower levels of social trust in urban as compared to rural areas,[63,128] which can be a reflection of lower social cohesion.

In summary, urban residents may be less connected to social contacts that are close geographically (i.e., neighbors) but may compensate for this by having more diverse networks that are not geographically linked but contain specialized members from various domains of life, such as work, family, and leisure.[128] However, Mueller[130] notes that a lack of connection to physically close contacts in urban environments may have negative impacts for those who are more home-bound, such as stay-at-home mothers and individuals out of the workforce, and some data do suggest this may be the case for older adults.

Apart from effects on the composition of social capital, urbanicity may also modify the effect of social capital on depression. Although seemingly counterintuitive, a few studies have found lower levels of social support in urban areas but stronger protective effects of social support on depression in rural areas while the associations in more urban areas were weaker or non-existent.[40,44,64] This could perhaps suggest some level of adaptation to risk factors, and in their multi-site study of urban-rural differences in depression in European women, Lehtinen et al.[39] [cite] also found that locations with higher rates of certain risk factors for depression had weaker associations between these

factors and depression than in the locations where they were less prevalent. This adaptive phenomenon has also been demonstrated for depression risk factors across the life course indicating that the strength of some associations is greater at ages when the prevalence of the risk factor is lower and therefore unanticipated.[134]

Despite the above findings, few studies have explored the inter-relationships among urbanicity, social capital, and depression, particularly with regard to formal analyses of moderation mechanisms and within African populations. Thus, much remains to be clarified about these relationships and in new geographic settings.

The Study of Depression Across Cultures

It would be remiss of me to conclude without a discussion of issues surrounding cross-cultural research on depression. Not only does context influence the occurrence of depression globally,[79,135] research demonstrates that culture plays a role in the expression and conceptualization of depression as well. There is not a common concept of depression across all societies, but similar symptoms have been identified among depressed individuals from different backgrounds although the relative contribution of several symptoms appears to differ.[136] For instance, the symptom of guilt features less prominently in non-Western societies such as those in Africa, [136,137]which Draguns and Tanaka-Matsumi[136] attribute to a lesser emphasis on individualism and personal responsibility in collectivist societies, and suicide also appears to be less common in low income countries.[79] Additionally, greater reporting of bodily symptoms has been documented in non-Western cultures,[136] including the two countries on which the

following analyses are based.[137,138] Explanatory models of depression in Africa often also include attribution to sorcery and spiritual sources.[137-139]

Tomlinson et al.,[137] however, warn against a tendency to become preoccupied with such differences and "exoticize" how depression is manifested in Africa. They note, that with adequate probing, there are many more similarities in the presentation of depression; and some of the differences may be driven by selective emphasis of patients in order to obtain care given the available treatment options. Thus, somatic complaints may be highlighted in an environment with little mental health specialists and access to mostly primary and physical health care while supernatural factors may be emphasized in the context of traditional healers. In the case of somatization, other scholars also point to the use of bodily metaphors to express symptoms and the lack of a distinct separation between body and mind as is made in Western medicine.[79,136] Additionally, common screening tools have been tested within African settings, with many demonstrating similar dimensionality.[137,140] However, a recent systematic review of screening tools in Africa did conclude that issues in the interpretation and relevance of items warrants adaptation and localization of many instruments.[140]

These points evoke the two main schools of thought from which depression and mental health research are approached across cultures. The universalist or etic point of view holds that underlying biologic processes are at the root of mental illnesses and are common across all populations; so observed variation in illness is only in the presentation but not the basic underlying condition.[136,141] The relativist or emic point of view, on the other hand, views mental illnesses as socially constructed and unique to the particular social setting, so the use of standard meanings and measures to compare populations is

not supported by this view.[136,141] These approaches have different implications for the nature of research conducted, with the emic perspective suggesting that attempts to do comparative quantitative analyses may be futile because conditions are fundamentally different across societies and therefore have no common measurement. The perspective would instead favor ethnographic research. This raises the question of whether it is even possible to assume equivalence of conditions across societies—not only in terms of whether the measures are arriving at the same construct but also in terms of whether the same true construct even exists in the first place.

In this regard, the following studies would belong more to the etic approach as they use a standard measure of depression and assume the condition is present and relevant in the study populations. Yet, these two perspectives do not have to be completely opposed but rather represent two ends of a spectrum with various positions in between, and Tomlinson et al.[137] argue that both perspectives are necessary for research. Thus, I would argue that it is possible to acknowledge the fact that an illness or variant of it that is being measured—albeit imperfectly using common instruments—may represent only one socially derived conceptualization of the condition while attempting to do research in different societies. With this in mind, analyses on depression in various cultural settings still have the potential to reveal information on and improve our understanding of the presence of negative psychological states in different settings and provide insight into how mood disorders present themselves among populations.

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Manuscript 1: Urbanicity of Residence and Depression among Older Adults in Ghana and South Africa: An Analysis of the WHO Study on Global Ageing and Adult Health (SAGE)

Abstract

Background: As the primary cause of disability worldwide, depression is a significant contributor to global morbidity and mortality and often disproportionately affects older adults. Several studies have demonstrated a link between urban residence and depression, but few studies have examined this association among older adult populations, and even fewer have studied it within an African context. Given that African societies are aging and urbanizing at rapid rates, this study aimed to assess the relationship between urbanicity and depression within older adult populations in two African countries.

Method: Data were drawn from the Ghana and South Africa samples of the World Health Organization Study on Global AGEing and Adult Health (SAGE) wave 1 (2007-2008). Depression over the past 12 months was measured using self-reported treatment and depressive symptoms based on ICD-10 criteria in 4,209 Ghanaian and 3,148 South African adults aged 50 years and older residing in their current location for over one year.

Results: The 12-month prevalence of depression was 7.5% and 4.0% in Ghana and South Africa, respectively; 41.1% and 65.6%, respectively, lived in urban areas. Comparing urban to rural residents, the adjusted odds ratio (OR) for depression in multivariable analysis was 1.13 (95% CI: 0.71-1.79) in South Africa and 0.85 (95% CI: 0.55-1.31) in Ghana.

Conclusion: Results do not support a significant difference in 12-month depression between urban and rural SAGE participants in Ghana or South Africa.

Introduction

Depression is the primary cause of disability internationally and is a significant contributor to global morbidity and mortality.[1] The global prevalence stands at 4.4% (95% uncertainty interval: 4.1%-4.7%) for current or past month major depressive disorder (MDD) based on the Global Burden of Disease 2010 estimates,[2] and the World Health Organization 2017 fact sheet indicates that over 300 million people are currently affected.[1] Depression not only negatively impacts quality of life, but it also increases the risk of heart disease and suicide[2] and can be a precursor to other mental illnesses.[3,4]

The world is urbanizing rapidly, particularly in low- and middle-income countries (LMICs).[5] In addition, the global population is aging due to declines in fertility and mortality and increases in life expectancy,[6,7] and a growing number of older adults are living in cities.[8] The continent of Africa is urbanizing rapidly and is projected to be the most quickly urbanizing region in the world by the start of the next decade.[5] Africa has also seen large increases in life expectancy, with African countries comprising half of the nations gaining over 10 years in life expectancy between 1990 and 2012.[6]

Several studies have demonstrated an association between urbanicity and depression—as well as other mental illness.[9] Though results vary, many findings appear to support a rural-urban disparity with increased rates of depression among people living in urban areas.[9-16] Yet, to date, a limited number of studies have focused specifically on older adults[17-22] despite their heightened susceptibility and experience of factors that may

put them at greater risk for depression.[23] Furthermore, most studies on the link between urban areas and depression have been limited to high-income countries, particularly in Europe and North America,[9-12,15,16,24-27] and increasingly in Asia.[17-19,22,28]

Given the suggested links between urbanicity and mental health and given that aging and urbanization are both growing global phenomena with marked growth on the African continent, depression has the potential to be an increasing problem for the elderly and the general population as a whole in the African region. Thus, the relative paucity of studies in African settings—with only a few studies identified that demonstrate both supportive and unsupportive results[29-31]—is a noticeable gap in the literature that needs to be addressed. It is therefore pertinent that the public health community gain a better understanding of how urbanicity relates to depression in this geographic area in order to prevent and manage its occurrence in the midst of urban growth; and prioritizing research on this topic among older populations may be a particular necessity.

This study will explore the relationship between urbanicity of current residence and depression in the African nations of Ghana and South Africa to begin to understand these associations within an African context. Given the general trends observed in the literature so far, we hypothesize that urban residents in both countries are more likely to suffer from depression.

Methods

Data

This study used data from wave 1 of the World Health Organization (WHO) Study on global AGEing and adult health (SAGE)—a multi-country, longitudinal study

of adults age 18 years and older, with an emphasis on individuals age 50 years and above.[32] SAGE was conducted in six low- and middle-income countries, including Ghana and South Africa, in addition to China, India, Mexico, and Russia.

SAGE employs a stratified, multistage cluster design for its sampling strategy.[33,34] Strata were created according to regions or provinces in each country and rural and urban location type, as well as race in South Africa. Enumeration areas within these strata were selected probabilistically based on the population size for adults 50 years and older. Households in the clusters were then selected randomly and all individuals 50 years or older were included as potential participants along with one person aged 18-49 per household. Individual response rates were 80% in Ghana and 77% in South Africa.[33,34] Data collection in the two countries took place in 2007 and 2008 using household and individual survey questionnaires, which were previously pilot tested. The survey instrument was adapted from the World Health Survey Model Questionnaire and translated from English to the major local languages of each country. Surveys were administered through in-person interviews lasting between 1.5 to 2 hours using paper instruments.[33,34]

Inclusion in the study sample used in this analysis was limited to adults 50 years and older who had resided in their current location for more than one year. The residency restriction was chosen to correspond to the 12-month time frame assessed for depression so as to reduce the likelihood that depression preceded residence in the area. Of the 5,573 individuals contained in the Ghana dataset, 839 were excluded due to an age under 50 years and 10 were excluded for missing or unknown age. An additional 485 were excluded due to missing or unknown length of residency in their current location, as well

as 30 individuals with 1 or fewer years of residency. This resulted in a final sample size of 4,209 for Ghana. Of the 4,227 individuals in the South Africa dataset, 385 were excluded for age less than 50 years, 2 were excluded for missing age, 663 were excluded because of unknown or missing information on length of residency, and 29 were excluded due to a residency of 1 year or less. The final sample in South Africa was thus 3,148. A flowchart of the process of selection for the sample in each country and a description of characteristics of those excluded is in Appendix A.

Measures

Depression: Individuals were classified as having depression in the past 12 months if they self-reported treatment for depression in the past 12 months or past two weeks or if in the past 12 months they met the *International Classification of Diseases*, 10th revision (ICD-10)[35] criteria for mild depressive episode based on an algorithm developed from reported symptoms. Symptom questions in the SAGE survey were modeled after the World Mental Health Survey Composite International Diagnostic Interview (CIDI).[36] To classify as having depression, respondents should have reported at least two of the three basic symptoms of depressed mood, lack of energy, or loss of interest lasting at least 2 weeks in duration and occurring nearly every day. The endorsement of a combination of additional symptoms related to low confidence or self-esteem, hopelessness, suicidal thoughts or attempts, impaired concentration, psychomotor retardation or agitation, sleep disturbance, or appetite changes was also required to reach a total of at least 4 symptoms. A table detailing the criteria and corresponding SAGE questions is included in Appendix B.

Urbanicity: The exposure of interest, urbanicity of participants' current area of residence, was based on the household questionnaire item designating the household setting as either urban ("an urban area that has been legally proclaimed as being urban. Such areas include towns, cities and metropolitan areas") or rural ("all other areas that are not classified as being urban. This includes commercial farms, small settlements, rural villages and other areas which are further away from towns and cities"). In Ghana, areas are considered urban if the population is at least 5,000 while South Africa designations are based on a combination of land use and type of settlement.[37,38] Two participants in the South Africa dataset had missing information on household setting. However, information on municipality names was used to assign an urban-rural designation for 1 of these participants.

Socio-Demographic Variables: Age (50-59, 60-69, 70-79, and 80+), sex (male/female), marital status (never married, currently married/cohabiting, separated/divorced, widowed), education level (no formal education, some primary, primary completed, secondary completed, post-secondary completed), household size, and employment status (currently working, not currently working, never worked) were among the covariates considered. Wealth was measured in quintiles based on household permanent income derived from a list of country-specific assets including the possession of hard goods, access to water, sanitation and cooking fuel, and physical properties of the residence (i.e., floors, walls, stove).[39] Religion categories were reduced to none, Christianity, Islam, primal indigenous, and Other in Ghana; and the additional category of Hinduism was also included in South Africa. Ethnicity was classified as Akan, Ewe,

Ga-Adangbe, Gur, and Other for Ghana and as African/Black, White, Coloured, Indian/Asian, and Other for South Africa.

To isolate the effects of urbanicity from those of migration, residential mobility was also included as a covariate and was based on responses to Q1020: "have you always lived in this village/town/city?" (yes/no). Bereavement was also assessed as a potential covariate based on household deaths in the past 24 months (yes/no).

Functional Disability: Functional disability was used as a marker of overall health status and chronic conditions and was calculated as a score based on the 12-item WHO Disability Assessment Schedule-II.[40] The items assessed trouble performing activities in the past 30 days, such as concentrating or learning a new task, interacting with friends and strangers, participating in community activities, standing, taking care of household responsibilities or daily work, walking, bathing, and dressing. The function scores were based on Likert scale ratings of 1 (none) to 5 (extreme/can't do), for a total possible functional disability score range from 12 (no disability) to 60 (extreme disability). If a respondent did not have a response to all 12 of the items, their total score was pro-rated by taking the average of the scores based on the number of answered questions and multiplying this average by 12.

Cognitive Performance: Cognitive performance was measured as a composite z-score based on five cognitive tests: immediate and delayed verbal recall, forward digit span, backward digit span, and verbal fluency. Verbal recall was tested through a list of 10 words recited by the interviewer and the number of words correctly repeated by the respondent. Immediate verbal recall was assessed in the survey with 3 trials, and scores were summed across the 3 trials. For individuals without all 3 trials, scores were prorated

based on the number of completed trials. Delayed verbal recall required respondents to remember the same list of 10 words after the completion of other tests (approximately 10 minutes later). Digit span scores were the longest digit sequence recited back correctly by the respondent, both forwards and backwards, after hearing a sequence of numbers (maximum of 9). Verbal fluency scores were based on the number of animals the respondent could correctly name in one minute. Z-scores were calculated for each cognitive test to standardize the results, and these were summed to produce a composite z-score. Overall z-scores were also pro-rated for those who did not complete all 5 tests.

For a detailed description of how independent variables were operationalized from survey items and how discrepancies in item responses were reconciled, refer to Appendix C.

Statistical Analysis

Data were analyzed using STATA 13. Point estimates for variables were calculated using the raw sample data as well as after applying individual survey weights using the svy command in STATA to produce nationally representative estimates. The svy command uses the Taylor linearization method to estimate standard errors.[41] Individual-level weights in the SAGE survey were calculated based on the individual selection probability and were post-stratified by region, locality, sex, and age in Ghana and by province, sex, and age in South Africa. Weights were not normalized.[33,34] Because some strata in the South Africa dataset contained only one primary sampling unit, which does not allow for estimation of variance, these single unit strata were centered at the overall mean.

Characteristics of each country's sample by the exposure variable were examined for significant differences with chi-square tests or with the design-based F statistic based on the Rao and Scott[42] second-order corrected Pearson statistic for categorical variable estimates with and without adjustment for the complex survey design, respectively. T-tests assuming unequal variances or Adjusted Wald tests, respectively, were used to examine differences in continuous variables by exposure status with and without adjustment for the complex survey design. Bivariate logistic regression models were run to determine the unadjusted association between independent variables and the depression outcome. Multivariable logistic regression was used to calculate odds ratios (ORs) for depression comparing urban to rural residents and adjusting for key demographic variables and covariates significantly associated with the outcome in each country. Age, sex, and residential mobility were included *a priori* as covariates.

Although weighting is generally considered to produce unbiased estimates,[43] because the utility of applying weights beyond descriptive statistics—which are intended to be nationally representative—to inferential statistics is debated,[43,44] and because in cases where weights are highly variable, they can lead to inefficient estimates,[45] we conducted exploratory data analysis of the weights to determine their distribution and potential inefficiency. Weights were very widely distributed and resulted in substantial inefficiency, particularly for South Africa (Appendix D). Therefore, regression analyses did not apply weights but employed design-based models to account for the clustering and stratification using the svy command with regression in STATA in addition to adjusting for most variables related to the survey design as an alternative.[43] However, to assess the sensitivity of results to the survey design, the main unweighted analyses were

compared to secondary analyses using design-based models adjusting for survey weights as well as clustering and stratification. These weighted analyses are included in Appendix F.

The possibility of modification by sex was also considered in the analyses due to known sex differences in depression[46,47] and the potential for differences in experiences in urban and rural settings by sex. As a result, interaction terms between sex and the exposure variable were tested in the models but were not significant and were dropped (see Appendix E).

Because of minimal missingness in most variables—generally 3% or less (Appendices B and C)—all analyses were conducted as complete case analyses.

Ethics

This study was given a determination of Not Human Subjects Research by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board due to its secondary analysis of existing, de-identified data available from the WHO for research.

Results

Characteristics of the Sample

41.1% of Ghanaian adults 50 years and older lived in urban areas based on national population estimates from the sample. Table 1.1 presents the characteristics of the Ghana sample by urban-rural residence and their corresponding national estimates. Apart from recent household deaths, which were equally low among urban and rural residents, there were significant urban-rural differences in all other sociodemographic

characteristics of the sample. At the population level based on weighted estimates, employment status, education, wealth, ethnicity, and religion differed significantly between urban and rural residents in Ghana. In particular, urban residents were more likely to be currently unemployed, have education, come from wealthier households, belong to Akan or Gur ethnic groups, and practice Christianity or Islam.

Nationally, 65.6% of older adults 50 years and older in South Africa were urban residents. Table 1.2 presents descriptive statistics for the South Africa sample. Population estimates indicate that urban residents were significantly more likely to be educated, have more wealth, have ever worked, be non-Black, and have ever moved but less likely to practice no or traditional religion.

The national prevalence of 12-month depression among adults 50 years and older was 7.5% and 4.0% in Ghana and South Africa, respectively.

Association between Urbanicity and Depression

7.8% of rural Ghanaian residents in the sample were depressed compared to 7.2% of urban residents. The crude association between urbanicity of current residence and depression comparing urban to rural Ghanaian residents was represented by an odds ratio (OR) of 0.92 (95% CI: 0.61-1.39). Sex, age, level of education, wealth, employment status, ethnicity, residential mobility, bereavement, functional disability, and cognitive function were independently associated with the depression outcome and therefore included in the multivariable model (Table 1.3). After adjusting for covariates, the association between urbanicity and depression was 0.85 (95% CI: 0.55-1.31), suggesting

that urban residents had a nonstatistically significant 15% lower odds of depression in the past 12 months than rural residents.

Women had a 39% increased odds (95% CI: 5% to 84%) of depression compared to men. Additionally, older age groups were significantly more likely to be depressed than younger age groups, increasing in a stepwise fashion with greater age groups. Current unemployment also led to a significantly increased odds of depression compared to those currently working, while moving during one's lifetime significantly reduced the odds of depression. Likewise, increased cognitive function significantly reduced the odds of depression. No consistent pattern was seen with depression for education or household income after adjustment; however, completing secondary school and belonging to the 2nd income quintile significantly increased the odds of depression compared to those without schooling and those in the lowest household income quintile.

In the South Africa sample, 3.3% of rural residents and 4.8% of urban residents in the sample suffered from depression in the past 12 months. The unadjusted OR for 12-month depression comparing urban to rural residents in South Africa was 1.46 (95% CI: 0.94-2.28) and only significant at the 10% alpha level. Age, marital status, education level, employment status, ethnicity, wealth, and functional disability were significantly associated with depression in bivariate analyses (Table 1.4) and included in the multivariable model along with sex and residential mobility. After controlling for covariates, the adjusted OR for the association between urbanicity and depression remained nonsignificant but decreased to 1.13 (95% CI: 0.71-1.79).

In the adjusted model, the odds of depression significantly decreased in a dose-response fashion with increasing age in the South Africa sample. Separated, divorced, or

widowed individuals also had significantly greater odds of depression than those who were never married, as did those who were currently unemployed or had never worked compared to those currently working. Individuals from wealthier households, particularly those in the middle and upper quintiles, also appeared to be at significantly increased risk of experiencing depression. The odds of depression also significantly increased with increasing functional disability by 4% (95% CI: 2%-6%) for each point increase in the functional disability score.

Discussion

Although relatively little population-based literature on depression in either country is available, the overall prevalence of depression among older adults in Ghana (7.5%) and South Africa (4.0%) based on this analysis was consistent with other findings,[2,48,49] as well as estimates from other studies involving SAGE data.[36,50-53] The results of this analysis did not confirm the hypothesis of higher rates of depression among urban residents. These findings contradict previous meta-analysis results, which indicated significant unadjusted and adjusted odds ratios of 1.39 (95% CI: 1.23-1.58) and 1.28 (95% CI: 1.13-1.44), respectively, for mood disorders including depression in urban compared to rural residents,[9] as well as a more recent systematic review of urbanicity and mental illness in Europe which revealed that of nine studies examining mood disorders, seven found at least some evidence of a higher occurrence of mood disorders in urban settings.[11] They also contrast with other individual studies,[10,12-14,19,28,54] although these findings are again based on studies from Europe, North America, and Asia. Within African settings, one study from Uganda also found that Ugandans born in urban areas

reported significantly more depressive symptoms in the past week compared to those born in rural areas.[29]

The direction of effects in South Africa appeared to be positive, suggesting potentially greater odds of 12-month depression in urban residents in line with the aforementioned studies. Other studies in South Africa conducted by Wissing et al.[30] also found no significant association between depressive symptoms and urban-rural residence, with the exception of one sample in which a significant rural preponderance of depressive symptoms was observed. None of these results were adjusted for demographic characteristics as was done in this study.

Conversely, all models for Ghana consistently demonstrated slightly lower, though nonsignificant, odds of depression for urban residents. This is in line with some studies, as not all literature has consistently supported a positive association between urbanicity and depression. Specifically, studies in Taiwan and former Soviet nations have also found elevated rates of depression and psychological distress in rural residents,[26,55] and a regional study in Nigeria also reported higher unadjusted prevalence rates in the participants from rural areas.[31] Similarly, some US-based studies have not observed significant or consistent associations,[56,57] while a study of women in the Southern US and two European multi-country studies demonstrated mixed results, with some populations showing greater depression rates in city dwellers and others showing lower rates or no association.[24,25,58]

In terms of older adults, a study of British residents at least 75 years of age found significantly higher adjusted odds of depression among those living in the densest and lower-intermediate density areas than those living in the least dense areas.[21] And a study

of depression in Nigerian adults 65 years and older found no significant urban-rural differences[59] while another reported significantly more cases of lifetime and 12-month major depressive disorder in urban compared to rural residents, though significance was lost after adjusting for economic status.[60] However, in a Swedish study of residents 85 years and older and Japanese studies of middle-aged and older adults, no significant prevalence differences were found for depression overall between urban and rural residents,[17,20,22] which is consistent with the present analysis, though significant differences did exist among specific age segments in the Sweden study.[20] A study of Chinese adults aged 60 and older observed a significantly higher prevalence of depression in rural residents consistent with other findings in China. However, differences attenuated or lost significance after adjusting for covariates such as socioeconomic status.[18]

While no studies have examined the association between urbanicity and depression as a primary research question using SAGE data, a few peer-reviewed studies have explored correlates of depression in SAGE countries, including the two countries in the present study. The studies involving South Africa and Ghana likewise did not find a significant association between residence and measures of depression in these samples.[51,53,61,62] However, some of these studies used limited definitions of depression and the study samples included all individuals 50 or older, regardless of length of residence, which limits the ability to rule out selective migration.

Although no significant difference was found for the association between urbanicity and depression in either country, the results may indicate a weak trend towards different directions of effects in each. Reasons for slight differences between the two

countries and disparate findings in other studies may reflect contextual differences between settings in the nature of urban and rural areas and of urbanization. The literature similarly suggests that variation in the association between depression and urbanicity may be affected by factors relating to the local context. For instance, Cheng et al.[55] noted that Taiwanese rural residents had greater health events and more chronic stressors, which could explain their higher rates of depression. Out-migration and neglect of rural areas has also been suggested for a lack of observed urban-rural differences in Finland,[63] and Stickley et al.[26] also note economic disadvantage and social problems as risk factors in rural former Soviet areas.

Differences may also be a result of variations in underlying mechanisms for the urbanicity-depression relationship. While the mechanisms remain unclear, a number of factors have been hypothesized, including lack of access to green space, neighborhood disadvantage, poverty, exposure to infectious agents, substance use, poor nutrition, in utero exposures, and social fragmentation.[64-66] Although from the perspective of an "urban health penalty,"[67,68] many of these detrimental factors are believed to be more common among city-dwellers in certain settings, this too may be context-specific, just as urban advantages in terms of health may be. For example, based on emerging evidence of inflammatory links to depression, the pathogen host defense theory of depression relates depressive symptoms and related behaviors—such as avoidance or loss of interest in activities—to inflammatory immune responses to infection or impending injury that developed as an evolutionary advantage.[69] The authors discuss how in the absence of frequent exposure to pathogens in "sanitized urban environments" compared to traditional "rural" settings, inflammatory responses and subsequent depression-like

sickness behaviors are still activated unnecessarily by social stressors and other modern pro-inflammatory stimuli but without regulation from coevolved microorganisms, resulting in depression. However, in cities in LMICs that are often densely populated and under-resourced,[70] it may very well be that urban settings are more unsanitary than rural environments, which would not lead to the urbanicity-depression relationship predicted by this hypothesis. And perhaps this may be more true in a lower middle-income country such as Ghana than the upper middle-income country of South Africa.

In terms of model results for other variables in the current analysis, as expected, women in Ghana were consistently at greater odds of experiencing depression in the last year, which is in accordance with the general preponderance of depression among women globally[46,47,71] as well as some other SAGE analyses for the country.[53,62] However, no significant difference was seen by gender in South Africa, which confirms results in some SAGE studies,[51,53,72] though other studies across all age groups have observed significant gender differences in South Africans.[30,48,49,73-75]

The direction of effects for age on depression also differed between the two countries, with odds increasing with age in Ghana—though not significantly after adjustment—but decreasing significantly with age in South Africa. This also confirms patterns seen in other findings.[51,53,61,62] Marital status did not have a significant effect on depression in Ghana, although the direction of effects was as expected. However, it was a significant factor in South Africa in the direction expected, although those never married appeared to be uncharacteristically at the least risk, which has been reported elsewhere.[76]

Lack of employment was a significant risk factor for depression in both countries as expected,[77] but having never worked in Ghana appeared protective, though the

numbers in this category were low. In some cases, never working may be a voluntary choice and thus would differ qualitatively from unemployment, which may explain this result. Or it may require greater self-reliance and enhance self-efficacy and a sense of control, thus reducing depression.[78]

Although socioeconomic status is generally believed to have an inverse relationship with depression and poverty is viewed as a risk factor,[77,78] surprisingly, education and wealth did not have predictable patterns with depression in either country; and whereas education was protective in Ghana in unadjusted analyses, it appeared to become a risk factor otherwise and was only slightly protective at the highest levels in the adjusted South Africa analyses. Wealth also appeared to be more of a risk factor in general, except for at the highest quintile in Ghana and the 2nd quintile in South Africa, which were the only estimates in the expected direction but were nonetheless not significantly different from the lowest quintile. These unexpected results may have been affected by multicollinearity between education and wealth; however, variance inflation factors for models with these variables were examined and were found to be low in the range of 1-2 in both countries, suggesting minimal multicollinearity. Furthermore, the literature suggests that education has a more regular association with common mental disorders than income,[79] and a few other SAGE studies confirm similar irregular and nonsignificant patterns in South Africa.[51,80] Alternatively, results may be related to the quality of the wealth measurement itself, although its basis on household possessions rather than reported income or expenditures should be less prone to bias.[39]

Surprisingly, residential mobility was consistently protective against depression in the Ghanaian setting, which goes against assumptions and findings that migration and

mobility are risk factors for depression and mental illness because of issues such as their disruptive effects on stability and social ties, associations with a sense of loss, or difficulties with adjustment.[81] However, given the diversity of reasons for migration and of outcomes following migration, acclimatization processes, and characteristics of migrants, impacts on mental health may vary, and research does point to variation in rates of depressive disorders in migrants.[81,82]

Results for health status variables, specifically functional disability and, in Ghana cognitive function, were consistent with the literature and in the expected direction.[83] Cognitive function did not appear to have much of an effect among South Africans in this analysis, which is in agreement with findings by Peltzer and Phaswana-Mafuya[51] that also did not observe a significant association, and a meta-analysis has likewise demonstrated ambiguous associations between cognitive impairment and depression in older adults.[83]

As a sensitivity analysis, unweighted results were compared to results from weighted models. Weighted analyses did not change the conclusions of the analysis and remained nonsignificant for the main effect in both countries (Appendix F). Weighted estimates for Ghana were similar to unweighted results; however, the magnitude and direction of the main effect was reversed for South Africa in weighted unadjusted analyses. After adjustment, differences between weighted and unweighted models attenuated.

Analyses were also run with additional depression-related outcomes using less stringent definitions to capture possible subsyndromal cases of depression. Specifically, results were compared to an outcome in which respondents were only required to have at

least 2 of the 3 key depressive symptoms (depressed mood, lack of energy, or loss of interest) lasting several days in the past 12 months. In addition, a dichotomous none/any outcome was created from a question on depressed affect based on item Q2018: "Overall in the last 30 days, how much of a problem did you have with feeling sad, low or depressed?" However, results of these additional analyses also did not indicate a significant difference between rural and urban residents, and for the most part the direction of effects for these depression-related outcomes appeared to be similar (Appendix G).

A sizeable number of observations were excluded from the sample because they did not meet the inclusion criteria due to missing data. Many of these individuals were similarly missing information on several covariates and the depression outcome. However, an assessment of these individuals revealed that there was no significant difference between them and the remaining sample in terms of urban-rural exposure (Appendix A), so it is not expected that their exclusion would have introduced considerable bias to the results.

A limitation of this study is that the data are cross-sectional, so the ability to draw conclusions about causation is limited since temporal order cannot be verified. While we limited the sample to individuals with at least 2 years of residence in their current location to minimize the potential for depressed individuals selectively moving to urban or rural areas, one cannot completely rule out the possibility that the outcome preceded the exposure rather than the other way around. However, according to a study of Finnish residents, depressive symptoms were not found to predict subsequent residential mobility or movement to areas of different population density—a measure of urbanicity—thus

suggesting no evidence of selective movement.[84] And other studies have utilized longitudinal data to arrive at incidence and still observed significant effects.[10]

Additionally, the assessment of urbanicity in the data was restricted to an urban-rural dichotomy based on the data, and this may mask important distinctions among areas that fall along the continuum of urbanicity because urban-rural binary classifications and measures based on unidimensional factors may not adequately account for the variations and multidimensionality of the construct.[85] Additionally, although the WHO CIDI on which the depression section of the SAGE survey is based is a common tool for international use on psychiatric disorders that has been previously tested in international settings,[86] there remains the question of the appropriateness of standard measures because of cross-cultural differences in how individuals may respond to items eliciting depressive symptoms—or even in the manifestation of depression itself—that may bias results.[87,88] Nonetheless, cross-national research has demonstrated a similar cluster of symptoms for depression,[87,89] though there are cultural differences in the relative contribution of various symptoms.[87]

Despite these limitations, this study is crucial in expanding and contributing to the knowledge on the association between urbanicity and depression in older adult populations and specifically from middle-income African countries, which have been understudied. Moreover, the use of population-based survey data from SAGE as opposed to clinical or other geographically limited samples increases confidence in the findings.

Conclusion

The study results do not support a significant difference in the odds of 12-month depression between urban and rural SAGE participants in Ghana or South Africa. The implications of this research are that the allocation of mental health resources for prevention and treatment may not need differential distribution between these setting types; thus, because mental health resources in Africa are disproportionately concentrated in urban areas,[90] the governments of Ghana and South Africa should bolster resources in rural areas to address inequities if rural residents are indeed no less likely to suffer from depression than their urban counterparts. Further research should attempt to replicate these findings, assess more detailed measurements of the exposure, use other statistical techniques and employ longitudinal study designs to ensure robustness of results.

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Table 1.1: Sociodemographic Characteristics of the Ghana Sample

	Rural (n=2487)		Urban (n=1722)		Total (n=4209)		
	N	**% (w%)**	**N**	**% (w%)**	**N**	**% (w%)**	
Sex							p<0.001 (p=0.657)
Male	1385	55.7 (53.2)	832	48.3 (52.3)	2217	52.7 (52.8)	
Female	1102	44.3 (46.8)	890	51.7 (47.7)	1992	47.3 (47.2)	
Age Categories							p=0.003 (p=0.349)
50-59	920	37.0 (38.2)	727	42.2 (41.8)	1647	39.1 (39.7)	
60-69	709	28.5 (28.0)	475	27.6 (27.1)	1184	28.1 (27.6)	
70-79	593	23.8 (23.7)	369	21.4 (22.2)	962	22.9 (23.1)	
80+	265	10.7 (10.1)	151	8.8 (8.9)	416	9.9 (9.6)	
Employment Status [a]							p<0.001
Currently Working	1909	76.9 (76.9)	1109	64.6 (63.7)	3018	71.9 (71.5)	
Never Worked	34	1.4 (1.3)	29	1.7 (2.2)	63	1.5 (1.6)	
Not Working	539	21.7 (21.9)	579	33.7 (34.1)	1118	26.6 (26.9)	
Marital Status [a]							p<0.001 (P=0.120)
Never Married	25	1.0 (1.1)	25	1.5 (1.5)	50	1.2 (1.3)	
Married/Cohabiting	1488	60.1 (60.7)	901	52.7 (57.5)	2389	57.1 (59.5)	
Separated/Divorced	310	12.5 (11.7)	282	16.5 (14.7)	592	14.1 (12.9)	
Widowed	652	26.3 (26.5)	503	29.4 (26.1)	1155	27.6 (26.3)	
Highest Education Level [a]							p<0.001
No Formal Education	1544	62.5 (61.2)	756	44.1 (43.4)	2300	55.0 (53.9)	
Some Primary	262	10.6 (11.0)	157	9.2 (9.5)	419	10.0 (10.4)	
Primary Completed	243	9.8 (10.2)	209	12.2 (11.8)	452	10.8 (10.9)	
Secondary Completed	376	15.2 (15.6)	488	28.5 (29.3)	864	20.6 (21.2)	
Post-Secondary Complete	47	1.9 (2.0)	103	6.0 (6.0)	150	3.6 (3.7)	
Permanent Income Quintile [a]							p<0.001
1	678	27.3 (25.5)	153	8.9 (7.6)	831	19.8 (18.1)	
2	610	24.5 (23.7)	221	12.9 (12.5)	831	19.8 (19.1)	
3	556	22.4 (23.9)	274	15.9 (15.1)	830	19.7 (20.3)	

	Rural (n=2487)		Urban (n=1722)		Total (n=4209)		
	N	**% (w%)**	**N**	**% (w%)**	**N**	**% (w%)**	
4	423	17.0 (17.4)	439	25.6 (25.9)	862	20.5 (20.9)	
5	219	8.8 (9.5)	631	36.7 (38.9)	850	20.2 (21.6)	
Ethnicity [a]							p<0.001
Akan	1127	46.1 (46.7)	895	52.9 (52.0)	2022	48.9 (48.9)	
Ewe	174	7.1 (8.4)	115	6.8 (5.9)	289	7.0 (7.4)	
Ga-Adangbe	220	9.0 (9.5)	205	12.1 (11.7)	425	10.3 (10.4)	
Gur	169	6.9 (6.6)	188	11.1 (13.3)	357	8.6 (9.3)	
Other	753	30.8 (28.8)	288	17.0 (17.1)	1041	25.2 (24.0)	
Religion [a]							p<0.001
None	151	6.1 (6.0)	59	3.4 (3.2)	210	5.0 (4.8)	
Christianity	1573	63.4 (65.4)	1313	76.4 (75.5)	2886	68.7 (69.6)	
Islam	370	14.9 (14.3)	294	17.1 (18.2)	664	15.8 (15.9)	
Primal Indigenous	372	15.0 (13.6)	43	2.5 (2.4)	415	9.9 (9.0)	
Other	14	0.6 (0.8)	9	0.5 (0.7)	23	0.5 (0.7)	
Ever Moved [a]							p=0.027 (p=0.212)
No	1708	68.7 (69.1)	1126	65.4 (65.0)	2834	67.3 (67.5)	
Yes	779	31.3 (30.9)	595	34.6 (35.0)	1374	32.7 (32.5)	
Any Household Deaths In 24 Months? [a]							p=0.503 (p=0.672)
No	2450	98.6 (98.6)	1691	98.8 (98.8)	4141	98.7 (98.7)	
Yes	35	1.4 (1.4)	20	1.2 (1.2)	55	1.3 (1.3)	
	Mean (wMean)	**SE (adj SE)**	**Mean (wMean)**	**SE (adj SE)**	**Mean (wMean)**	**SE (adj SE)**	
Total Household Members	5.61 (5.55)	0.07 (0.11)	5.37 (5.64)	0.08 (0.14)	5.52 (5.59)	0.05 (0.08)	p=0.020 (p=0.603)
Functional Disability Score	21.91 (21.95)	0.17 (0.35)	21.32 (21.21)	0.22 (0.41)	21.67 (21.65)	0.13 (0.26)	p=0.033 (p=0.163)
Cognitive Performance Z-Score	-0.32 (-0.34)	0.07 (0.13)	0.30 (0.38)	0.09 (0.17)	-0.07 (-0.05)	0.05 (0.10)	p<0.001

p-values in parentheses are based on Pearson design-based F statistics for weighted results. Where no second p-value is listed, the p-value is also <0.001 as in the standard chi-square results

[a]Totals for variable are less than the sample total due to missing data.
SE: standard error; w or adj denote weighted or adjusted values accounting for the sampling weights

Table 1.2: Sociodemographic Characteristics of the South Africa Sample

	Rural (n=1036)		Urban (n=2111)		Total (n=3148)		
	N	**% (w%)**	**N**	**% (w%)**	**N**	**% (w%)**	
Sex							p=0.027 (p=0.463)
Male	442	42.7 (38.8)	814	38.6 (41.0)	1256	39.9 (40.3)	
Female	594	57.3 (61.2)	1297	61.4 (59.0)	1891	60.1 (59.7)	
Age Categories							p=0.009 (P=0.328)
50-59	425	41.0 (47.2)	947	44.9 (51.1)	1372	43.6 (49.7)	
60-69	330	31.9 (30.8)	703	33.3 (31.4)	1033	32.8 (31.2)	
70-79	204	19.7 (16.2)	346	16.4 (13.2)	550	17.5 (14.2)	
80+	77	7.4 (5.8)	115	5.4 (4.4)	192	6.1 (4.9)	
Employment Status[a]							p<0.001
Currently Working	274	26.5 (25.4)	579	27.7 (33.1)	853	27.3 (30.4)	
Never Worked	180	17.4 (23.2)	227	10.8 (8.4)	407	13.0 (13.5)	
Not Working	579	56.1 (51.4)	1287	61.5 (58.5)	1866	59.7 (56.1)	
Marital Status[a]							p=0.033 (p=0.308)
Never Married	116	11.5 (15.3)	321	15.4 (15.1)	437	14.1 (15.1)	
Married/Cohabiting	525	52.0 (49.8)	1042	50.0 (54.4)	1567	50.7 (52.8)	
Separated/Divorced	69	6.8 (6.3)	134	6.4 (6.7)	203	6.6 (6.5)	
Widowed	300	29.7 (28.6)	585	28.1 (23.8)	885	28.6 (25.5)	
Highest Education Level[a]							p<0.001
No Formal Education	427	41.9 (39.2)	359	17.4 (15.1)	786	25.5 (23.4)	
Some Primary	284	27.9 (27.1)	480	23.2 (23.2)	764	24.7 (24.5)	
Primary Completed	157	15.4 (16.6)	595	28.8 (26.8)	752	24.4 (23.3)	
Secondary Completed	120	11.8 (14.3)	509	24.6 (27.4)	629	20.4 (22.9)	
Post-Secondary Complete	30	2.9 (2.9)	126	6.1 (7.5)	156	5.1 (5.9)	
Permanent Income Quintile[a]							p<0.001
1	318	30.8 (33.0)	292	13.9 (14.6)	610	19.5 (20.9)	
2	256	24.8 (23.8)	364	17.3 (17.5)	620	19.8 (19.7)	
3	211	20.5 (21.1)	402	19.1 (17.3)	613	19.6 (18.6)	

	Rural (n=1036)		Urban (n=2111)		Total (n=3148)		
	N	**% (w%)**	**N**	**% (w%)**	**N**	**% (w%)**	
4	162	15.7 (14.4)	478	22.7 (22.7)	640	20.4 (19.8)	
5	84	8.1 (7.6)	567	27.0 (28.0)	651	20.8 (21.0)	
Ethnicity[a]							p<0.001
African/Black	861	83.5 (91.4)	1087	51.6 (64.4)	1948	62.1 (73.7)	
White	50	4.8 (4.0)	207	9.8 (12.3)	257	8.2 (9.4)	
Coloured	105	10.2 (3.9)	536	25.5 (18.2)	641	20.4 (13.3)	
Indian/Asian	14	1.4 (0.6)	269	12.8 (4.9)	283	9.0 (3.5)	
Other	1	0.1 (0.1)	6	0.3 (0.1)	7	0.2 (0.1)	
Religion[a]							p<0.001
None	110	10.6 (10.8)	42	2.0 (2.1)	152	4.9 (5.1)	
Christianity	867	83.9 (83.1)	1802	85.8 (89.3)	2669	85.2 (87.1)	
Hinduism	6	0.6 (0.1)	105	5.0 (2.1)	111	3.5 (1.4)	
Islam	2	0.2 (0.2)	96	4.6 (3.7)	98	3.1 (2.5)	
Primal Indigenous	38	3.7 (4.2)	10	0.5 (0.6)	48	1.5 (1.9)	
Other	10	1.0 (1.6)	45	2.1 (2.2)	55	1.8 (2.0)	
Ever Moved[a]							p=0.115 (p=0.027)
No	773	74.7 (74.9)	1519	72.0 (67.2)	2292	72.9 (69.9)	
Yes	262	25.3 (25.1)	590	28.0 (32.8)	852	27.1 (30.1)	
Any Household Deaths In 24 Months? [a]							p=0.738 (p=0.263)
No	1034	99.8 (99.9)	2104	99.9 (99.7)	3138	99.8 (99.7)	
Yes	2	0.2 (0.1)	3	0.1 (0.3)	5	0.2 (0.3)	
	Mean (wMean)	**SE (adj SE)**	**Mean (wMean)**	**SE (adj SE)**	**Mean (wMean)**	**SE (adj SE)**	
Total Household Members	4.05 (4.35)	0.08 (0.18)	4.05 (3.89)	0.05 (0.14)	4.05 (4.05)	0.04 (0.11)	p=0.928 (p=0.053)
Functional Disability Score	19.81 (21.03)	0.27 (0.62)	19.97 (20.30)	0.19 (0.39)	19.92 (20.55)	0.15 (0.32)	p=0.606 (p=0.335)
Cognitive Performance Z-Score	-0.51 (-0.57)	0.12 (0.22)	0.17 (0.32)	0.08 (0.18)	-0.05 (0.02)	0.07 (0.14)	p<0.001 (p=0.001)

p-values in parentheses are based on Pearson design-based F statistics for weighted results. Where no second p-value is listed, the p-value is also <0.001 as in the standard chi-square results

[a]Totals for variable are less than the sample total due to missing data.

SE: standard error; w or adj denote weighted or adjusted values accounting for the sampling weights

Table 1.3: Regression Results for Odds of Depression in Ghana

	Unadjusted OR (CI)	Adjusted OR (CI)
Residence		
Rural	Ref	Ref
Urban	0.92 (0.61 -1.39)	0.85 (0.55-1.31)
Sex		
Male	Ref	Ref
Female	1.66 (1.30-2.12)***	1.39 (1.05-1.84)*
Age		
50-59	Ref	Ref
60-69	1.46 (1.06-2.02)*	1.25 (0.86-1.93)
70-79	1.76 (1.25-2.50)**	1.27 (0.81-1.99)
80+	2.73 (1.87-3.99)***	1.48 (0.84-2.61)
Marital Status		
Never married	Ref	-
Married/Cohabiting	0.71 (0.21-2.36)	-
Separated/Divorced	1.25 (0.36-4.30)	-
Widowed	1.29 (0.37-4.46)	-
Education Level		
None	Ref	Ref
Some Primary	0.84 (0.57-1.24)	1.27 (0.84-1.93)
Primary Completed	0.51 (0.32-0.81)**	0.81 (0.48-1.34)
Secondary Completed	0.77 (0.57-1.05)	1.60 (1.03-2.47)*
Post-Secondary Completed	0.44 (0.18-1.10)	1.27 (0.48-3.38)
Ethnicity		
Akan	Ref	Ref
Ewe	0.51 (0.27-0.97)*	0.52 (0.27-0.99)*
Ga-Adangbe	0.59 (0.34-1.02)	0.60 (0.34-1.06)
Gur/Northern	1.00 (0.60-1.67)	1.22 (0.71-2.09)
Other	0.74 (0.47-1.17)	0.78 (0.46-1.30)
Religion		
None	Ref	-
Christianity	0.35 (0.77-1.33)	-
Islam	1.07 (0.58-1.95)	-
Primal indigenous	0.70 (0.33-1.48)	-
Other	Cd	-
Ever Moved		
No	Ref	Ref
Yes	0.51 (0.35-0.74)***	0.54 (0.36-0.80)**
Employment Status		
Currently working	Ref	Ref
Never worked	0.25 (0.03-1.89)	0.19 (0.03-1.48)
Not working	2.10 (1.63-2.71)***	1.61 (1.18-2.18)**
Permanent Income Quintile		
1	Ref	Ref

2	1.56 (1.10-2.22)*	1.65 (1.14-2.38)**
3	1.07 (0.72-1.59)	1.06 (0.69-1.64)
4	1.11 (0.72-1.70)	1.10 (0.70-1.75)
5	0.73 (0.48-1.11)	0.83 (0.52-1.34)
Recent Household Deaths		
No	Ref	Ref
Yes	2.43 (1.09-5.40)*	2.38 (0.94-6.06)
Total Household Members	1.01 (0.96-1.06)	-
Functional Disability	1.03 (1.02-1.05)***	1.00 (0.98-1.02)
Cognitive Performance	0.89 (0.87-0.92)***	0.93 (0.89-0.96)***

*p<0.05, **p<0.01, ***p<0.001

Cd: category dropped out of the analysis due to an absence of depression cases

Table 1.4: Regression Results for Odds of Depression in South Africa

	Unadjusted OR (CI)	Adjusted OR (CI)
Residence		
Rural	Ref	Ref
Urban	1.46 (0.94 -2.28)	1.13 (0.71-1.79)
Sex		
Male	Ref	Ref
Female	1.25 (0.86-1.82)	0.96 (0.65-1.42)
Age		
50-59	Ref	Ref
60-69	0.55 (0.37-0.81)**	0.36 (0.23-0.56)***
70-79	0.48 (0.28-0.83)**	0.24 (0.12-0.45)***
80+	0.17 (0.04-0.67)*	0.08 (0.02-0.32)**
Marital Status		
Never married	Ref	Ref
Married/Cohabiting	1.26 (0.69-2.31)	1.26 (0.67-2.37)
Separated/Divorced	2.38 (1.10-5.13)*	2.46 (1.07-5.65)*
Widowed	1.69 (0.89-3.22)	2.09 (1.03-4.22)*
Education Level		
None	Ref	Ref
Some Primary	1.64 (0.95-2.84)	1.23 (0.70-2.16)
Primary Completed	1.81 (1.04-3.14)*	1.21 (0.68-2.15)
Secondary Completed	1.68 (0.96-2.92)	0.97 (0.49-1.91)
Post-Secondary Completed	1.38 (0.51-3.78)	0.77 (0.23-2.56)
Ethnicity		
African/Black	Ref	Ref
White	1.65 (0.92-2.94)	1.48 (0.65-3.37)
Coloured	1.39 (0.91-2.13)	1.16 (0.76-1.78)
Indian/Asian	2.21 (1.26-3.87)**	1.34 (0.71-2.56)
Other	Cd	Cd
Religion		
None	Ref	-
Christianity	1.11 (0.35-3.56)	-
Hinduism	3.08 (0.86-10.99)	-
Islam	1.20 (0.27-5.35)	-
Primal indigenous	3.09 (0.83-11.59)	-
Other	0.50 (0.05-5.40)	-
Ever Moved		
No	Ref	Ref
Yes	1.21 (0.82-1.78)	1.09 (0.74-1.60)
Employment Status		
Currently working	Ref	Ref
Never worked	1.93 (0.95-3.95)	2.18 (1.02-4.67)*
Not working	2.21 (1.26-3.88)**	3.07 (1.71-5.51)***
Permanent Income Quintile		

1	Ref	Ref
2	0.95 (0.48-1.87)	0.87 (0.43-1.77)
3	2.00 (1.13-3.54)*	1.74 (0.99-3.03)
4	1.87 (1.00-3.49)*	1.59 (0.82-3.09)
5	2.05 (1.16-3.64)*	2.13 (1.10-4.15)*
Recent Household Deaths		
No	Ref	-
Yes	5.54 (0.58-52.74)	-
Total Household Members	0.94 (0.87-1.02)	-
Functional Disability	1.03 (1.02-1.05)***	1.04 (1.02-1.06)***
Cognitive Performance	1.02 (0.97-1.07)	-

*p<0.05, **p<0.01, ***p<0.001

Cd: category dropped out of the analysis due to an absence of depression cases

Manuscript 2: Urban-Rural Residence over the Life Course and Depression among Ghanaian and South African Older Adults

Abstract

Background: Urban residence has been associated with depression in numerous studies. However, most studies have only focused on current residence, and little research has addressed the rapidly urbanizing African region.

Methods: This study uses data from wave 1 of the World Health Organization Study on Global Ageing and Adult Health (SAGE) for Ghana and South Africa to assess the association between depression and urban-rural residence at different life stages and throughout one's lifetime in adults age 50 and older. Depression over the past 12 months was assessed using reported treatment for depression and depressive symptoms based on ICD-10 criteria. We employed multivariable logistic regression analyses to examine the association between depression and urban-rural residence separately in early childhood and adulthood as well as across the childhood, adulthood, and current time periods.

Results: Depression rates were slightly, but not significantly, higher in Ghanaian rural residents and South African urban residents, particularly for adulthood. However, adjusted results attenuated the effects in South Africa. Adjusted odds ratios (aORs) for depression comparing urban to rural residents were 0.80 (95% CI: 0.53-120) for both childhood and adulthood residence in the Ghana sample and 1.00 (95% CI: 0.66-1.53) and 1.01 (95% CI: 0.65-1.56) for childhood and adulthood residence, respectively, in South Africans. Odds ratios decreased after controlling for current residence. Although differences were not statistically significant, among Ghanaians, depression rates were

highest in more recent rural-urban migrants (8.28%, aOR=1.76, 95%CI: 0.75-4.16 compared to lifetime rural residents) and lowest in later-life returnees to rural areas who had rural childhood but urban adulthood (3.33%, aOR=0.62, 95% CI: 0.13-2.88). In contrast, among South Africans, depression rates were lowest in more recent urban-rural migrants (1.16%, aOR=0.24, 95% CI: 0.04-1.66) and highest in those with urban childhood and rural adulthood (8.33%, aOR=1.62, 95% CI: 0.15-17.50).

Conclusion: Results do not support a significant association between urbanicity in earlier life periods and depression in later life. Likewise, significant differences were not observed across life-course residence patterns, but trends suggest that depression prevalence may be higher among those recently migrating between urban and rural setting types in Ghana and lower among recent migrants in South Africa.

Introduction

Aging and urbanization are demographic and social changes occurring rapidly worldwide.[1-3] These processes have consequences for rates of depression, a leading cause of disease burden internationally.[4,5] Namely, older adults often face many factors that put them at risk for the disorder and, particularly among the oldest age groups, are affected by depression at higher rates than younger individuals;[6-8] and living in urban environments has also been linked to an increased risk of depression.[9]

Although Africa is urbanizing and its older population is increasing at rapid rates,[10-12] most research on the urbanicity-depression relationship is limited to high-income countries, so the role urbanicity plays in depression in African contexts remains unclear. Moreover, the majority of studies have only used current residence as a measure

of urbanicity and have therefore not taken into account the role of urbanicity at other stages of life and across the life course.

The life course perspective suggests that there may be critical or vulnerable periods in human development for the etiology of disease, and risk to a given exposure can accumulate over time.[13] Early life exposures have already been implicated in the development of some mental illness.[14,15] Furthermore, the experience of migration itself can also impact health and the risk of mental illnesses.[16] Scholars have recognized the role aging is playing in the growth of non-communicable diseases in poorer nations; and as exposures emerge, change, or intensify in these settings, Tollman et al.[17] argue that it becomes increasingly important to adopt a life course perspective to understanding, predicting, and addressing health challenges in populations of all ages, including older adults and not just from early life to adulthood. Thus, an examination of the effects of urbanicity on depression that not only addresses understudied geographic contexts but that also encompasses longer periods of the life course is important to better understand this relationship.

The following study therefore aims to assess whether urban-rural residence across the life course and at specific life stages affects the likelihood of depression in later life within the context of two middle-income African countries. Given the connection identified between urbanicity early in life and depression in some studies,[18,19] we hypothesize that childhood urban residence as well as adulthood urban residence are associated with depression. Furthermore, using the concept of cumulative exposure as a guiding principle, we also hypothesize that individuals who have more periods of urban residence are more likely to experience depression.

Methods

Data

This study uses data from wave 1 of the World Health Organization Study on Global Ageing and Adult Health (SAGE) for Ghana and South Africa. Wave 1 SAGE data for the two countries were collected from 2007 to 2008 through a household survey that employed a stratified multistage cluster design.[20,21] Data were collected using paper survey instruments.[20,21] The details of the survey are described elsewhere.[22] The overall samples for the study included 4,304 Ghanaian and 3,278 South African adults aged 50 years and older with information on former residence.

Measures

Exposure Variables: For part one of the analysis comparing the role of childhood residence and adulthood residence in later-life depression, responses to survey questions on where individuals spent most of their childhood (before age 10) and most of adulthood (18+ years) were classified as urban or rural based on response categories. For a description of item response options and their corresponding codes, see Appendix H.

For part 2 of the analysis, the survey questions on where individuals spent most of their childhood and most of adulthood, along with current residence, were used to create categories of lifetime residence with responses classified as urban or rural. This resulted in 8 possible life course patterns: 1) rural-rural-rural; 2) rural-rural-urban; 3) rural-urban-urban; 4) rural-urban-rural; 5) urban-rural-rural; 6) urban-urban-rural; 7) urban-rural-urban and 8) urban-urban-urban. Individuals with missing or unknown responses on any of the three components were excluded from analysis; thus the analysis included 4,199

Ghanaian and 3,174 South African adults at least 50 years of age with complete residence information.

Outcome Variable: Depression over the past 12 months was classified using self-reported treatment for depression in that time period and depressive symptoms based on the ICD-10 criteria for a depressive episode. This is described in greater detail elsewhere (Manuscript 1).

Covariates: sex, age, marital status, education, ethnicity, residential mobility, employment status, bereavement, household permanent income quintiles, functional disability, and cognitive performance were considered as independent variables for adjustment in the analysis. These variables and their definitions are described in detail in Manuscript 1.

Statistical Analysis

Characteristics of the sample were calculated as proportions for categorical variables and means for continuous variables based on the sample data, and corresponding national estimates were also produced using individual-level survey weights. These weights were based on the individual probability of selection and were post-stratified by region, locality, sex, and age in Ghana and by province, sex, and age in South Africa and are not normalized.[20,21] Bivariate logistic regression models between the outcome and each independent variable were run to determine the unadjusted association. Multivariable logistic regression models accounting for the clustered and stratified survey design were employed to examine the association between depression and urban-rural residence in early childhood and adulthood as well as lifetime urban-rural residence,

adjusting for sex, age, and variables significantly associated with the depression outcome in each country. Residential mobility—defined as having ever moved—was also included as a covariate to isolate the effects of urbanicity from those of migration. Weights were not applied in the main regression analyses due to their highly skewed distribution; however, weighted analyses are included in Appendix G for comparison.

To separate the effect of childhood and adulthood residence from current residence in the first part of the analysis, additional models were run controlling for current residence. Because the correlation between current residence and both primary childhood residence and primary adulthood residence was expected to be high, we checked the variance inflation factors (VIFs) for crude models with these variables to determine whether they would be affected by multicollinearity. However, VIFs were low to moderate (2.43 and 3.06 for childhood and adulthood residence, respectively, with current residence in Ghana and 2.64 and 3.12, respectively, in South Africa). Data were analyzed using Stata 13.

Results

Descriptive statistics on both the Ghana and South Africa samples are contained in Table 2.1. In Ghana, roughly half of the older adult population was male and about half had received no formal education. The majority were currently married and currently working. Most had not experienced a recent death in the household, and about one third of the older adult population had relocated at some point in time. The average household size was between 5 and 6 members, and respondents had mild functional disability on average. In South Africa, about 40% of the population was male, around a quarter were

not formally educated, half were currently married or cohabiting, and close to a third were currently working. Approximately one third of the population had moved in their lifetime, and essentially none of the population had a household death in the past 24 months. Households had an average size of 4 people, and respondents were on average mildly functionally disabled.

Part 1: Urbanicity of Residence at Different Life Stages

38.9% and 41.4% of Ghanaian older adults lived in urban areas in childhood and adulthood, respectively, and overall depression prevalence was 7.5% based on national population estimates. In South Africa, 60.8% and 62.1%, respectively, were childhood and adulthood urban residents. Depression prevalence was 4.1%. Among the sample with urban childhood residence, the rate of depression was 7.2% in Ghana and 4.7% in South Africa, while the rate among those with rural childhood residence was 7.9% and 4.0% in Ghana and South Africa, respectively. The rates of depression in the samples based on type of adulthood residence were 7.1% for urban and 8.1% for rural in Ghana and 4.8% for urban and 3.8% for rural in South Africa (Figure 2.1).

In the Ghana sample, sex, age, education, household wealth, employment status, ethnicity, residential mobility, bereavement, functional disability, and cognitive function were individually associated with the depression outcome and included in the multivariable model. The adjusted odds ratio (OR) for depression comparing urban to rural residents was 0.80 (95% CI: 0.53-1.20) for both primary childhood and adulthood residence. After adjusting for current residence, the adjusted ORs reduced to 0.75 (95% CI: 0.43-1.32) for childhood residence and 0.66 (95% CI: 0.35-1.23) for adulthood residence (Table 2.2).

In the South Africa sample, age, marital status, education, employment status, ethnicity, household wealth, and functional disability were significantly associated with depression in bivariate analyses and included in the multivariable model along with sex and residential mobility, which were included *a priori*. The adjusted OR for depression comparing urban to rural residents was 1.00 (95% CI: 0.66-1.53) for primary childhood residence and 1.01 (95% CI: 0.65-1.56) for primary adulthood residence. After controlling for current residence, the adjusted ORs reduced to 0.98 (95% CI: 0.56-1.72) and 0.99 (95% CI: 0.57-1.70) for childhood and adulthood residence, respectively (Table 2.2).

Part 2: Urbanicity of Residence across the Life Course

Based on depression rates within each lifetime category, the highest percentages of depressed individuals in the Ghana sample were among recent rural-urban migrants (rural-rural-urban, 8.28%), followed by lifetime rural (rural-rural-rural, 8.22%) and then lifetime urban residents (urban-urban-urban, 7.58%) (Table 2.3). Intermediate depression rates were seen among the two groups with urban childhood but current rural residence (5.00-5.56%). Lowest rates were seen among the groups with rural childhood but urban adulthood (3.33-3.60%). This information is also depicted graphically in Figure 2.2. In the adjusted analyses, the highest odds ratio for depression compared to lifetime rural residents was among the rural-rural-urban group (OR=1.76, 95% CI: 0.75-4.16). The lowest odds of depression compared to lifetime rural residents was among the rural-urban-rural group (OR=0.62, 95% CI: 0.13-2.88) followed by the rural-urban-urban group (OR=0.75, 95% CI: 0.28-2.03). The odds of depression in lifetime urban residents

compared to lifetime rural residents was OR=0.80, 95% CI: 0.50-1.26 while urban-rural migrants had ORs close to null (Table 2.4). These estimates did not reach statistical significance.

In South Africa, the highest rates of depression were seen among the rural-urban-rural and urban-rural-rural groups (8.33%), followed by rural-urban-urban residents (7.55%) (Table 3). Lifetime urban residents had the next highest depression rates (4.87%), followed by lifetime rural residents (3.81%). The lowest rates of depression were seen among the recent urban-rural migrants (1.16%). These rates are displayed in Figure 2. After adjusting for covariates, the urban-rural-rural category had the greatest likelihood of depression (OR=1.62, 95% CI: 0.15-17.50). Based on adjusted results, the lowest likelihood was observed among the urban-urban-rural group (OR=0.24, 95% CI: 0.04-1.66) followed by the rural-rural-urban group (OR=0.55, 95% CI: 0.19-1.60). Lifetime urban residents had essentially similar odds of depression compared to lifetime rural residents. Estimates did not reach statistical significance. Complete adjusted results are contained in Table 2.5.

In both countries, the urban-rural-urban group had no cases of depression and is therefore not considered in the comparisons of depression rates across life-course residence categories.

Discussion

Urbanicity of Residence at Different Life Stages

Contrary to our hypothesis, as well as other findings, urban residence in childhood and adulthood was not significantly associated with depression in Ghanaian older adults,

though depression rates were slightly higher in Ghanaian rural residents. This is similar to the adjusted effect for the Manuscript 1 model looking at current residence, which had an OR of 0.85 (95% CI: 0.55-1.31). Results suggest a slightly stronger magnitude of effect for both childhood and adulthood residence than current residence, which may imply a lag period in the observation of effects. When adjusting for current residence, the estimates became more protective, particularly for primary adulthood residence, although the direction of effect for current residence changed. Although all effect estimates remained nonsignificant, the stronger magnitude of effect for adulthood residence may suggest that it could be more relevant for depression in later life than childhood residence. Weighted and unweighted model results were similar.

In South African older adults, depression rates were slightly higher in urban residents in both childhood and particularly adulthood but did not reach significance; however, adjusted results attenuated the effects such that the overall model results indicated essentially no effect of childhood or adulthood residence on depression. Unlike the adjusted effects of primary adulthood and primary childhood residence, the adjusted results for the effect of current urban residence on depression in Manuscript 1 were in the positive direction, with an OR of 1.13 (95% CI: 0.71-1.80), which is consistent with the ORs greater than one for current residence in the models from the present analysis controlling for this variable (Appendix I). Weighting appeared to have a greater impact on the South Africa models, particularly for the unadjusted results, and reversed the direction of the effect of residence in the models controlling for both current residence and adulthood or childhood residence (Appendix I), as it also did for the current

residence exposure in Manuscript 1 (Appendix F). However, in all cases, results were not statistically significant.

In a study of adults in Uganda, urban birthplace was significantly associated with recent experience of depressive symptoms in the past week, as well as with symptoms of anxiety and psychosis and lifetime experience of delusional ideation.[19] Likewise, another study showed that the incidence rate for depressive disorder was significantly higher among Danish individuals born in urban as compared to rural environments.[18] Although the SAGE survey does not provide information on place of birth, the results of this analysis for childhood residence do not support an association between urban-rural location in early life and later depression as found in these studies. A study of urbanicity and depressive symptoms in British children at age 12 also did not find a significant association,[23] but adulthood outcomes were not assessed.

Urbanicity of Residence across the Life Course

Results for the Ghana sample likewise do not support a significant difference in depression in older adults based on different residence and migration patterns over the life course, and patterns do not confirm the cumulative exposure hypothesis. However, compared to lifetime rural residents, recent urban migrants (rural-rural-urban) may be more likely to suffer from depression. Rural-urban migrants who moved earlier (i.e., from childhood to adulthood)—and particularly those who have currently returned to rural residence—appear to be least likely to suffer from depression.

Moving in general during one's lifetime seems to have a beneficial effect in terms of depression in Ghanaian older adults, as the significant OR for the residential mobility

variable demonstrates. However, these lifetime patterns suggest that the timing of the move matters. Depression rates appear worse for those coming from rural to urban settings more recently. Individuals who made the rural-urban transition earlier may be more acclimated to their new environments and better able to reap the benefits of their new setting, which may have prompted their move; and these situations may therefore make them less prone to depression. This is supported by findings from longitudinal studies.[24] Apart from recent rural-urban migrants, individuals who have experienced both urban and rural settings appear less likely to have later-life depression than lifetime residents of either setting. This is particularly true of return rural migrants, which goes against some literature on rural-urban migration indicating that unhealthier or unhappier individuals may selectively return to their original locations.[25]

Similarly, no significant differences in the odds of depression were found among South African older adults based on residency in rural and urban areas across the life course. Although clear, consistent patterns were not observed, based on the rate of depression in each category, highest rates were observed among those whose location of residence changed from childhood to adulthood, regardless of initial or current residence. However, these rates may be affected by small numbers in these categories. Nonetheless, some research does point to a significant negative impact of relocation during childhood on the development of depressive disorder and other psychiatric conditions in teenage years to middle age.[26] Similarly, childhood residential instability was significantly associated with lifetime development of depression in another study, but the effect was modified by age of onset and only significant among those with onset of depression by age 14.[27] However, individuals in this onset age group were also most likely to have

recurring episodes, which may indicate that effects of childhood residential instability on depression may extend into adulthood. As no information on depression onset is included in the SAGE survey, it is not possible to determine whether effects of life-course urbanicity on current depressive outcomes relate to age at onset in the present study.

Lowest rates of depression in South Africa were observed among those who moved recently, especially the urban-urban-rural group followed by rural-rural-urban group. Based on adjusted results, recent migrants seemed to have better outcomes in terms of depression in the South African context. Weighted and unweighted results differ substantially in unadjusted analyses but become more similar after adjustment due to the inclusion of many of the survey design variables as controls (Appendix I).

Several studies have examined the effects of rural-urban migration on depression and other psychological outcomes,[24,28-30] with the majority demonstrating that rural-urban migrants suffer more from depression than individuals who do not make this transition. Study authors point to migration as a stressful and disruptive life event in explaining these findings. However, these studies focus on migration as the main factor and do not address life-course exposure to urbanicity. Thus, little distinction is made based on the timing of migration. In the few studies that purport to take a life course approach, Kim et al.[31] also found higher rates of depression among recent rural-urban migrants in Korean older adults, which agrees with the literature and the present results in the Ghana sample, although other observed patterns differ from the current analysis. However, among Thai adults, Yiengprugsawan et al.[32] found a dose-response relationship with the rural-rural group showing the lowest psychological distress and diagnosed depression, followed by the rural-urban group, and highest among the urban-urban group. This is in line with our

original hypothesis suggesting longer duration of residence in urban areas may be detrimental. However, neither of the life course studies assessed urban-rural migrants because of small numbers and a primary interest in rural-urban migration patterns. A cumulative impact of length of urban residence in early life has also been reported in the case of schizophrenia, which is in agreement with life course theory.[33]

In the present analysis, the urban-rural-urban group was very small in both countries and therefore contained no cases of depression and is not discussed. Interpretation of results is also limited by small numbers and, consequently, wide confidence intervals in other categories, which may have limited power to detect significant differences in depression across the life course groups. Furthermore, despite attempts to arrive at a measure of exposure throughout one's lifetime, SAGE survey questions did not cover the entire lifespan. For instance, the item on childhood residence only focused on the time period up to and including age 9. As a result, categories in this analysis represent approximations of lifetime residence only.

Nevertheless, this study provides new insights into the role of urbanicity of residence at different points in time on depression, specifically in African contexts. It represents one of a very limited number of studies that incorporates a life course approach to understanding the urbanicity-depression relationship, and the only such study the authors were able to identify for the countries in question. It also begins to shed light on variations in the experience of depression based on different migration patterns.

Conclusion

Results of this study do not support a significant difference in later-life depression based on urban-rural residence in either childhood or adulthood as well as across the life course. However, results may be suggestive of a potentially negative impact of recent migration in Ghana but a potentially positive impact of recent migration in South Africa in terms of depression. Additional quantitative and qualitative studies are needed to further explore and confirm these results as well as to elucidate the migratory choices and reasons for migration among various subpopulations in addition to the contexts of individuals that may be driving such findings. As additional waves of the WHO-SAGE and other aging studies become available, they will also provide opportunities for longitudinal research that will lead to better understanding social determinants of health such as urbanicity across the life course.

Although findings may not warrant changes in or differential allocation of mental health services, they may inform the identification and targeting of interventions for individuals who may be more at risk. In particular, they may suggest a need to monitor the mental health of recent rural-urban migrants, at least in the Ghanaian context, as well as the mental health of individuals whose settings change in between the childhood to adulthood transition in South Africa.

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content is solely the responsibility of the author and does not necessarily represent the official views of the National Institutes of Health.

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Table 2.1: Sample Characteristics by Country

	Ghana	South Africa
	% (w%)*	% (w%)*
Male	52.2 (52.4)	39.9 (40.2)
Age		
50-59	39.2 (39.8)	43.8 (49.9)
60-69	28.0 (27.5)	32.3 (30.6)
70-79	22.9 (23.1)	17.5 (14.1)
80+	9.9 (9.6)	6.4 (5.4)
Education Level		
None	55.1 (53.9)	25.8 (23.6)
Some Primary	10.1 (10.4)	24.9 (25.2)
Primary Completed	10.8 (10.9)	24.0 (22.7)
Secondary Completed	20.5 (21.1)	20.3 (22.8)
Post-Secondary Completed	3.5 (3.6)	5.0 (5.8)
Marital Status		
Never Married	1.2 (1.3)	14.0 (15.2)
Married/Cohabiting	56.8 (59.3)	50.8 (52.7)
Separated/Divorced	14.2 (12.9)	6.4 (6.3)
Widowed	27.9 (26.5)	28.8 (25.8)
Employment Status		
Currently working	71.8 (71.4)	27.6 (31.1)
Never worked	1.5 (1.6)	13.0 (13.6)
Not working	26.8 (27.0)	59.4 (55.4)
Recent Household Death	1.3 (1.3)	0.2 (0.2)
Ever Moved	34.1 (33.9)	29.9 (33.4)
Total Household Members, mean ($mean_w$)	5.5 (5.6)	4.1 (4.0)
Functional Disability Score, mean ($mean_w$)	21.7 (21.6)	20.0 (20.7)

*w% and $mean_w$ are weighted to account for survey design and provide national population estimates

Table 2.2: Odds Ratios and 95% Confidence Intervals for Depression by Country

	Ghana			South Africa		
	Unadjusted	*Model 1*	*Model 2*	*Unadjusted*	*Model 1*	*Model 2*
Childhood Residence						
Rural	Ref	Ref	Ref	Ref	Ref	Ref
Urban	0.91 (0.61-1.35)	0.80 (0.53-1.20)	0.75 (0.43-1.32)	1.18 (0.83-1.69)	1.00 (0.66-1.53)	0.98 (0.56-1.72)
Adulthood Residence						
Rural	Ref	Ref	Ref	Ref	Ref	Ref
Urban	0.87 (0.59-1.29)	0.80 (0.53-1.20)	0.66 (0.35-1.23)	1.28 (0.87-1.88)	1.01 (0.65-1.56)	0.99 (0.57-1.70)

Model 1 adjusts for significant covariates and model 2 adjusts for covariates and also controls for current residence

Table 2.3: Distribution of Residence Patterns and Rates of Depression by Lifetime Residence

	Ghana		South Africa	
	Distribution % (n)	*Depressed % (n)*	*Distribution % (n)*	*Depressed % (n)*
Rural-Rural-Rural	53.20 (2234)	8.22 (183)	29.58 (939)	3.81 (34)
Rural-Rural-Urban	4.05 (170)	8.28 (14)	4.47 (142)	3.55 (5)
Rural-Urban-Urban	2.67 (112)	3.60 (4)	1.76 (56)	7.55 (4)
Rural-Urban-Rural	1.43 (60)	3.33 (2)	0.38 (12)	8.33 (1)
Urban-Rural-Rural	1.43 (60)	5.00 (3)	0.38 (12)	8.33 (1)
Urban-Urban-Rural	3.00 (126)	5.56 (7)	2.74 (87)	1.16 (1)
Urban-Rural-Urban	0.21 (9)	0.00 (0)	0.19 (6)	0.00 (0)
Urban-Urban-Urban	34.01 (1428)	7.58 (108)	60.49 (1920)	4.87 (91)
Total	*100 (4199)*	*7.67 (321)*	*100 (3174)*	*4.46 (137)*

Denominators for the percent depressed may differ from the total sample size in each category due to missing data. Percentages reflect values based on the samples and corresponding sample sizes for each category rather than population estimates

Table 2.4: Adjusted Odds of Depression in Ghana

Life-Course Residence	
Rural-Rural-Rural	Ref
Rural-Rural-Urban	1.76 (0.75-4.16)
Rural-Urban-Urban	0.75 (0.28-2.03)
Rural-Urban-Rural	0.62 (0.13-2.88)
Urban-Rural-Rural	1.01 (0.27-3.77)
Urban-Urban-Rural	1.09 (0.51-2.32)
Urban-Rural-Urban	Cd
Urban-Urban-Urban	0.80 (0.50-1.26)
Sex	
Male	Ref
Female	1.43 (1.09-1.90)*
Age	
50-59	Ref
60-69	1.27 (0.87-1.87)
70-79	1.29 (0.82-2.03)
80+	1.52 (0.86-2.68)
Education Level	
None	Ref
Some Primary	1.25 (0.82-1.91)
Primary Completed	0.85 (0.51-1.40)
Secondary Completed	1.65 (1.06-2.58)*
Post-Secondary Completed	1.28 (0.47-3.48)
Ethnicity	
Akan	Ref
Ewe	0.51 (0.26-0.98)
Ga-Adangbe	0.62 (0.36-1.07)
Gur/Northern	1.18 (0.69-2.02)
Other	0.77 (0.46-1.29)
Ever Moved	0.52 (0.33-0.83)**
Employment Status	
Currently working	Ref
Never worked	0.19 (0.03-1.47)
Not working	1.62 (1.19-2.20)**
Permanent Income Quintile	
1st	Ref
2nd	1.58 (1.08-2.30)*
3rd	1.02 (0.66-1.58)
4th	1.08 (0.69-1.70)
5th	0.82 (0.51-1.30)
Recent Household Death	2.30 (0.91-5.79)
Functional Disability	1.00 (0.98-1.02)
Cognitive Performance	0.93 (0.89-0.96)***

Analyses account for the clustered and stratified design. * p< 0.05, ** p<0.01, *** p<0.001; Cd: category dropped out of the analysis due to an absence of depression cases.

Table 2.5: Adjusted Odds of Depression in South Africa

Life-Course Residence	
Rural-Rural-Rural	Ref
Rural-Rural-Urban	0.55 (0.19-1.60)
Rural-Urban-Urban	1.04 (0.29-3.75)
Rural-Urban-Rural	Cd
Urban-Rural-Rural	1.62 (0.15-17.50)
Urban-Urban-Rural	0.24 (0.04-1.66)
Urban-Rural-Urban	Cd
Urban-Urban-Urban	0.97 (0.61-1.54)
Sex	
Male	Ref
Female	0.97 (0.65-1.44)
Age	
50-59	Ref
60-69	0.38 (0.24-0.61)***
70-79	0.24 (0.13-0.46)***
80+	0.07(0.02-0.30)***
Marital Status	
Never married	Ref
Married/Cohabiting	1.32 (0.71-2.46)
Separated/Divorced	2.43 (1.06-5.59)*
Widowed	2.02 (1.01-4.06)*
Education Level	
None	Ref
Some Primary	1.25 (0.72-2.16)
Primary Completed	1.18 (0.67-2.09)
Secondary Completed	1.01 (0.52-1.98)
Post-Secondary Completed	0.79 (0.23-2.69)
Ethnicity	
African/Black	Ref
White	1.47 (0.62-3.44)
Coloured	1.17 (0.75-1.82)
Indian/Asian	1.38 (0.74-2.59)
Other	Cd
Ever Moved	1.30 (0.83-2.01)
Employment Status	
Currently working	Ref
Never worked	1.97 (0.93-4.18)
Not working	2.81 (1.57-5.02)**
Permanent Income Quintile	
1st	Ref
2nd	1.01 (0.51-2.00)
3rd	1.72 (0.98-3.03)
4th	1.71 (0.88-3.32)
5th	2.19 (1.11-4.31)*

Functional disability	1.05 (1.02-1.07)***

Analyses account for the clustered and stratified design. * p< 0.05, ** p<0.01, *** p<0.001; Cd: category dropped out of the analysis due to an absence of depression cases.

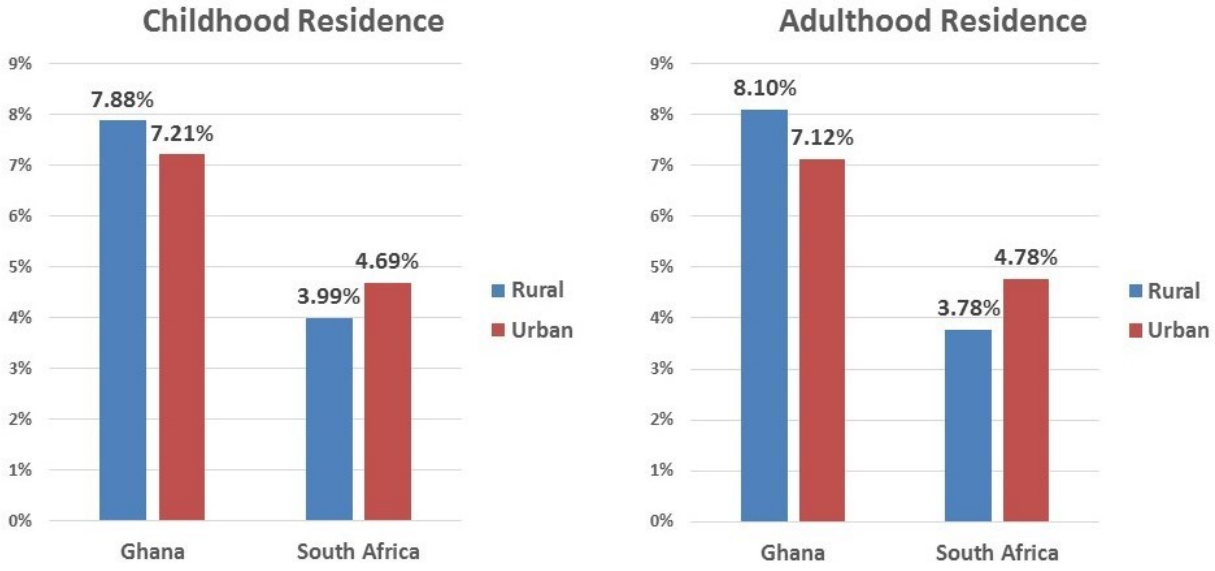

Figure 2.1: Proportion of the Sample with Depression by Country and Location of Residence

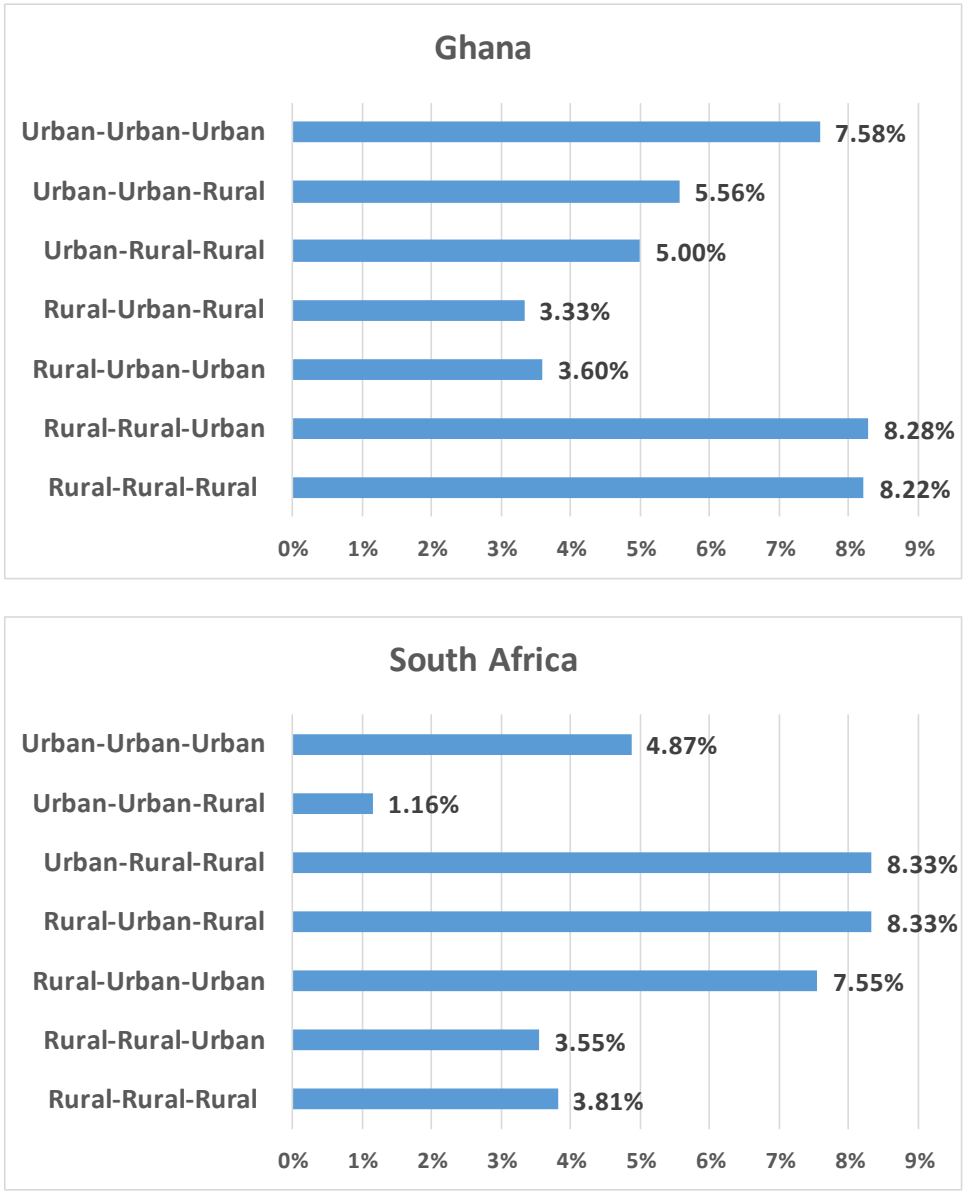

Figure 2.2: Proportion of the Sample with Depression by Country and Life-Course Residence Pattern

Manuscript 3: Assessing Urban-Rural Differences in the Relationship between Social Capital and Depression among Ghanaian and South African Older Adults

Abstract

Background: Social relationships are beneficial for physical and mental health. The association between social capital and depression has been investigated; however little attention has been given to possible variations in this relationship by geographic characteristics such as urbanicity. ***Methods:*** Using data on Ghanaian and South African adults aged 50 years and above from the World Health Organization Study on Global AGEing and Adult Health (SAGE), exploratory and confirmatory factor analyses (EFA and CFA) were conducted to determine the dimensionality of survey items related to social capital. Structural equation models were then used to estimate the association between social capital and depression in each country and test for group differences between urban and rural settings using tests for measurement and structural invariance between groups.

Results: The EFA suggested three dimensions of social capital: community engagement, sociability, and trust. There were no substantial urban-rural differences in the structural paths linking community engagement, sociability, or trust to depression in either country. However, urban-rural differences in the measurement of social capital emerged in both countries. Additionally, urban Ghanaian older adults were less socially integrated and trusting than rural residents (standardized mean difference: -0.28, -0.24, and -0.38 for

community engagement, sociability, and trust, respectively) while urban South African older adults appeared less engaged in community activities but significantly more trusting and socially active informally than their rural counterparts (standardized mean difference: -0.33, 0.30, and 0.17 for community engagement, sociability, and trust, respectively). In Ghana overall, greater levels of community engagement were associated with lower risk of depression while sociability and trust significantly increased the risk of depression. In South Africa, only trust was associated with lower risk of depression.

Conclusion: Results indicate that the composition and average levels of social capital differ between urban and rural residents in Ghana and South Africa although urban-rural differences in the strength of the association between social capital and depression were not substantial. Moreover, the associations between social capital and depression are context-specific and may not be uniformly beneficial.

Introduction

The importance of social capital for health has been increasingly recognized and widely studied in the public health literature.[1] Although varying definitions of social capital exist, notable scholars credited for the term's popularization include Pierre Bourdieu, who described social capital essentially as the resources derived from one's social affiliations that are obtained through expending time in social interactions. The benefits arising from this process of exchange motivate the formation and sustenance of social groups and lead to group unity.[2] In its application to public health, Robert Putnam's conceptualization of social capital, which emphasizes civic participation and community organizations as well as networks and customs of trust and reciprocity, has

been most commonly used.[3,4] Despite the lack of consensus in defining the concept, its basis in social interactions and relationships is a common thread, and it has often been used to encompass related constructs such as social integration, social support, participation, and social cohesion.[5]

Specifically regarding mental illness, there is convincing evidence that social connections can also play a protective role. For example, individual-level measures of social capital including social participation, trust, neighborhood attachment, and sense of belonging have been shown to be negatively associated with common mental disorders.[3] Relationship quality has also shown significant negative associations with depression,[6,7] and a recent systematic review concluded that perceived and received emotional support, perceived instrumental support and having a larger social network and a network consisting of both friends and family protect against depression.[8] Not all studies have universally confirmed such protective effects, and although aggregate level social capital measures are also suggestive of positive impacts, they have produced less consistent findings.[3,9]

The role of social connections for the mental well-being of older adults has also become a subject of study,[7] with some indication that an increased likelihood of insufficient support and interaction may partly explain elevated rates of depression in this population.[10] Research likewise suggests many benefits of social support, integration, quality relationships and other aspects of social capital in terms of depressive outcomes in older adults,[7,10-14] although the significance of findings have also varied.[7,14,15]

Studies have also examined variations in the association between social relationships and depression based on different personal characteristics, and the

relationship has been shown to vary by gender, age, personality traits, and even genetics.[8] However, little research has been devoted to variations in the social capital-depression association by geographic factors. For example, the question of urban-rural differences in the association between social capital and depression is largely unstudied, yet urbanization is happening at a rapid rate globally and particularly in low- and middle-income countries (LMICs).[16] Additionally, urban-rural differences have also been demonstrated in the occurrence of depression itself in several cases, with results of a meta-analysis suggesting a roughly 30% increase in odds of mood disorders such as depression in urban as compared to rural settings.[17] Thus, understanding the differential effects of social capital on depression by urbanicity may be important for elucidating potential explanatory factors behind urban-rural disparities observed in depression rates, and it may have utility for informing the planning of appropriate points of interventions across these settings.

Furthermore, there is growing recognition that the effects of social relationships may differ across cultures, indicating the need for particular attention to these differences.[7,8,18] Yet, evidence from regions such as Africa is especially lacking. Taking these points into consideration, this study therefore examines urban-rural differences in the relationship between social capital and depression in the context of two African nations. We hypothesize that the association between social capital and depression is in fact modified by the type of geographic setting. More specifically, while it is expected that social capital will have protective effects on depression, we hypothesize that the strength of the association will be weaker for residents of urban areas as compared to residents of rural areas. This hypothesis is informed firstly by the fact that rural areas are

generally under-resourced and suffer from inadequate health and other services compared to urban areas,[19,20] which may make rural residents depend more heavily on their social networks for the fulfillment of support needs. As a result, they may be more vulnerable to the effects of an absence of strong social capital.

Additionally, some studies have identified effect modification of the social support-depression association by degree of urbanicity in the hypothesized direction. For example, a study in an urban and a rural area of a region in Japan identified significant associations between inadequate social support and depression only in rural but not in urban residents after adjustment;[21] and another study in Korean older adults found a weaker association between social support deficits and depression in urban residents compared to rural residents—despite lower levels of support among urban dwellers—with a dose-response relationship according to length of urban residence and essentially no association in lifetime urban residents.[22] The authors suggested that urban individuals may place a lower value or emphasis on social relationships than rural residents, and this decreased relevance could make urban residents less affected by insufficient social support. Likewise, low levels of emotional social support had a stronger effect on psychological distress among those living in villages than in cities in former Soviet countries.[23] Thus, the hypothesized differential effects of social capital on depression may be related to the greater availability of alternative resources to compensate for social capital deficits and a lower valuation of the importance of social connectedness in urban settings.

Methods

Data for this analysis were taken from the first wave of the World Health Organization (WHO) Study on Global AGEing and Adult Health (SAGE), a nationally representative population-based household survey conducted in six low- and middle-income countries.[24] Data for Ghana and South Africa were collected in 2007 and 2008 and used a stratified, multistage cluster design.[25,26] All individuals aged 50 years and older were eligible to participate, along with one individual 18-49 years old per household.[24] The study is described in greater detail elsewhere.[24] The samples used in this analysis were restricted to 4,209 Ghanaian and 3,148 South African adults 50 years of age and older who had lived in their current location for over one year. The exclusion of individuals with one or fewer years of residency in their current locality was to ensure that the social capital and depression measures, which are based on the previous 12-month period, were relevant to respondents' current location.

Measures

Urbanicity: Households were classified as urban or rural based on official designations within each country. In Ghana, an urban designation is given to localities with a population of at least 5,000, and in South Africa designations incorporate land use and type of settlement.[27,28]

Depression: Depression in the past 12 months was defined using survey items on treatment for depression within that time period as well as the reported experience of depressive symptoms. Because of the structured nature of the symptom questions, which are based on the World Mental Health Survey Clinical International Diagnostic Interview

(CIDI)[29] and contain skip patterns designed to align with recognized diagnostic criteria, depression was operationalized as a binary yes/no variable based on either an affirmative response to depression treatment or satisfaction of the *International Classification of Diseases*, 10th revision (ICD-10)[30] criteria for a depressive episode based on an algorithm developed from the symptom items.

Social Capital Measures: 15 items consisting of Questions 6001-6010 and 6012-6016 of the Social Cohesion section of the SAGE survey were selected as potential measures of social capital. These items assessed interpersonal interactions, participation in community and social activities, and general and group-specific trust through a combination of categorical questions. A complete list of these questions and their response formats are included Table 3.1.

Statistical Analysis

After cross-tabulating individual social capital items with the depression outcome as well as the urbanicity variable to explore their distributions and preliminary associations (Appendix J), exploratory factor analysis (EFA) was used to identify latent factors representing dimensions of social capital underlying the questions. The selection of a potential range for the appropriate number of factors was guided by the number of factors with eigenvalues greater than one derived from the sample correlation matrix; assessments of scree plots of eigenvalues for the number of points above where the slope of the plot begins to level off; and parallel analysis results from principal components indicating the number of eigenvalues larger than eigenvalues produced from random data.[31,32] Multiple EFA models were run comparing possible solutions starting from 1

factor to the ideal number of factors suggested from the aforementioned methods. Fit statistics for these models were compared in addition to the factor loadings and residual variances to select the most appropriate factor solution demonstrating good fit, adequate factor loadings, minimized item residual variance, and minimal cross-loading. Goodness of fit tests included the chi-square (χ^2) test (lower test statistic and non-significant p-value indicate better fit);[33] root mean square error of approximation (RMSEA) (<0.05 indicates very good fit, <0.08 is acceptable);[32,34] and standardized root mean square residual (SRMR) (<0.10 or at least 0.08 is adequate).[32,35] At least 3 items were also required per factor[35] to improve model identification.

After the factor number was determined, items with factor loadings below 0.32 or with cross-loading—i.e., factor loadings of 0.32 on more than one factor and/or a difference of less than 0.15 between the 2 highest loadings[31,32] —were deleted one at a time and the EFA re-run until a final solution was produced. An oblique rotation (promax) was used to allow for potential correlation between the factors.

Confirmatory factor analysis (CFA) was used to verify the fit of the final factor structure obtained from the EFA. Depression was then introduced as the outcome in initial structural equation modeling (SEM) with the social capital latent factors, and secondary models adjusted for sex (male/female) and age (continuous and centered at the mean). Preliminary assessments of identifiability of the models were also conducted prior to model fitting by applying the T-rule, null B rule, recursive rule, and two- and three-indicator rules to the models to demonstrate that they could produce unique solutions.[33,36] Adequacy of the CFA and SEM models was assessed with the following goodness of fit

statistics: χ^2 tests, RMSEA, and the comparative fit index (CFI) and Tucker-Lewis index (TLI) (> 0.9 is acceptable, ≥ 0.95 good).[32,34,35]

Finally, a multi-group analysis was conducted to determine whether differences existed between urban and rural residents in the SEM of the relationship between social capital latent factors and depression. Invariance, or equivalence, between the two groups for the measurement models specified in the CFA was first examined as a necessary prerequisite. Although there are varying degrees of measurement invariance that place increasingly stringent requirements of equality on parameters,[33] the analysis assessed scalar invariance, which assumes that factor loadings and item thresholds—or cutpoints on the latent variables underlying each item that demarcate item categories—are equal across groups.[34] Scalar invariance allows for comparisons of factor means.[34] To test invariance, the scalar model constraining loadings and thresholds to be equal between rural and urban residents was compared to the model allowing these parameters to vary but maintaining the same CFA structure (configural invariance).[34] A χ^2 difference test was used to examine the null hypothesis of no significant difference between the constrained (scalar) model and the unconstrained (configural) model. If full measurement invariance was not supported, a partially invariant measurement model was examined by allowing the most disparate factor loadings and items thresholds between urban and rural residents to vary.[33,34] This was based on comparisons of unstandardized loadings between urban and rural groups and examinations of modification indices, which specify how much a χ^2 estimate would change if constraints on a given parameter are lifted.[37] Lastly, the structural paths in SEM were compared by constraining the paths between the social capital factors and the depression outcome to be equal across urban and rural residents

and comparing that to a model allowing the path estimates to vary using a χ^2 difference test of the hypothesis of no worse performance of the constrained model compared to the unconstrained model.

Due to the categorical nature of the questions, factor analysis was based on the polychoric correlation between the items[38] (see Appendix K for correlation matrix). For the same reason, EFA, CFA, and SEM modeling employed robust weighted least squares estimation (WLSMV) to accommodate violations of normality in the categorical items and produce valid standard errors and χ^2 test statistics.[39] WLSMV estimation with categorical factor indicators results in the use of probit regression to model relationships between indicators and factors as well as structural paths,[37] which models predicted probabilities as the outcome.

Observations missing on all dependent variables (factor indicators and the depression outcome) were dropped in the analysis. In cases where only some variables were missing, EFA, CFA, and SEM were modeled with all available information assuming missing data are only dependent on observed independent variables.[37] Missingness in the two samples was minimal, generally less than 1% (n=14) in the Ghana sample and 3.7% (n=117) in the South Africa sample. In the South Africa data, larger numbers of the responses were missing for items related to socializing with coworkers and trust of coworkers, which appears to be a result of the high levels of unemployment in this sample. For a more detailed description of missingness in the data, refer to Appendix L.

All models adjusted the standard errors and χ^2tests for clustering and stratification in the survey data by using the sandwich estimator to calculate standard errors.[37] For

strata with only one cluster, which occurred in the South Africa data, the variance calculation was centered on the overall cluster average. Due to the highly skewed distribution of weights with numerous outliers (Appendix D), model results are based on unweighted data. However, weighted versions of the models were also analyzed and are included in Appendix Q for comparison. Analyses were conducted in STATA 13 and Mplus 7.4. Each country's data were analyzed separately.

Results

Sample Characteristic

In the Ghana sample, 47.3% of respondents were female. The age distribution of the sample was 39.1% 50-59 years, 28.1% 60-69 years, 22.9% 70-79 years, and 9.9% 80+ years. Urban residents constituted 40.9% of the sample, and 7.6% of the sample were classified as depressed in the past 12 months. Over half of the sample had no formal education, and a similar proportion was currently married. Nearly three-quarters were currently employed. In South Africa, 60.1% of the sample was female. The age distribution was 43.6% 50-59 years, 32.8% 60-69 years, 17.5% 70-79 years, and 6.1% 80+ years. Two-thirds of the sample lived in urban areas, and 4.3% had depression in the past 12 months. Additionally, less than one-third of the sample was currently employed, about half were married, and about one quarter had no formal education.

Exploratory & Confirmatory Factor Analyses

In the Ghana data, 17 participants had missing or unknown values on all social capital indicators, resulting in a sample size of 4,192 for the EFA. The EFA of the Ghana

data produced 5 factors with eigenvalues above one; however, a scree plot illustrated that 3 data points were above the bend and a parallel analysis also demonstrated that 3 eigenvalues derived from the data were larger than the eigenvalues produced from random data (Appendix M). Nonetheless, EFA models were run comparing a range of 1 to 5 factor solutions, and the 3-factor solution appeared optimal as it resulted in acceptable fit and improved residual variances over models with fewer factors while minimizing cross-loading and factors with less than 3 indicators compared to models with more than 3 factors.

With the 3-factor solution established, examination of factor loadings indicated that the item on satisfaction with how often respondents go out did not have substantial loadings on any factor (all loadings were below 0.17), so the item was removed. Subsequently, the item on going out for social activities met the minimum 0.32 factor loading criteria for inclusion and loaded highest on factor 2, but it cross-loaded on factor 1 and was also removed. The final factor structure thus contained 13 items distributed among the 3 factors (Table 3.2). Based on its emphasis on involvement in neighborhood and organized group activities, the first factor was labeled "community engagement." The second factor represented items related to informal social interaction and was named "sociability." Finally, the third factor included the items assessing general and specific trustworthiness of others and was referred to as "trust." Eigenvalues for the 3 factors in the final EFA model were 4.02, 2.59, and 1.57 and fit statistics were χ^2=561.10 (df: 42, $p<0.001$), RMSEA=0.054, and SRMR=0.047. Items and their factor loadings along with correlations between factors are presented in Table 3.2. Item loadings for each iteration of the EFA after item removal along with item residual variances and the structure matrix

for the final EFA are included in the Appendix N. CFA of the final factor structure also suggested that the model was appropriate based on most fit statistics (RMSEA=0.057 (95% CI: 0.054-0.061), CFI=0.93, and TLI=0.92), apart from the χ^2 (911.99 df=62, p<0.001). All model parameter estimates were significant except for the correlation between factor 2 (sociability) and factor 3 (trust), which was only borderline significant. Standardized CFA results are also displayed in Table 3.2.

In the South Africa data, 121 participants had missing or unusable responses to all potential social capital indicators and 1 was missing cluster and stratification information, resulting in a sample size of 3,026 for the EFA. EFA of the sample correlation matrix resulted in 6 eigenvalues exceeding one. However, in the scree plot, 4 data points appeared to precede the bend, and in parallel analysis, 4 eigenvalues were greater than those obtained from random data (Appendix M). EFA models were run comparing 1 to 6 factor solutions, and the 3-factor solution demonstrated improved fit statistics and residual variances compared to the 1- and 2-factor models. It also did not have cross-loading compared to the 2- and 4-factor solutions, and it contained at least 3 items per factor unlike higher factor models. Moreover, the 5- and 6- factor models had items with factor loadings greater than one and/or negative residual variances, suggesting over-factoring. As a result, a 3-factor solution was also selected for the South Africa data.

Similar to the Ghana results, the 3 factors represented community engagement, sociability, and trust (Table 3.2). However, there were slight differences in the corresponding items. As in Ghana, the item on adequacy of outings had very low loadings on all factors and was removed. Though the items on general trust and having a confidant also loaded highest on the trust factor, their loadings were in the 0.2 range and

did not meet the minimum inclusion criteria, so they were likewise removed. Similarly, the item on attending religious activities loaded highest on sociability, as in Ghana, but did not meet the cutoff and showed some degree of cross-loading and was subsequently dropped. Rather, the item on going out for social activities loaded more strongly in the South Africa data than Ghana and was retained in the sociability factor. Thus, the final 3-factor solution contained 11 items. Final eigenvalues were 3.43, 2.33, and 1.57 and fit statistics for the EFA model were χ^2=411.12 (df=25, p<0.001), RMSEA=0.071, and SRMR=0.043. CFA verifying this solution demonstrated good model fit, with χ^2 of 550.97 (df=41, p<0.001), RMSEA=0.064 (95% CI: 0.059-0.069), CFI=0.95, and TLI=0.94. EFA and CFA factor loadings and factor correlations are presented in Table 3.2.

Structural Equation Modeling

A diagram of the general SEM for Ghana and South Africa with the final CFA and depression as the outcome is illustrated in Figure 3.1. Preliminary assessments of identifiability of the model demonstrated that the overall SEM met basic model identification rules (Appendix O). In Ghana, 14 participants were missing data on all variables, resulting in a sample size of 4,195 for the SEM. Fit statistics for the model were acceptable (χ^2=1058.50 (df=72, p<0.001), RMSEA=0.057 (95% CI: 0.054-0.060), CFI=0.92, TLI=0.90). Model results indicated that increases in the community engagement factor score significantly decreased the predicted probability of depression (standardized estimate: -0.14, p=0.005) while increases in the sociability and trust factors significantly increased the predicted probability of depression (standardized estimates:

0.18 and 0.29, respectively, $p<0.001$). As in the CFA results, community engagement and sociability were significantly associated with each other, as was community engagement and trust; however, sociability and trust were only minimally correlated and borderline significant. Unstandardized and standardized model results are presented in Table 3.3.

Age and sex were then added to the model as covariates to adjust for their effects on depression. Because of a clear temporal order with age and sex preceding the latent social capital variables rather than resulting from them, directed paths from these demographic variables to the factors were also included while still allowing the factor residual errors to correlate with each other. The addition of age and sex to the model attenuated the relationship between community engagement and depression such that it was no longer significant ($p=0.31$); however, sociability and trust remained positively and significantly linked to depression. Additionally, female sex had a significant direct effect increasing the predicted probability of depression, and female sex led to lower levels of all three social capital dimensions, though this was only significant at the 10% alpha level for sociability. Increased age also significantly increased the probability of depression directly and was linked to significantly lower levels of community engagement and sociability but did not have a significant effect on trust. Model fit statistics were reasonable, with a χ^2 of 1216.74 (df=92, $p<0.001$), RMSEA=0.054 (95% CI: 0.051-0.057), CFI=0.91, and TLI=0.89.

In the South Africa sample, 103 participants were missing data on all variables and 1 lacked information on survey design statistics, leading to a sample size of 3,044 for the structural equation models. Model fit was also acceptable, $\chi^2=573.67$ (df: 49, $p<0.001$), RMSEA=0.059 (95% CI: 0.055-0.064), CFI=0.95, TLI=0.94. Results indicated

that community engagement was not significantly associated with depression (p=0.904), though the estimate was slightly negative. Sociability was also only significant at the 10% alpha level but as a positive predictor of depression (standardized estimate: 0.082, p=0.093); however increased trust significantly reduced the predicted probability of depression (standardized estimate: -0.132, p<0.001). Community engagement and sociability correlated positively with each other, as did trust and sociability. However, trust and community engagement were not significantly related. After adjusting for age and sex, trust remained significant and negatively associated with depression while the other factors remained non-significant. Additionally, increasing age directly decreased the predicted probability of depression while sex had no significant direct effect on depression. Female sex and increasing age also led to significantly lower levels of community engagement while age significantly decreased sociability but sex had no effect. Trust was not significantly affected by sex or age. Model fit indices had the following values: χ^2=645.28 (df: 65, p<0.001); RMSEA=0.054 (95% CI: 0.050-0.058); CFI=0.95, and TLI=0.93. Parameter estimates for South Africa SEM models are presented in Table 3.4.

Analysis of Urban-Rural Differences

The initial test to establish configural invariance of the measurement model between urban and rural Ghanaian residents—which assumes the latent factors are each represented by the same items but allows factor loadings and thresholds for item categories to vary—suggested acceptable fit (Table 3.5). The scalar model testing strong measurement invariance with factor loadings and thresholds constrained to be equal

between the urban and rural groups was not supported as the χ^2 difference test was significant (181.67, df=40, p<0.001). This indicates that constraining loadings to be the same for urban and rural residents was significantly worse than allowing them to vary. Subsequently, partial measurement invariance models were run successively freeing indicators with large differences in unstandardized loadings or large modification indices. After allowing 5 of the 13 item loadings and their thresholds to vary (club, lead, relig, revtrstw, and support) the χ^2 difference test reached non-significance (25.84, df=23, p=0.31). Additional model fit parameters are in Table 5.

The partial measurement invariance model was used in structural models to assess whether the paths between the three social capital latent variables and depression differed, suggesting effect modification by urbanicity. Results of these models indicated that constraining the structural paths to be equal was not appreciably worse than allowing them to vary between urban and rural groups, implying that structural invariance could be assumed (χ^2 difference test: 3.61, df=3, p=0.31). The social capital-depression paths for both the constrained and unconstrained models mirrored the overall SEM results reported above. However, the stratified analysis showed that the correlation between trust and sociability, which was smallest in both groups, was not significant in the rural group (p=0.85) but reached significance in the urban group (p=0.02). Additionally, based on the unconstrained model that allowed for group differences in the structural paths, the path for factor 1 (community engagement) to depression did not reach significance in the rural group (p=0.30), so the overall significance in this association was primarily driven by the urban group (Table 3.6).

In the age- and sex- adjusted version of the test for structural invariance, constraining the social capital-depression relationship to be the same in urban and rural groups likewise did not perform significantly worse than allowing them to differ between the groups (χ^2difference test: 2.92, df=3, p=0.40). As in the SEM results reported previously, in both unconstrained and constrained versions of the model community engagement was no longer significantly associated with depression for either urban or rural residents. However, based on the unconstrained model, sociability and trust were again significant positive predictors of depression in the rural group while sociability trended towards significance in the urban group (p=0.052). An additional difference revealed in the stratified output was that female sex significantly decreased trust in the rural sample but was only borderline significant in the urban group (p=0.072). Additionally, female sex was a significant predictor of lower sociability in the urban group but had no effect on sociability in the rural group, and age significantly increased trust in the urban group but was not significant in the rural group.

All CFA and SEM models also indicated a significantly lower mean for the three social capital latent factors among urban residents compared to rural residents (Table 3.6). Standardized versions of these differences in means for the unadjusted and adjusted models, respectively, were -0.28 and -0.22 for community engagement, -0.24 and -0.19 for sociability, and -0.38 and -0.40 for trust. These approximate Cohen's *d* effect sizes and their values represent small to moderate average decreases in levels of social capital in urban compared to rural residents. The translation into effect size for trust, however, is likely a conservative estimate since it is standardized by only the urban group's variance, which was substantially larger than the rural variance for that factor.

In South Africa, the configural model allowing factor loadings and thresholds to vary between groups indicated good model fit (Table 3.5). The scalar model constraining factor loadings and thresholds to be equal between the urban and rural groups did not support measurement invariance, with a significant value for the χ^2 difference test (83.82, df=38, $p<0.001$). Models were then run to test partial measurement invariance, and after allowing 2 of the 11 item loadings (meet and lead) and their thresholds to vary, the χ^2 difference test lost significance (34.99, df=30, $p=0.24$), suggesting this partially constrained measurement model was no worse than the unconstrained model.

Using the partially invariant measurement model to assess urban-rural differences in the relationships between the three social capital domains and depression, the SEM allowing the paths to differ between groups resulted in acceptable fit (Table 3.5). In the rural group, both community engagement and trust were negatively related to depression while sociability was in the positive direction. None reached statistical significance, however, but trust was significant at the 10% level ($p=0.072$) while the p-value for community engagement suggested essentially no effect. In the urban group, community engagement and sociability had positive parameter estimates, although neither was significant. Trust significantly decreased the predicted probability of depression. In both groups, there were significant correlations between community engagement and sociability as well as between trust and sociability, but community engagement and trust were not associated in the rural group and had only a borderline significant correlation ($p=0.090$) in the urban group. The constrained version of the model also demonstrated good fit (Table 3.5) and suggested that trust significantly decreased the predicted probability of depression while community engagement and sociability had no significant

effect. The χ^2 difference test between the two models was not significant (0.97, df=3, p=0.8080), indicating that there was no substantial difference in the association between social capital and depression between urban and rural residents.

After accounting for age and sex, in the rural group the factors maintained the same pattern of relationships with depression as before, with trust being nearly significant (p=0.052). Neither sex nor age was a significant predictor of depression directly. Age significantly reduced the probability of community engagement and sociability but had no significant effect on trust. Sex was not significantly related to any of the social capital dimensions. Among urban residents, the relationships between social capital dimensions and depression were likewise similar, with trust significantly reducing the predicted probability of depression. Unlike in the rural case, age did reach significance as a direct predictor of depression, reducing the probability of the condition as it increased. Additionally, female sex and increasing age significantly reduced community engagement, and age also significantly reduced sociability. But neither variable had an effect on trust. When the structural paths between the social capital factors and depression were fixed to be equal in both groups, the outcome mirrored that in the unadjusted model and was not significantly worse than the unconstrained model (χ^2 difference test=1.11, df=3, p=0.78). Fit statistics for all models used to test invariance are contained in Table 3.5 and parameter estimates for the structural models comparing urban and rural South Africans are presented in Table 3.7.

All models for South Africa suggested that the mean for the latent community engagement factor was significantly lower in urban residents as compared to rural residents while urban residents scored significantly higher on average for the sociability

and trust latent factors than their rural counterparts. However, after accounting for age and sex, the mean level of community engagement for an average aged urban man was only borderline significant (p=0.085). Respectively, the Cohen's *d* equivalent of the unadjusted and adjusted mean differences between urban and rural residents in the dimensions of social capital were -0.33 and -0.20 for community engagement, 0.30 and 0.27 for sociability, and 0.17 and 0.21 for trust. Thus, mean differences in dimensions of social capital between the two groups are not large, but the community engagement estimate is likely conservative given the much larger variance in the urban compared to the rural sample for that factor.

Discussion

Dimensions of Social Capital

The results of the exploratory factor analysis revealed that the selected social capital items were distributed into three dimensions in both countries, namely community engagement, sociability, and trust. Although there were some differences in the composition of these three latent constructs between countries, the included items had their largest loadings on the same factors across the two countries regardless of whether the item met the criteria for retention. This provides evidence in support of the validity of the identified dimensions and a common core structure between the two countries. The dimensions extracted from this analysis also mirror the groupings of social action, sociability, and trust and solidarity, respectively, used by Ramlagan et al.[40] for the selected SAGE survey items, though the categories in their study were not empirically derived. Interestingly, in both countries, socializing with coworkers outside of work was

more strongly linked to factor 1, community engagement, than factor 2, sociability, which differs from the classification assumed by Ramlagan and colleagues[40] and was contrary to expectations.

Additionally, although significant correlations were expected between all three factors, results for Ghana demonstrated that trust and sociability were not significantly correlated. By contrast, in South Africa, trust and sociability were correlated while trust and community engagement were not meaningfully correlated. The associations between sociability and community engagement in both countries is understandable as both represent forms of social activity and may therefore both be influenced by other factors, such as physical functioning or time availability.[41,42] Indeed, evidence of their positive correlation has been demonstrated,[43-45] though this is not universal and in some cases they have been shown to replace each other and negatively correlate.[44] Likewise, as Putnam argued, increased civic engagement builds trust and vice versa,[46] and trust and aspects of community involvement, such as group membership, have been shown to be positively correlated.[47-49] It is surprising, therefore, that this was not the case in South Africa. Trust in South Africa—which was also shown to have the lowest levels in an analysis of all six countries participating in SAGE[50]—could perhaps be more related to other factors, such as very high rates of crime and violence in the nation,[51] which have been linked to trust.[52] Although longitudinal evidence from Europe suggested that social participation results from and does not produce trust,[49] a study from one South African province instead indicated that trust did not predict future involvement in groups—apart from financial groups—but group membership did predict trust at a later time point.[53] Therefore, the cross-sectional timing of the current study may affect the strength of the correlation if

there is a substantial lag. Moreover, the nature of formal participation such as group membership may also influence trust, and some research has found that organizations that are disconnected from other groups do not have the same degree of positive association with trust.[54]

One would also expect informal social activity to correlate with trust through the sheer exposure to other people, but perhaps the lack of a correlation in the Ghana case is due to the fact that the sociability survey items involve personal contacts while many of the targets in the trust questions are more general. Thus, the distinction between "thick" trust of close contacts and "thin" trust of people in general[46] may explain the absence of a correlation, and research has demonstrated a difference in the strength of association between social network measures and specific versus general trust, though both were significant.[47]

Social Capital and Depression

Although it was hypothesized that the social capital factors would be significant and negatively associated with depression, findings suggesting sociability and trust were actually positively associated with depression in the Ghana sample contradicted this. Cross-tabulations between individual social capital items and depression prior to the analysis (Appendix J) are in general agreement with these results, and an analysis of Ghana SAGE data by Ayernor[55] similarly demonstrated that those who had daily or weekly interaction with social ties had significantly greater odds of the depressive symptoms of sadness and/or loss of interest than those with less frequent interaction.

Likewise, although the relationship between trust and depression fit expectations in the South Africa sample, neither community engagement nor sociability were significant and sociability was in the positive direction. These findings also reflect patterns in item-level cross-tabulations with depression (Appendix J). Moreover, in the Ramlagan et al.[40] analysis of South Africa SAGE data, of the 3 social capital components corresponding to the factors in the present analysis, only the trust and solidarity component was significantly negatively associated with depressive symptoms. And an analysis by Peltzer and Phaswana-Mafuya[56] that created an index from nine items corresponding to those in factors 1 and 2 also found no significant difference in index scores based on depression status. Thus, the findings of the current study are corroborated by other analyses of SAGE data and do not appear to be erroneous.

Both cross-sectional and longitudinal studies in older adults from numerous countries have found that aspects of social capital, such as social engagement, network diversity and size, social interaction, trust, and social support are linked to a lower likelihood of depression and related outcomes.[10-13,48,57-62] One potential reason for some of the unexpected positive and non-significant relationships with depression in the present analysis could be related to the data's cross-sectional nature. Thus, even though models attempted to estimate directed relationships, temporality cannot be verified and they may be capturing other potentially reverse-causal relationships. However, most research on social relationships and depression has also been cross-sectional;[8] and in comparing cross-sectional and longitudinal studies of older adults on the topic, Schwarzbach et al.[7] found little difference in findings for most facets of social relationships except for measures of social integration, which were more consistent in

longitudinal studies but often failed to demonstrate an effect cross-sectionally. They attributed this to a potential stronger preventive role of social activities but little effect among the depressed.

As the review indicates, the beneficial role of social capital in relation to depression is not always supported empirically, and in particular, there may be a strong dependence on the type of social capital assessed. In general, the strongest evidence on social relationships and depression seems to come from measures of social support, and more specifically, perceived support as compared to received support.[8] Yet, only 1 item in the SAGE survey assessed what could be viewed as perceived emotional support, which may also play a role in the observed results. Likewise, the review by Schwarzbach et al.[7] concluded that qualitative aspects of social relations were more consistently linked to depression than quantitative aspects of social networks, and the De Silva et al.[3] review also found stronger evidence for cognitive forms of social capital (i.e., trust, sense of belonging) while evidence for structural social capital (i.e., social participation and networks) was less decisive. This finding of stronger effects of cognitive social capital was also confirmed by Fujiwara and Kawachi[63] in their follow-up study on contextual social capital and depression in US adults; and Cao et al.[64] found significant associations with depression for cognitive social capital, social support, and social network characteristics but not for group membership in adjusted models using older Chinese adults. An analysis of national data from South Africa also found a negative association between social trust and depression but no effect of civic participation.[65] These findings lend support to the results of the present study particularly for South Africa in which trust

had the strongest and only significant effect estimate overall. And although in Ghana the direction of effect was reversed, trust was also most strongly linked to depression.

In terms of the positive relationship observed between sociability and depression, depressed individuals are known to become more withdrawn and decrease social interaction[66-68] rather than more social as the current analysis suggests. Yet, given the mixed results linking structural social capital and common mental disorders in the review by de Silva and colleagues,[3] the authors posit that they could be influenced by the fact that individuals suffering from mental illness may also be less likely to be actively or regularly working and thus be more available to participate in social activities. These competing forces of withdrawal and availability may therefore muddle the effects. A related explanation could also be that depressed individuals may increase their informal social interactions as a form of overcompensation in an attempt to cope with, distract from, or self-medicate their illness.[69] And perhaps this may also be more relevant in lower income country contexts where professional treatment may not be widely available or may be stigmatized.[70,71] Conversely, close social contacts of depressed individuals could potentially choose to visit and engage with the afflicted persons more frequently out of concern for their well-being. Evidence for greater involvement and support from social ties in terms of self-rated health has been demonstrated among those in poor health.[45]

Additionally, some research suggests that if excessive or within the context of constrained resources, social capital—particularly the bonding variety amongst people of similar backgrounds and statuses—can be burdensome and detrimental for mental health;[1,72] and Mitchell and Grady[73] found significantly greater mental distress with

increased social participation in the context of a poor, racially segregated southern US community—though they mostly assessed involvement in formal groups. And de Silva et al. also observed higher levels of depression and anxiety among individuals with greater community participation and received support in some of the LMICs in their analysis.[69] Thus, it is possible that the degree of sociability may exceed the desired level in older adults in this study—given the LMIC context where there still remains a high degree of poverty and hardship—but may be carried out as a result of personal or cultural obligations and expectations. In both the Ghana and South Africa samples, depressed individuals were less satisfied with how much they got out, but, at least in Ghana, this appeared to be mostly due to a desire to go out more than less (results not shown). Nonetheless, determining how satisfaction relates to actual reported levels of participation would be a necessary next step to determine whether appraisals match reported activity.

The positive relationship between trust and depression in Ghana is also difficult to explain. One potential reason could relate to discrepancies between personal feelings of trust and a sense of trust at the contextual level. Low general trust has been observed on the aggregate level among collectivist cultures that emphasize strong in-group ties and have a high degree of familism, or duty and allegiance to kin relations.[74] This leads to a small radius of trust beyond the close family ties.[74] As a result, individuals with high trust may be maladapted to a low-trust environment and thus more likely to be depressed. For example, research does suggest that mismatches between personal and societal values can negatively impact mental and physical health.[75] However, South Africans had the lowest levels of trust of the 6 SAGE countries (26-32% for men and women), while Ghana

ranked in the middle (59-63%),[50] which does not seem to support the notion of a cross-level interaction in which discordance between individual- and contextual- level trust is driving the results in Ghana. Another possibility could be biased or untruthful reporting, namely that depressed individuals in Ghana inaccurately report high degrees of trust. However, another study did find a positive correlation between trust and mortality among older Japanese women,[76] thus negative effects of trust could be possible.

The direct relationships between the covariates, age and sex, and depression in the two country samples mirrored the findings in the previous papers (see Manuscripts 1 and 2) as well as other studies,[56,77,78] with a significantly higher likelihood of depression among women in Ghana but not South Africa and significantly increasing and decreasing probabilities of depression, respectively, with age in Ghana and South Africa. In both countries, age significantly decreased the probability of community engagement and sociability but did not have any significant effects on trust. This conforms with expectations, as physical functioning typically decreases with age in older adults, as does one's network, and would therefore limit social activity and interaction.[41,42] Trust, on the other hand, is perception-based and would be unaffected by declining functionality. However, some research suggests that older adults can maintain high levels of engagement, and increases in certain forms of formal social participation and community involvement have even been observed with age among them.[42] It is also interesting to note that in this analysis the parameter estimates and p-values for the structural paths between age and trust were almost identical in both countries (unstandardized estimate: 0.002, p=0.31), though because the factor structure slightly differs, direct comparisons are limited.

In both countries, being female significantly decreased the likelihood of community engagement. However, there was no significant sex difference in informal social participation as represented by the sociability factor, though in Ghana it was trending towards significance (p=0.094) in the lower direction for females. This is supported by literature which suggests that men are typically more involved in formal social participation[41] although women have been shown to participate more informally and have larger and more close-knit social networks as well as more frequent contact with network ties than men.[41,42,61] Van Groenou et al.[41] suggest that gender differences in resources, such as education, may account for differences in formal and informal participation between men and women. Additionally, lower formal participation in women could potentially be related to cultural norms and gender roles surrounding who may be expected or permitted to participate in community affairs (i.e., meeting with leaders or attending community meetings), and this may also limit women's ability to engage formally, as well as their greater likelihood to be home-bound due to household duties.[79] Perhaps a bit surprising was that trust was significantly lower in Ghanaian women but not in South Africa. Given greater perceived or actual vulnerability in women compared to men, a finding of lower trust is understandable.[80] Nonetheless, some studies have demonstrated that women are more trusting than men[81] and others have found no difference,[54] which is consistent with the result for South Africa.

Urban-Rural Differences in Social Capital and Depression

Results indicated that the measurement of the three social capital dimensions differs between urban and rural residents in both countries, though to a greater extent in

Ghana. Specifically, items pertaining to meeting with a community leader or participating in organizations (factor 1: community engagement), attending religious services (factor 2: sociability), and trusting coworkers and having a confidant (factor 3: trust) differed between urban and rural residents in Ghana while in South Africa items on attending public meetings and meeting with a community leader (factor 1) differed most. Differences in factor loadings and/or thresholds between groups suggest that the interpretation of the dimensions themselves and of the fundamental levels of the items used to measure them are not exactly the same or carry somewhat different meanings between groups. However, all factors did have at least two item loadings and thresholds fixed between the two groups, which would enable drawing legitimate conclusions on group differences in the means of factors.[34]

After freeing equality constraints of the disparate items in the SEM, slight differences in the nature of the relationship between dimensions of social capital and depression did emerge between urban and rural residents in the two countries, but they were not substantial enough to suggest true effect modification. Based on the stratified results, it appeared that among urban residents in Ghana, there was a stronger protective effect of community engagement on depression but a weaker promotive effect of sociability and minimal differences for trust, with slight changes after the addition of covariates although the differences remained non-significant. In South Africa, there appeared to be a slightly stronger protective effect of trust on depression and a weaker promotive effect of sociability on depression among urban residents, though these effects were not significant. The results did not support the hypothesized weaker protective effects of social capital on depression and findings from other studies previously

mentioned.[21-23] In terms of other outcomes, however, varying results for effect modification by urbanicity have been observed; for instance stronger positive associations between trust and self-rated health were reported in Finnish rural areas compared to urban and suburban areas,[82] though the interaction effects were not significant; but in a study combining social trust and social participation, the significant effects on self-rated health were only sustained in the urban areas but not other areas.[83]

Despite the lack of meaningful urban-rural differences in the effects of social capital on depression, significant urban-rural differences did emerge in the means of the latent factors. In particular, average levels of community engagement, sociability, and trust were significantly lower in urban Ghanaian older adults compared to rural Ghanaian older adults. However, in South Africa, community engagement factor scores were significantly lower among urban residents—but becoming only borderline significant in the covariate model—while sociability and trust were significantly higher on average in urban older adults. These model results are also supported in the item-level exploratory data analysis where cross-tabulations showed that rural residents appeared more active in their communities and social interactions as well as more trusting and likely to have a confidant in the Ghana data. On the other hand, South African urban residents appeared to be less socially integrated than rural residents in terms of community activities but equally if not more active for all of the sociability items as well as having a confidant and trusting strangers (Appendix J).

The findings of lower social capital in Ghanaian urban residents could be seen as consistent with assumptions that urban residents are generally more lacking in social connections,[84] which is supported by some studies that have demonstrated less social

support among urban dwellers (Kim et al., 2004; Paykel, Abbott, Jenkins, Brugha, & Meltzer, 2003; Stickley et al., 2015),[22,23,85] a greater likelihood of living alone,[86] as well as lower levels of social trust at the ecological level.[86,87]

Nonetheless, empirical evidence of deteriorating social ties in urban settings has also been inconsistent. Some research has shown that the number of ties in urban environments is no different from, if not more than, in rural areas.[88] Levels of participation in organizations and social activities also have not varied significantly across area of residence in some studies.[86,89] And people in desolate rural areas are also believed to be at risk of social isolation.[88] Some scholars conclude that the nature and composition rather than the amount of social relationships may differ between urban and rural areas, with urban dwellers having more fragmented networks and more social ties and support from friends as opposed to family members, as well as less familiarity with and social support from neighbors.[84,86,87,90] Therefore, findings of no difference or higher average levels of dimensions of social capital in South Africa can also be viewed as consistent with the literature.

As previously mentioned, the results presented and discussed here are unweighted, but the above analyses were also run applying the weights (Appendix Q), yielding similar results for the Ghana data in terms of factor structure, relationships between social capital and depression, and urban-rural differences in the relationships. In South Africa, there were slight differences in the weighted version, particularly socializing with coworkers failed to meet the item retention criteria in the EFA, and the SEM revealed that although the direction of effects between social capital dimensions and depression was the same, none of the path estimates were significant. Additionally,

the multi-group analysis indicated that urbanicity did significantly modify the association between social capital and depression once age and sex were accounted for in the model.

Strengths and Limitations

A limitation that is important to acknowledge is that the structural model analyzed here is a simplification and does not represent the totality of relationships between dimensions of social capital and depression. For example, reciprocal causation has been documented between social interaction and support and depression,[68,91] and the association between social relationships, and in particular social support, and depression is known to function not only directly but also through a buffering mechanism by reducing the impact of stress.[72,92] However, most of the survey items dealt not with social support but forms of social integration such as participation, and this has been shown to have direct effects on health outcomes rather than operate through stress,[92] so the stress-buffering mechanism may be less applicable to this study. Additionally, many other personal characteristics (described above) have an effect on depression and vice versa, and these were also not included in the models. The decision to exclude these additional covariates and bidirectional relationships was made in the interest of reducing complexity in the SEM and facilitating interpretation, as well as ensuring identifiability of the model.

The points discussed above raise additional limitations, namely the limited measures included in the survey for assessing factors such as social support, and, as described earlier, the cross-sectional survey design, which prevents clear ascertainment of the direction of modeled relationships. Furthermore, traditional CFA does not allow for items to load on more than one factor, which is a strong assumption particularly for

psychosocial research and may also negatively impact model fit.[93] New approaches such as exploratory SEM that allow for cross-loading are increasingly being utilized and could therefore be a useful alternative.[93]

Nonetheless, models in this analysis generally showed acceptable fit, which provides some degree of confidence in the results and is a strength of the study. And although χ^2 tests were still significant in all cases, this test statistic is easily affected by sample size and thus cannot be interpreted in isolation given that large samples will tend towards significance.[33,34]

Another strength of the study is the use of a data-driven approach to identify dimensions of social capital through EFA. This allowed for determining population-specific relationships between indicators of social capital rather than applying a standard dimensional structure that may be inappropriate for the data. Furthermore, the use of SEM for data analysis was particularly important. The usual approach to an analysis with multiple indicators of a measure is to sum items to produce overall scores. However, this assumes each item has equal weight, which may not be warranted. It also assumes the item responses can be taken as the true values that are measured exactly without error.[36] SEM has the advantage of simultaneously modeling the relationship between items and their underlying factors as well as the main relationships of interest, thus accounting for measurement error. Moreover, it has an advantage over modeling relationships for each of the items separately in that it reduces the analytic burden if there are numerous items and simplifies the synthesis of results.

Conclusions

In summary, this analysis provided insight into the structure of social capital and its relationship to depression for urban and rural older adults in understudied African settings. Results of this study suggested that a three-factor solution was favored in the EFA, covering the domains of community engagement, sociability, and trust. Results further demonstrated that the distributions of dimensions of social capital differ between urban and rural residents in Ghana and South Africa even though substantial differences in the magnitude or strength of the association between social capital and depression were not observed. In addition, the relationships between social capital and depression varied depending on the country. Based on the results, it can therefore be assumed that the relationship between social capital and depression is similar within each nation as a whole but not across the two countries, even though the composition of social capital may have some within-country differences depending on urban-rural residence.

The implications of the study results are complex, given that the relationships between social capital and depression were not found to be solely beneficial. If these findings hold true, efforts to increase community engagement among older adults, particularly in urban areas, may still have modest positive effects on mental health in both countries; but lower levels of informal social participation among urban compared to rural older adults may actually be protective in terms of depression in Ghana; and easing the burden of informal social activity in South African urban residents in particular may also have positive outcomes for depression. Alternatively, if depressed individuals are choosing to engage more informally, this might provide opportunities for trying to capitalize on this activity to maximize the therapeutic potential of such interactions or

link afflicted individuals to care. Additionally, promoting trust or identifying and reducing barriers to it may be important in preventing depression in South Africa, with a particular emphasis on trust in rural areas where it is more lacking. However, this may not be the case for older Ghanaian adults, and determining how to transform trust into an asset would be necessary in the Ghanaian older adult context before attempts at enhancing it can be made.

Further analyses are needed to identify which particular elements of the dimensions of social capital may be driving the results as well as to establish possible interactions with other factors, such as poverty or wealth and area-level social capital. Future research would also benefit from including additional measures of social capital to determine whether relationships are consistent, and supplementation with qualitative methods could also assist in understanding contextual differences and identifying other factors influencing these findings.

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Table 3.1: List of Survey Items Considered for the Social Capital Measures

Survey Item [variable name]	Scale
How often in the last 12 months have you…	
Attended any public meeting in which there was discussion of local or school affairs [meet]	1 (never) to 5 (daily)
Met personally with someone you consider to be a community leader [lead]	1 (never) to 5 (daily)
Attended any group, club, society, union or organizational meeting [club]	1 (never) to 5 (daily)
Worked with other people in your neighborhood to fix or improve something [neigh]	1 (never) to 5 (daily)
Had friends over to your home [guest]	1 (never) to 5 (daily)
Been in the home of someone who lives in a different neighborhood than you do or had them in your home [visit]	1 (never) to 5 (daily)
Socialized with coworkers outside of work? [cowrk]	1 (never) to 5 (daily)
Attended religious services (not including weddings and funerals) [relig]	1 (never) to 5 (daily)
Gotten out of the house/your dwelling to attend social meetings, activities, programs or events or to visit friends or relatives [out]	1 (never) to 5 (daily)
Would you like to go out more often or are you satisfied with how much you get out of the house [adequate]	1 (more often) to 3 (not more often)
Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people [trust]	Can be trusted/ can't be too careful
Do you have someone you can trust and confide in [support]	Yes/no
First think about people in your neighborhood. Generally speaking, would you say that you can trust them [revtrstn]	1 (very great extent) to 5 (very small extent)*
Now think about people whom you work with. Generally speaking, would you say that you can trust them [revtrstw]	1 (very great extent) to 5 (very small extent)*
And how about strangers? Generally speaking, would you say that you can trust them? [revtrsts]	1 (very great extent) to 5 (very small extent)*

*coding was reversed to mirror direction of other items

Table 3.2: Factor Loadings of Social Capital Dimensions by Country

	Ghana						South Africa					
	Final EFA			CFA			Final EFA			CFA		
Item	**Factor 1 (CE)**	**Factor 2 (S)**	**Factor 3 (T)**	**Factor 1 (CE)**	**Factor 2 (S)**	**Factor 3 (T)**	**Factor 1 (CE)**	**Factor 2 (S)**	**Factor 3 (T)**	**Factor 1 (CE)**	**Factor 2 (S)**	**Factor 3 (T)**
Meet	0.810	-0.183	-0.024	0.674			0.869	-0.144	-0.003	0.812		
Lead	0.656	0.090	0.051	0.725			0.863	-0.131	-0.002	0.811		
Club	0.677	0.103	-0.015	0.724			0.745	0.034	-0.003	0.756		
Neigh	0.847	-0.012	0.007	0.838			0.668	0.103	0.010	0.712		
Guest	-0.019	0.831	0.046		0.863		-0.160	0.936	-0.033		0.797	
Visit	-0.030	0.920	-0.045		0.850		-0.023	0.786	-0.018		0.818	
Cowrk	0.466	0.276	-0.141	0.567			0.391	0.242	-0.054	0.515		
Relig	0.164	0.320	0.019		0.455		-	-	-	-	-	-
Out	-	-	-	-	-	-	0.164	0.456	0.101		0.585	
Trust	0.051	0.135	0.630			0.675	-	-	-	-	-	-
Support	-0.068	0.107	0.535			0.517	-	-	-	-	-	-
Revtrstn	-0.157	0.128	0.900			0.824	0.017	-0.057	0.805			0.786
Revtrstw	0.068	-0.164	0.884			0.898	-0.012	-0.013	0.940			0.941
Revtrsts	0.255	-0.195	0.547			0.629	-0.018	0.060	0.622			0.640
Factor Correlations												
CE with S	0.393			0.464			0.349			0.328		
CE with T	0.263			0.268			0.068			0.045		
S with T	0.065			0.059			0.251			0.243		

Reported CFA parameter estimates are standardized with factor variances fixed to 1 for ease of comparison to EFA results
CE: Community Engagement; S: Sociability; T: Trust

Table 3.3: Unstandardized and Standardized Structural Equation Model Results for Ghana[a]

	Unadjusted			Adjusted		
	Estimate	**Std Error**	**p-value**	**Estimate**	**Std Error**	**p-value**
Factor Loadings						
F1 (Community Engagement) BY						
Neigh	1.000 (0.839)	0.000 (0.012)	-- (<0.001)	1.000 (0.888)	0.000 (0.015)	-- (<0.001)
Meet	0.803 (0.674)	0.022 (0.016)	<0.001	0.790 (0.701)	0.023 (0.019)	<0.001
Lead	0.864 (0.725)	0.018 (0.013)	<0.001	0.849 (0.754)	0.019 (0.014)	<0.001
Club	0.864 (0.724)	0.022 (0.016)	<0.001	0.848 (0.753)	0.022 (0.018)	<0.001
Cowrk	0.676 (0.567)	0.025 (0.020)	<0.001	0.646 (0.573)	0.025 (0.021)	<0.001
F2 (Sociability) BY						
Guest	1.000 (0.872)	0.000 (0.018)	-- (<0.001)	1.000 (0.885)	0.000 (0.018)	-- (<0.001)
Visit	0.965 (0.841)	0.037 (0.017)	<0.001	0.948 (0.839)	0.037 (0.018)	<0.001
Relig	0.518 (0.452)	0.029 (0.024)	<0.001	0.507 (0.448)	0.028 (0.024)	<0.001
F3 (Trust) BY						
Revtrstw	1.000 (0.901)	0.000 (0.008)	-- (<0.001)	1.000 (0.903)	0.000 (0.008)	-- (<0.001)
Revtrstn	0.910 (0.820)	0.015 (0.010)	<0.001	0.912 (0.824)	0.015 (0.011)	<0.001
Revtrsts	0.702 (0.633)	0.018 (0.016)	<0.001	0.702 (0.633)	0.018 (0.016)	<0.001
Trust	0.747 (0.673)	0.023 (0.021)	<0.001	0.748 (0.675)	0.023 (0.021)	<0.001
Support	0.567 (0.511)	0.033 (0.030)	<0.001	0.565 (0.510)	0.033 (0.030)	<0.001
Factor Variances/Covariances [b]						
CE WITH S	0.340 (0.464)	0.019 (0.023)	<0.001	0.333 (0.454)	0.020 (0.024)	<0.001
CE WITH T	0.203 (0.269)	0.022 (0.028)	<0.001	0.204 (0.273)	0.022 (0.029)	<0.001
S WITH T	0.046 (0.059)	0.024 (0.031)	0.057	0.047 (0.059)	0.025 (0.031)	0.057 (0.056)
CE VARIANCE	0.704 (1.000)	0.020 (0.000)	<0.001 --	0.693 (0.879)	0.021 (0.013)	<0.001
S VARIANCE	0.760 (1.000)	0.031 (0.000)	<0.001 --	0.775 (0.990)	0.031 (0.004)	<0.001
T VARIANCE	0.813 (1.000)	0.015 (0.000)	<0.001 --	0.810 (0.994)	0.015 (0.003)	<0.001
Predictors						
CE→DEP	-0.163 (-0.137)	0.058 (0.049)	0.005	-0.059 (-0.052)	0.059 (0.052)	0.315 (0.314)

	Unadjusted			Adjusted		
	Estimate	**Std Error**	**p-value**	**Estimate**	**Std Error**	**p-value**
S→DEP	0.200 (0.175)	0.046 (0.040)	<0.001	*0.170 (0.151)*	*0.170 (0.037)*	*<0.001*
T→DEP	0.320 (0.289)	0.046 (0.041)	<0.001	*0.306 (0.276)*	*0.043 (0.039)*	*<0.001*
SEX→DEP				*0.259*	*0.063*	*<0.001*
AGE→DEP				*0.013*	*0.003*	*<0.001*
SEX→CE				*-0.377 (-0.425)*	*0.032 (0.033)*	*<0.001*
AGE→CE				*-0.022 (-0.024)*	*0.002*	*<0.001*
SEX→S				-0.058 (-0.065)	0.035 (0.039)	0.094 (0.093)
AGE→S				*-0.008 (-0.009)*	*0.001 (0.002)*	*<0.001*
SEX→T				*-0.140 (-0.155)*	*0.033 (0.036)*	*<0.001*
AGE→T				0.002	0.002	0.313

CE: Community Engagement; S: Sociability; T: Trust

[a]Values in parentheses represent standardized values. Where not present, standardized estimates are the same. (Standardization uses only the variances of the latent factors and not the outcome or covariates because of their binary form, which would not result in meaningful interpretation if standardized). Factor loadings fixed to 1 represent the reference variable used to scale the factor for unstandardized estimates. Significant structural path coefficients are in italics.

[b] In the adjusted model with age and sex predicting the factors, these values represent residual variances or covariances/correlations in residual errors

Table 3.4: Unstandardized and Standardized Structural Equation Model Results for South Africa[a]

	Unadjusted			Adjusted		
	Estimate	Std Error	p-value	Estimate	Std Error	p-value
Factor Loadings						
F1 (Community Engagement) BY						
Meet	1.000 (0.812)	0.000 (0.013)	-- (<0.001)	1.000 (0.819)	0.000 (0.014)	-- (<0.001)
Lead	0.999 (0.811)	0.023 (0.013)	<0.001	1.002 (0.821)	0.023 (0.013)	<0.001
Club	0.932 (0.756)	0.020 (0.015)	<0.001	0.937 (0.767)	0.012 (0.016)	<0.001
Neigh	0.877 (0.712)	0.021 (0.015)	<0.001	0.884 (0.724)	0.022 (0.016)	<0.001
Cowrk	0.634 (0.515)	0.033 (0.025)	<0.001	0.629 (0.515)	0.032 (0.025)	<0.001
F2 (Sociability) BY						
Visit	1.000 (0.817)	0.000 (0.017)	-- (<0.001)	1.000 (0.823)	0.000 (0.017)	-- (<0.001)
Guest	0.975 (0.797)	0.040 (0.019)	<0.001	0.974 (0.802)	0.040 (0.020)	<0.001
Out	0.716 (0.585)	0.023 (0.018)	<0.001	0.713 (0.587)	0.023 (0.018)	<0.001
F3 (Trust) BY						
Revtrstw	1.000 (0.940)	0.000 (0.012)	-- (<0.001)	1.000 (0.939)	0.000 (0.012)	-- (<0.001)
Revtrstn	0.836 (0.786)	0.021 (0.012)	<0.001	0.838 (0.788)	0.021 (0.012)	<0.001
Revtrsts	0.716 (0.639)	0.018 (0.016)	<0.001	0.680 (0.587)	0.019 (0.018)	<0.001
Factor Variances/Covariances [b]						
CE WITH S	0.218 (0.328)	0.021 (0.030)	<0.001	0.211 (0.321)	0.021 (0.030)	<0.001
CE WITH T	0.035 (0.045)	0.029 (0.038)	0.236 (0.237)	0.040 (0.054)	0.029 (0.039)	0.167
S WITH T	0.187 (0.243)	0.024 (0.029)	<0.001	0.189 (0.247)	0.024 (0.029)	<0.001
CE VARIANCE	0.659 (1.000)	0.021 (0.000)	<0.001 --	0.645 (0.961)	0.021 (0.010)	<0.001
S VARIANCE	0.668 (1.000)	0.027 (0.000)	<0.001 --	0.667 (0.985)	0.027 (0.005)	<0.001
T VARIANCE	0.885 (1.000)	0.022 (0.000)	<0.001 --	0.882 (0.999)	0.022 (0.001)	<0.001
Predictors						
CE→DEP	-0.007 (-0.006)	0.057 (0.047)	0.904	-0.036 (-0.030)	0.058 (0.048)	0.533
S→DEP	0.100 (0.082)	0.060 (0.049)	0.093	0.088 (0.072)	0.060 (0.049)	0.139
T→DEP	*-0.140 (-0.132)*	*0.044 (0.041)*	*0.001*	*-0.141 (-0.132)*	*0.045 (0.042)*	*0.002*

				Unadjusted		Adjusted
SEX→DEP				0.099	0.087	0.257
AGE→DEP				*-0.020*	*0.005*	*<0.001*
SEX→CE				*-0.174 (-0.212)*	*0.037 (0.045)*	*<0.001*
AGE→CE				*-0.014 (-0.017)*	*0.002*	*<0.001*
SEX→S				0.043 (0.052)	0.035 (0.043)	0.225
AGE→S				*-0.011 (-0.013)*	*0.002*	*<0.001*
SEX→T				-0.025 (-0.027)	0.036 (0.038)	0.488 (0.487)
AGE→T				0.002	0.002	0.311

CE: Community Engagement; S: Sociability; T: Trust

[a]Values in parentheses represent standardized values. Where not present, standardized estimates are the same. (Standardization uses only the variances of the latent factors and not the outcome or covariates because of their binary form, which would not result in meaningful interpretation if standardized). Significant structural path coefficients are in italics. Factor loadings fixed to 1 represent the reference variable used to scale the factor for the unstandardized estimates.

[b]In the adjusted model with age and sex predicting the factors, these values represent residual variances or covariances/correlations in residual errors

Table 3.5: Model Fit Statistics for Invariance Testing*

Model	χ^2	df	p-value	RMSEA (95% CI)	CFI	TLI	χ^2 Difference Test
Ghana							
1: Measurement non-invariance (configural model/unconstrained loadings & thresholds)	1032.932	124	<0.001	0.059 (0.056-0.062)	0.928	0.910	
2: Measurement invariance (Scalar model/constrained loadings & thresholds)	1116.849	164	<0.001	0.053 (0.050-0.056)	0.925	0.928	2 vs 1: 181.667 (df: 40, p<0.001)
3: Partial measurement invariance (selected loadings & thresholds unconstrained)	1019.982	147	<0.001	0.053 (0.050-0.056)	0.931	0.927	3 vs. 1: 25.844 (df: 23, p=0.3083)
4: Structural non-invariance (unconstrained structural paths between factors & depression)	1161.141	167	<0.001	0.053 (0.050-0.056)	0.920	0.913	
5: structural invariance (constrained structural paths between factors & depression)	1084.676	170	<0.001	0.051 (0.048-0.054)	0.927	0.922	5 vs. 4: 3.605 (df: 3, p=0.3073)
6: structural non-invariance w/ covariates	1329.883	207	<0.001	0.051 (0.048-0.053)	0.909	0.895	
7: structural invariance w/ covariates	1252.485	210	<0.001	0.049 (0.046-0.051)	0.915	0.904	7 vs. 6: 2.922 (df: 3, p=0.4039)
South Africa							
1: Measurement non-invariance (configural model/unconstrained loadings & thresholds)	601.441	82	<0.001	0.065 (0.060-0.070)	0.955	0.940	
2: Measurement invariance (Scalar model/constrained loadings & thresholds)	602.657	120	<0.001	0.052 (0.048-0.056)	0.958	0.962	2 vs 1: 83.816 (df: 38, p<0.001)
3: Partial measurement invariance (selected loadings & thresholds unconstrained)	575.585	112	<0.001	0.052 (0.048-0.057)	0.960	0.961	3 vs. 1: 34.993 (df: 30, p=0.2429)
4: Structural non-invariance (unconstrained structural paths between factors & depression)	615.913	128	<0.001	0.050 (0.046-0.054)	0.958	0.957	
5: structural invariance (constrained structural paths between factors & depression)	585.680	131	<0.001	0.048 (0.044-0.052)	0.961	0.961	5 vs. 4: 0.972 (df: 3, p=0.8080)
6: structural non-invariance w/ covariates	660.830	160	<0.001	0.045 (0.042-0.049)	0.956	0.951	
7: structural invariance w/ covariates	640.256	163	<0.001	0.044 (0.040-0.047)	0.958	0.954	7 vs. 6: 1.107 (df: 3, p=0.7754)

*Chi-square difference testing for WLSMV estimation is not calculated from chi-square values in the same manner as standard difference testing.[37] Additionally, the behavior of other fit statistics for WLSMV estimation with categorical indicators can be irregular, limiting direct comparison of their magnitudes between. For this reason, constrained model fit statistics may not always appear to have worse values than their unconstrained counterparts.

Table 3.6: Results of Structural Equation Models Comparing Urban to Rural Residents: Ghana[a]

	Unadjusted						Adjusted					
	Rural			Urban			Rural			Urban		
	Est	S.E.	p-value	Est	S.E.	p-value	Est	S.E.	p-value	Est	S.E.	p-value
Factor Loadings												
F1 (Community Engagement) BY												
Neigh	1.253	0.039	<0.001	1.253	0.039	<0.001	1.282	0.042	<0.001	1.282	0.042	<0.001
Meet	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--
Lead*	1.023	0.036	<0.001	1.166	0.057	<0.001	1.025	0.038	<0.001	1.167	0.060	<0.001
Club*	1.179	0.038	<0.001	1.048	0.060	<0.001	1.183	0.041	<0.001	1.050	0.062	<0.001
Cowrk	0.840	0.037	<0.001	0.840	0.037	<0.001	0.824	0.038	<0.001	0.824	0.038	<0.001
F2 (Sociability) BY												
Guest	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--
Visit	0.950	0.039	<0.001	0.950	0.039	<0.001	0.940	0.041	<0.001	0.940	0.041	<0.001
Relig*	0.549	0.038	<0.001	0.541	0.049	<0.001	0.546	0.039	<0.001	0.521	0.050	<0.001
F3 (Trust) BY												
Revtrstw*	1.555	0.055	<0.001	1.153	0.059	<0.001	1.555	0.055	<0.001	1.160	0.059	<0.001
Revtrstn	1.319	0.038	<0.001	1.319	0.038	<0.001	1.323	0.038	<0.001	1.323	0.038	<0.001
Revtrsts	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--
Trust	1.084	0.057	<0.001	1.084	0.057	<0.001	1.079	0.057	<0.001	1.079	0.057	<0.001
Support*	0.912	0.065	<0.001	0.629	0.060	<0.001	0.913	0.065	<0.001	0.630	0.061	<0.001
Factor Variances/Covariances[b]												
CE WITH S	0.240	0.019	<0.001	0.303	0.030	<0.001	0.229	0.020	<0.001	0.293	0.031	<0.001
CE WITH T	0.094	0.015	<0.001	0.133	0.025	<0.001	0.088	0.015	<0.001	0.138	0.024	<0.001
S WITH T	-0.004	0.022	0.850	0.069	0.030	0.020	-0.005	0.022	0.835	0.071	0.030	0.016
CE VARIANCE	0.443	0.025	<0.001	0.444	0.045	<0.001	0.419	0.025	<0.001	0.418	0.043	<0.001
S VARIANCE	0.741	0.033	<0.001	0.724	0.085	<0.001	0.749	0.034	<0.001	0.741	0.093	<0.001
T VARIANCE	0.352	0.022	<0.001	0.579	0.062	<0.001	0.351	0.022	<0.001	0.568	0.061	<0.001
Predictors												
CE→DEP	-0.114	0.091	0.210	*-0.296*	*0.105*	*0.005*	0.007	0.093	0.943	-0.151	0.109	0.164
S→DEP	*0.203*	*0.055*	*<0.001*	*0.179*	*0.084*	*0.034*	*0.170*	*0.050*	*0.001*	*0.154*	*0.079*	*0.052*
T→DEP	*0.436*	*0.084*	*<0.001*	*0.443*	*0.086*	*<0.001*	*0.433*	*0.081*	*<0.001*	*0.406*	*0.085*	*<0.001*

	Unadjusted						Adjusted					
	Rural			Urban			Rural			Urban		
	Est	S.E.	p-value	Est	S.E.	p-value	Est	S.E.	p-value	Est	S.E.	p-value
SEX→DEP							*0.267*	*0.082*	*0.001*	*0.241*	*0.098*	*0.014*
AGE→DEP							*0.012*	*0.005*	*0.016*	*0.016*	*0.004*	*<0.001*
SEX→CE							*-0.261*	*0.033*	*<0.001*	*-0.311*	*0.039*	*<0.001*
AGE→CE							*-0.017*	*0.002*	*<0.001*	*-0.018*	*0.002*	*<0.001*
SEX→S							0.003	0.046	0.941	*-0.119*	*0.051*	*0.019*
AGE→S							*-0.009*	*0.002*	*<0.001*	*-0.006*	*0.002*	*0.002*
SEX→T							*-0.092*	*0.029*	*0.002*	-0.075	0.042	0.072
AGE→T							-0.001	0.001	0.318	*0.004*	*0.002*	*0.035*
Factor Means[c]												
CE	0.000	0.000	--	*-0.187*	*0.044*	*<0.001*	0.000	0.000	--	*-0.152*	*0.052*	*0.003*
S	0.000	0.000	--	*-0.203*	*0.065*	*0.002*	0.000	0.000	--	*-0.165*	*0.076*	*0.031*
T	0.000	0.000	--	*-0.291*	*0.049*	*<0.001*	0.000	0.000	--	*-0.304*	*0.055*	*<0.001*

CE: Community Engagement; S: Sociability; T: Trust

[a] For purposes of comparison between the two groups, results presented are unstandardized and for models without equality constraints on the social capital-depression relationships (Models 4 & 6 in Table 5). Results for the constrained version of the models (Model 5 & 7) are included in Appendix P. Factor loadings fixed to 1 represent the reference variable used to scale the factor. Significant structural path coefficients and factor means are in italics

[b] In the adjusted model with age and sex predicting the factors, these values represent residual variances or covariances/correlations in residual errors

[c] In the adjusted model including sex and age as predictors, these values represent intercepts for the factors. The rural group served as the reference for comparison of factor means

* Factor loadings freed between urban and rural groups to establish partial measurement invariance

Table 3.7: Results of Structural Equation Models Comparing Urban to Rural Residents: South Africa[a]

	Unadjusted[b]						Adjusted[b]					
	Rural			Urban			Rural			Urban		
	Est	S.E.	p-value	Est	S.E.	p-value	Est	S.E.	p-value	Est	S.E.	p-value
Factor Loadings												
F1 (Community Engagement) BY												
Meet*	1.248	0.053	<0.001	0.926	0.055	<0.001	1.302	0.055	<0.001	0.975	0.059	<0.001
Lead*	1.162	0.044	<0.001	0.960	0.057	<0.001	1.221	0.051	<0.001	1.012	0.062	<0.001
Club	1.000	0.000	--	1.000	0.000	--	1.059	0.045	<0.001	1.059	0.045	<0.001
Neigh	0.957	0.039	<0.001	0.957	0.039	<0.001	1.000	0.000	--	1.000	0.000	--
Cowrk	0.720	0.051	<0.001	0.720	0.051	<0.001	0.736	0.057	<0.001	0.736	0.057	<0.001
F2 (Sociability) BY												
Visit	1.000	0.000	--	1.000	0.000	--	1.208	0.063	<0.001	1.208	0.063	<0.001
Guest	0.992	0.048	<0.001	0.992	0.048	<0.001	1.191	0.062	<0.001	1.191	0.062	<0.001
Out	0.832	0.041	<0.001	0.832	0.041	<0.001	1.000	0.000	--	1.000	0.000	--
F3 (Trust) BY												
Revtrstw	1.567	0.068	<0.001	1.567	0.068	<0.001	1.536	0.066	<0.001	1.536	0.066	<0.001
Revtrstn	1.160	0.040	<0.001	1.160	0.040	<0.001	1.169	0.039	<0.001	1.169	0.039	<0.001
Revtrsts	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--
Factor Variances/Covariances[c]												
CE WITH S	0.239	0.021	<0.001	0.226	0.035	<0.001	0.188	0.018	<0.001	0.174	0.027	<0.001
CE WITH T	0.000	0.020	0.987	0.043	0.026	0.090	0.003	0.019	0.889	0.046	0.025	0.069
S WITH T	0.071	0.022	0.001	0.129	0.019	<0.001	0.062	0.018	0.001	0.108	0.016	<0.001
CE VARIANCE	0.475	0.037	<0.001	0.708	0.085	<0.001	0.430	0.034	<0.001	0.619	0.077	<0.001
S VARIANCE	0.605	0.034	<0.001	0.634	0.075	<0.001	0.412	0.040	<0.001	0.433	0.050	<0.001
T VARIANCE	0.373	0.028	<0.001	0.337	0.032	<0.001	0.378	0.028	<0.001	0.341	0.034	<0.001
Predictors												
CE→DEP	-0.022	0.148	0.883	0.029	0.061	0.632	-0.029	0.156	0.853	-0.028	0.063	0.665
S→DEP	0.163	0.110	0.139	0.054	0.075	0.479	0.191	0.133	0.150	0.063	0.092	0.495
T→DEP	-0.191	0.106	0.072	*-0.232*	*0.089*	*0.009*	-0.208	0.107	0.052	*-0.229*	*0.088*	*0.009*
SEX→DEP							0.123	0.164	0.455	0.084	0.108	0.436
AGE→DEP							-0.010	0.009	0.267	*-0.024*	*0.006*	*<0.001*

	Unadjusted[b]						Adjusted[b]					
	Rural			Urban			Rural			Urban		
	Est	S.E.	p-value	Est	S.E.	p-value	Est	S.E.	p-value	Est	S.E.	p-value
SEX→CE							-0.055	0.041	0.183	*-0.219*	*0.054*	*<0.001*
AGE→CE							*-0.007*	*0.002*	*0.006*	*-0.021*	*0.003*	*<0.001*
SEX→S							0.004	0.052	0.932	0.041	0.034	0.226
AGE→S							*-0.009*	*0.002*	*<0.001*	*-0.007*	*0.002*	*<0.001*
SEX→T							0.017	0.040	0.677	-0.035	0.027	0.186
AGE→T							0.003	0.002	0.182	0.001	0.002	0.585
Factor Means[d]												
CE	0.000	0.000	--	*-0.275*	*0.085*	*0.001*	0.000	0.000	--	-0.162	0.094	0.085
S	0.000	0.000	--	*0.239*	*0.064*	*<0.001*	0.000	0.000	--	*0.180*	*0.055*	*0.001*
T	0.000	0.000	--	*0.098*	*0.045*	*0.031*	0.000	0.000	--	*0.123*	*0.052*	*0.017*

CE: Community Engagement; S: Sociability; T: Trust

[a] For purposes of comparison between the two groups, results presented are unstandardized and for models without equality constraints on the social capital-depression relationships (Models 4 & 6 in Table 5). Results for the constrained version of the models (Models 5 & 7) are included in Appendix P. Factor loadings fixed to 1 represent the reference variable used to scale the factor. Significant structural path coefficients and factor means are in italics.

[b] Different reference variables were used to scale the factors in the adjusted model than in the unadjusted model due to failure of the model to converge

[c] In the adjusted model with age and sex predicting the factors, these values represent residual variances or covariances/correlations in residual errors

[d] In the adjusted model including sex and age as predictors, these values represent intercepts for the factors. The rural group served as the reference for comparison of factor means

*Factor loadings freed between urban and rural groups to establish partial measurement invariance

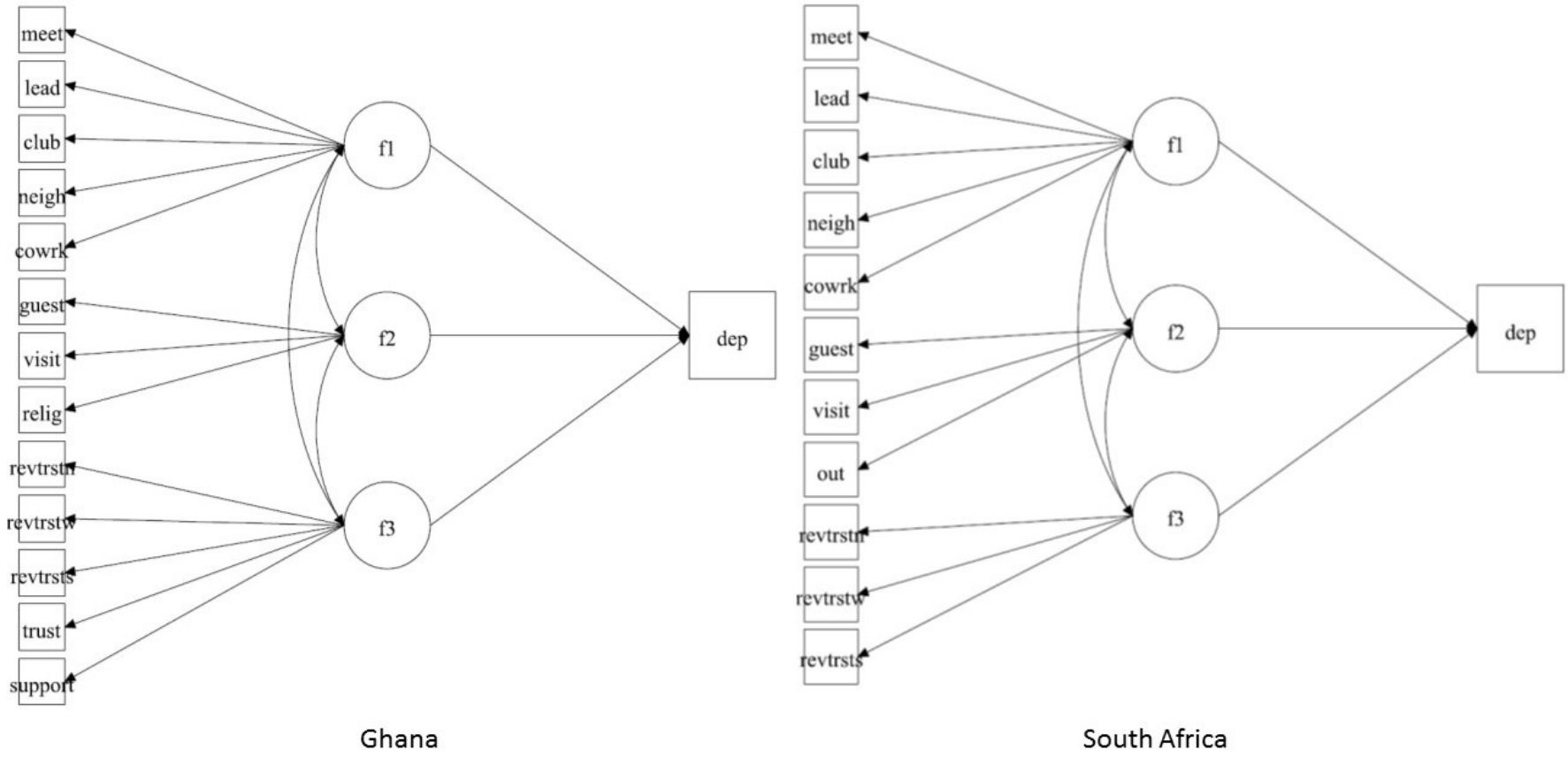

Figure 3.1: Basic Structural Equation Model of the Relationship between Dimensions of Social Capital and Depression

Concluding Remarks

Summary of Findings

The preceding papers attempted to answer three main questions that addressed the subject of urbanicity, social capital, and depression. Namely, these questions were: 1) is current urban residence associated with an increased likelihood of depression compared to rural residence for older adults in Ghana and South Africa? 2) is urbanicity of residence across the life course related to depression in these populations? And lastly 3) does urbanicity modify the association between social capital and depression?

Findings from these studies were somewhat unexpected. Results of the first analysis revealed that in both countries, no significant difference was observed between urban and rural residents in terms of the odds of having depression in the past twelve months. However, the direction of effects indicated that rural Ghanaian older adults may actually be slightly more prone to depression than their urban counterparts (adjusted OR: 0.85 (95% CI: 0.55-1.31)). Conversely, rural South African adults appeared somewhat less prone to depression than their urban counterparts (adjusted OR: 1.13 (95% CI: 0.71-1.80)). Additionally, in Ghana, women and individuals who were older, unemployed, had never moved from their current location, or had cognitive impairments exhibited greater odds of depression. For South Africans, on the other hand, older age was protective against depression and no significant sex differences emerged; but individuals who were unemployed, functionally disabled, and no longer married experienced more depression.

The second analysis likewise did not find any significant differences in depression when urbanicity was addressed from a life course perspective. It did, however, seem to

suggest that the magnitude of effects for urbanicity of adulthood residence was greater than for childhood residence, implying that a more proximal time period may be most relevant for later-life depression. Furthermore, depression rates were greatest among recent rural-urban migrants and lowest among return migrants (i.e., rural-urban-rural) in Ghana while in South Africa rates were greatest among those with urban childhood who migrated to rural settings earlier in adulthood but lowest in adult migrants who made a transition more recently, particularly from urban to rural.

The third study demonstrated that there was no meaningful modification of the association between social capital and depression by urbanicity, but there were some urban-rural differences in the composition of social capital between urban and rural locations in each country. Additionally, urban Ghanaians had lower average levels of all three dimensions of social capital that were assessed while urban South Africans only had lower levels of community engagement but higher levels of sociability and trust.

Study Conclusions and Implications

Taken together, these results suggest that urbanicity may not be an important factor in the occurrence of later-life depression in Ghana and South Africa. In other words, rural and urban environments might be equally depressogenic for older adults or each has their own risk and protective elements. Consequently, in efforts to improve mental health resources—which are noticeably lacking in African countries, with less than one percent of healthcare spending devoted to mental health on average[1]—both rural and urban areas could be given similar priority. Yet, because most mental health resources in Africa are overwhelmingly concentrated in urban areas,[1] increased emphasis

on rural areas may still be necessary to eliminate disparities and create a more equitable distribution of resources. And given the slight trends towards higher rates of depression in either setting as well as potential differences in the susceptibility of certain migrant groups, monitoring is necessary to track and respond to changes in need.

Urbanicity does, however, have relevance for social connections, as levels of social capital were observed to vary between urban and rural locations in the two study countries. As a result, these findings may have implications for identifying ways to influence social capital through planning and design. Already, social capital is being incorporated into the field of urban planning in various ways, with an emphasis on factors such as cohesion, neighborhood stability, and sustainable development.[2] And studies have confirmed that features such as walkability of neighborhoods promote social capital while driving-oriented environments are detrimental to social networks.[3,4] Although no significant association was found for urbancity in terms of depression in this study, built environment features *within* cities have been linked to depression and other mental health outcomes and could potentially overlap or be implemented in concert with those geared towards social capital. For instance, in a cohort study within an Italian city, greater building density and transport accessibility were significantly associated with less antidepressant use,[5] and factors such as housing quality and walkability may also be important for preventing depression among older adults.[6]

However, one of the main points that emerged from this research is that what constitutes a protective or risk factor for health is not always constant. Not only was urbanicity unconfirmed as a determinant of depression in the study countries, but social capital—which is typically conceptualized as a protective factor in public health—

appeared to confer risk in some circumstances based on the results of this study. Particularly, in this analysis the sociability and trust dimensions of social capital were significantly and positively associated with depression in Ghana overall, and in South Africa sociability was also in the positive direction though it did not reach significance. As public health researchers, we should therefore be more cognizant of the flexibility of determinants of health and of the language of risk and protection we use to describe them.

Moreover, this flexibility also has consequences for interventions aimed at promoting social capital for mental health, and several such interventions have been introduced. For example, the Act-Belong-Commit campaign is being implemented in different countries as a first-of-its-kind population-based program aimed at mental health promotion, with an emphasis on promoting activity and social engagement.[7] This campaign, which was first implemented in Australia, uses media and programs in collaboration with governments, organizations and other social institutions to encourage individuals to keep their minds and bodies active (Act); foster a sense of belonging by cultivating relationships and being involved in the community (Belong); and build a sense of purpose by devoting themselves to a cause or activity (Commit).[7] Evaluations of the campaign do demonstrate improvements in perceptions of mental health and engagement in promotive behaviors, particularly among individuals with mental illness.[7] Yet, in terms of effectiveness of interventions, a systematic review of randomized trials of social capital interventions in older adults concluded that of the 17 trials assessing mood (depression and anxiety), five produced positive results while the remaining were not significant.[8] Most of the trials were conducted in high-income countries, and most were also considered potentially susceptible to bias, but unsupportive results on the

whole may also be a reflection of some of the complexities of the relationships between social capital and depression. However, the effective studies identified included at least one judged to be of higher quality and also tended to be among very specific target groups, so this may be indicative of some promise for social capital interventions, particularly among high-risk populations.

But in the midst of conflicting relationships between social capital and depression observed in this analysis, the question then becomes whether and how social capital should be promoted. Community engagement was the only dimension that appeared to be consistently, though not always significantly, beneficial in terms of depression in both Ghana and South Africa. Thus, interventions emphasizing formal participation may be useful. But interventions focusing on other aspects of social capital could be counterproductive given the observed results. Also, because most cases in which aspects of social capital—such as participation in community groups or received support—have been positively associated with depression and anxiety were situated in low-income settings,[9,10] simultaneous attention should be given to interventions aimed at reducing poverty or alleviating other stresses that cause engagement in social activity to become burdensome for older adults. Perhaps more emphasis may need to be placed on freedom of choice to participate as well as the selection and prioritization of responsibilities so high levels of social interaction are not viewed as obligatory and a better balance can be attained.

Additionally, given the cross-sectional nature of the data, the results may indicate a treatment gap if social participation is being used among the depressed for therapeutic purposes. It could therefore offer a potential point of intervention that could serve as an

alternative or supplementary means of mental health care. For example, community members and social network contacts could be trained in recognizing signs of depression and basic counseling that could be offered to depressed individuals in informal encounters. A similar approach has been implemented in Zimbabwe with the Friendship Bench Project where lay community health workers—often older women locally referred to as therapy "grannies"—are provided basic training and are stationed at benches outside primary health centers where community members can sit and talk with them.[11] Additionally, these lay therapists offer advice and screening for common mental disorders and are able to link cases to additional care, and the intervention has been well-received by the communities.

Another overarching theme across all studies included in this dissertation is that few things are universal, which highlights the importance of context. In all analyses, the primary findings did not always conform to those found in other studies and often ran counter to them. In addition, results demonstrated differences or opposition between the two study countries themselves. For example, increasing age was a significant risk factor for depression in Ghana while it was a significant protective factor in South Africa. And the direction of effects related to urbanicity and depression as well as social capital and depression also conflicted in many cases.

This should not be entirely surprising, given the distinctiveness of most places. Low- and middle- income countries, such as those on the African continent, and their urban areas also differ culturally and structurally from high-income countries. Many African cities, for instance, are characterized by a mixture of more traditional pre-existing indigenous ethnic areas in addition to ethnically diverse, metropolitan growth around

them; and religion and religious identity often play a prominent role.[12] Additionally, although both Ghana and South Africa are rapidly growing economies in sub-Saharan Africa, they also differ in many respects, including geographic location, climate, historical backgrounds, culture, political and social conditions, and demographic makeup. Moreover, their experience of urbanization is also not the same.

For example, Ghana is a lower middle-income country in West Africa with a slight majority of its overall population (53%) living in urban areas and an estimated annual average urbanization rate of 1.1%.[13] Urbanization is primarily a result of internal migration from rural areas and natural population growth in urban areas,[14] and much of its urban growth is geographically restricted to a few major urban locations in the country.[15] In contrast, South Africa is an upper middle-income country with a higher proportion of the population urban (64%) but a lower annual urbanization rate (0.7%).[13] Most of its urbanization is a result of migration, both internal as well as external.[16] In terms of aging, 2016 estimates of life expectancy at birth are 66.6 years in Ghana and 63.1 years in South Africa.[17]

There are also qualitative differences in the urban environments of the two countries. While both have Dutch and British colonial history, the establishment of South Africa as a settler colony in contrast to indirect rule in Ghana has led to a more racially diverse population in South Africa with a high degree of residential segregation.[18] Informal settlements as well as stark inequality between the rich and poor also characterize both countries' urban areas, although to a much greater extent in South Africa.[19] However, as a poorer nation, urban areas in Ghana may suffer more from a lack of infrastructure.[19] Such varying characteristics and situations, among numerous others,

are likely to influence the relationships between urbanicity, social capital, and depression in the two countries. And the importance of context when it comes to understanding urbanicity and mental health is also echoed in the literature.[20,21]

Therefore, as public health researchers, it is important to gain an understanding of the locations in which we work and continue to generate locally relevant evidence in multiple settings to increase the context-specific knowledge base. This will better inform programs and policies that are proposed and implemented to improve health rather than assuming similarity or transferability of evidence from other locations. And in keeping with this observation, comparative research can also enhance our understanding and help to illuminate how and why outcomes differ across settings as well as differences in the effectiveness of programs and policies.

The Way Forward

Although this body of work begins to provide answers to questions surrounding urbanicity, social capital, and depression in African older adults, it also raises additional questions for further research. In particular, the interrelationship between these three factors requires further clarification and may be more complicated than hypothesized. Despite the fact that this dissertation did not explicitly explore mediation due to the cross-sectional design of the survey, a lingering question is whether urbanicity and depression are indirectly related and mediated by social capital and/or whether urbanicity moderates the relationship between social capital (and possibly other factors) and depression. Though not usually directly tested empirically, the literature has generally suggested that social capital may be a mediator between the observed urbanicity-depression relationship,

and thus urbanicity is a main effect linked to depression through features of social relationships. Specifically, urban environments have been purported to decrease social capital, which in turn would lead to an increase in depression. As described in the literature review, however, and depending on the setting, this assumption may not be supported as urban residents do not always differ from their rural counterparts in measures of social capital.[22] And urban/rural differences in depression have persisted in some studies even when accounting for some of these factors.[23] Moreover, though levels of social capital differed between urban and rural residents in this analysis, the direction of this difference varied and the failure of this study to observe urban-rural differences in depression itself may also preclude investigations of a mediating relationship.

Alternatively, this dissertation examined the role of urbanicity as a modifier of the relationship between social capital and depression. And if urban residents were found to have less social capital but the strength of the association between social capital and depression was also weaker among them—due to adaptation to the low social capital environment as hypothesized and observed in some cases[24-26]—this could result in some attenuation of the association between urbanicity and depression. Such a phenomenon could explain weak observed associations between urbanicity and depression in this and other studies; or in instances where clear associations have been identified, it could suggest incomplete attenuation or that other factors may be more important. Yet, in the current analyses, evidence of effect modification also was not clearly observed. Thus, the true nature of the relationship between these three variables, if there is one, remains unclear and requires further investigation.

Moreover, the fact that dimensions of social capital had conflicting associations with depression further complicates our understanding and calls for additional study. Lower social capital in urban Ghana coupled with a mostly positive association of social capital with depression—apart from community engagement, which was less prevalent than the other forms of social capital—may partly explain a slight rural preponderance of depression in the country. In South Africa, on the other hand, community engagement was higher in rural areas but had essentially no association with depression while sociability was higher in urban areas and had a marginal positive association with depression and trust was also higher in urban areas and significantly decreased depression. This might suggest that the different dimensions of social capital and urbanicity are acting in opposing directions, which could also partly explain null associations between urbanicity and depression observed in this study; but the findings also would suggest a tendency towards lower urban rates of depression driven by the effects of trust, which was not the case. Therefore, these results could imply that social capital may very well not be as important in the way urbanicity relates to depression and the significant urban-rural differences in social capital may not be practically meaningful, or other factors may have a larger relative contribution when it comes to the role of urbanicity. Longitudinal studies to assess effects of these factors over time will be particularly useful in clarifying relationships by allowing for more accurate determinations of temporality.

More generally, there is uncertainty and debate about how to approach the urbanicity-depression question moving forward. While the topic of the impact of cities on mental health was a popular subject of study in the early part of the 20th century, and

notably among sociologists as well as those in health-related professions, interest in the issue subsequently diminished but is seeing a revival.[27] Fitzgerald et al.[27] see this renewed interest as an opportunity to bridge the divide between sociology and biomedicine and reintegrate the two fields. An interdisciplinary approach that brings together the social and health sciences—including public health, urban studies, medicine, and sociology, among others—could be what is needed to greatly advance research in this area, and others have called for the same.[28,29]

But what should the nature of this inquiry be? Some scholars think the question of whether urban or rural settings have higher rates of mental illness is unimportant and should focus instead on how these settings affect mental health.[21,30] Thus, the emphasis should be on identifying mechanisms and delving deeper within the city or neighborhood to study what aspects of urban (or rural) environments are linked to mental health.[29-31] Additionally, rather than focus on discrete conditions, it may be more appropriate to examine specific disease components or types of symptoms, as they may not be affected equally.[28,31] Furthermore, calls for explicit analysis of interactions between urbanicity or urban features and other factors have also been made because associations may be heterogeneous.[28,30] Specifically, Judd et al.[30] suggest going beyond even two-way interactions to three-way interactions (i.e., combining urbanicity with age and sex) to identify vulnerable subgroups and how associations differ among them.

Yet, there is a tension that arises amidst these calls for more specific and complex analyses as others contend that identifying and quantifying the specific components of the environment constitute a rather reductionist approach and run the risk of missing the larger picture.[27] And if, as Galea[31] argues, the urban environment is indeed a complex

system in which numerous of its features may intersect to create effects that go beyond each component or some combination of them, then the issue becomes how much will be gained by decomposing the environment. Furthermore, the choice between approaches also depends on how urbanicity is conceptualized and what exactly researchers are trying to identify. For instance, some note that after accounting for personal sociodemographic characteristics, such as marital and socioeconomic status, unique effects of urbanicity on depression and other mental health outcomes disappear.[20,21] Yet, one could also conceive of such compositional differences and other social conditions as a very part or product of the urban environment rather than being separate from it, and thus controlling for them or trying to isolate a pure "urbanicity" effect excluding these factors may be unnecessary.

Alternatively, addressing the urbanicity-mental health question may require a complete paradigm shift. In their analysis of the urban environment in psychotic disorders, Soderstrom et al.[32] put forth a new approach that considers "the city as an experiential milieu rather than as a set of substances." In essence, the city and its features should be regarded as an experience and not an exposure. Their research with individuals suffering from psychoses demonstrated that people feel and process what they encounter in different ways at different times. Rather than a group of fixed objects, elements of the city—as well as the people within them—are dynamic and take on various meanings in changing situations. As a result of this experience-based perspective, the authors argue that research should make a distinction between "having an urban postal address and living an urban way of life."

These arguments call for new modes of analysis, and public health research in this area could especially benefit from a greater use of qualitative methods to better

understand individuals' experiences as well as contextual differences and circumstances behind research findings. This would be relevant not just to understanding how urbanicity influences mental health but also how social capital is related to the two as well.[2,33]

Although the issue of the relevance of the larger question of urban-rural differences in depression—as compared to more specific and perhaps more interesting questions—remains, it is rather likely that research along both lines of reasoning will and should continue in tandem. As this dissertation has argued, in regions such as Africa, urban-rural differences—or the lack thereof—have largely not been characterized, so such comparisons may still be needed.

A question that follows from this is, even if observed, are urban-rural differences meaningful? In their meta-analysis, Wiens et al.[34] conclude that the statistically significant pooled odds ratio of 1.18 (95% CI: 1.13-1.25) for depression in urban compared to rural regions of Canada is not sizeable and may have little practical import. But although on the individual level an 18% increase in the odds of depression may not seem significant, I would argue that on the population level where hundreds of thousands, if not millions, of individuals may be concerned, this could amount to a substantial impact. And as Galea[31] claims, an emphasis on contextual factors such as urbanicity addresses the root causes of illness that affect whole populations rather than individuals, as the classic work of Rose[35] suggests.

Depression is currently a primary cause of disability globally[36] and with population growth and aging, its burden will only continue to increase.[37] To put its significance in context, analysis of data from 60 countries participating in the World Health Surveys demonstrated that depression accounted for the greatest decline in overall

health status compared to four other chronic conditions studied (diabetes, asthma, arthritis, and angina); and depression in combination with another condition resulted in larger health impairments than any other combination of conditions.[38] Thus, depression is a disorder with disproportionate burden globally that cannot be ignored, and identifying its determinants is key for the health of individuals and populations around the world.

Moreover, we continue to live in an urbanizing world; therefore, it is imperative that we understand if and how the ongoing process of urbanization affects health, both physically and mentally. And given that population aging is another demographic shift with widespread occurrence, an emphasis on older adults as a key and potentially vulnerable population is necessary.

The field of inquiry into the relationship between urbanicity and depression specifically and on mental health in general is an important one with many questions left to be answered. This dissertation aimed to shed light on this issue and its significance and advance knowledge in the area with respect to aging in Africa. While these studies only begin to accomplish these aims, I believe they are a step in the right direction.

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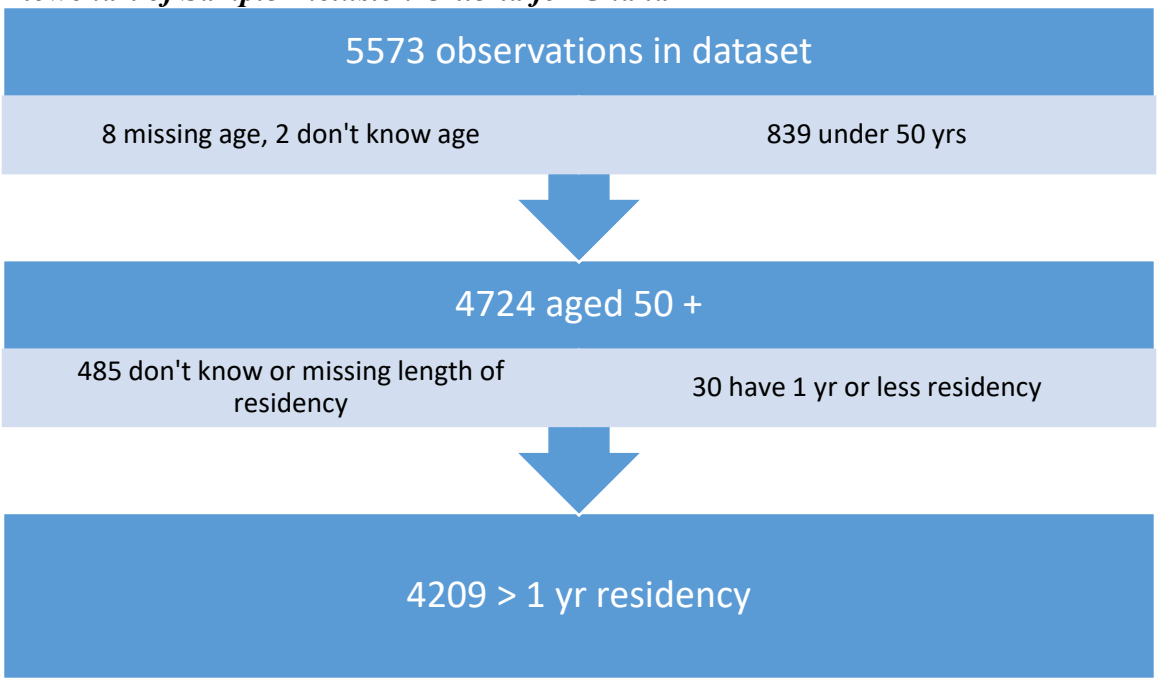
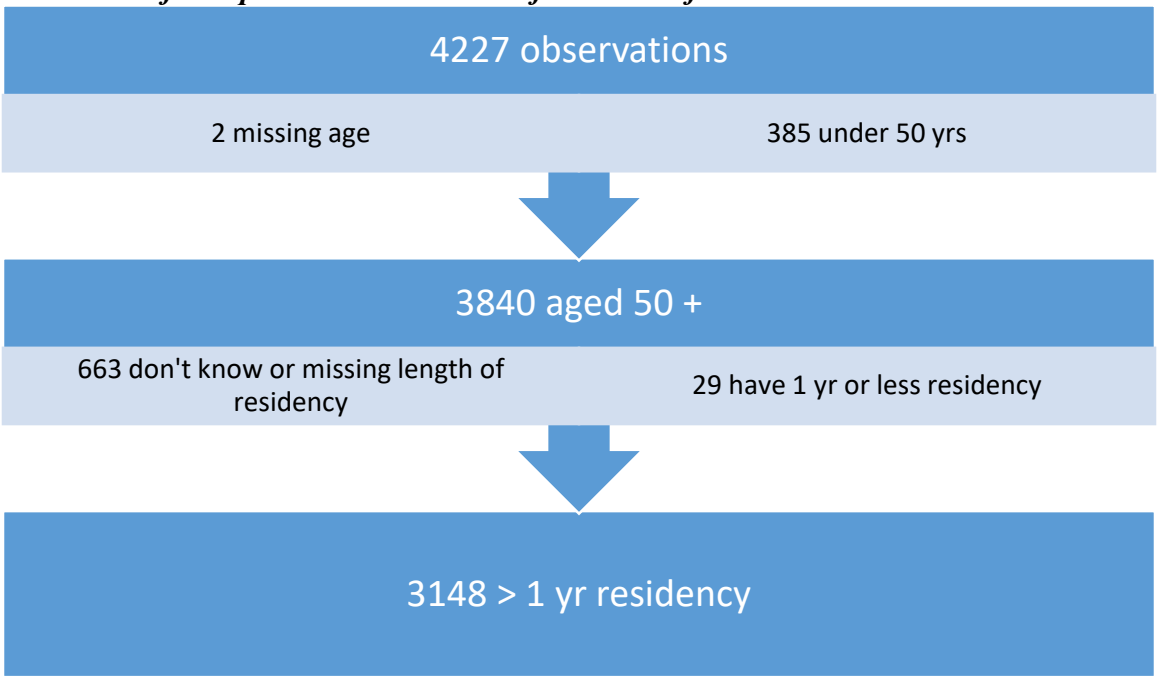
Appendices

Appendix A: Description of Observations Included and Excluded from the Samples

Flowchart of Sample Inclusion Criteria for Ghana



Flowchart of Sample Inclusion Criteria for South Africa



Characteristics of Observations Excluded from the Sample

For the 485 individuals in the Ghana data who were excluded due to missing or unknown responses to the questions q1020: "have you always lived in this village/town/city?" and q1021: "how long have you been living (continuously) in this area?", an indicator variable was created denoting missing response. All of the individuals missing on these two items (n=421) were also missing on variables including religion, ever working, any education, interviewer judgment of any cognitive limitations, and the initial screener questions on depressive symptoms (depressed mood, loss of interest, lack of energy). Slightly less than half of missing respondents had missing responses for having completed the interview and the remaining mostly had other codes indicating incomplete interview or inability to interview (i.e. refusal). This may be a result of the fact that all 50+ individuals in the household are eligible for participation but not all may have participated. (Respondents with unknown responses to q1020 and q1021 (n=64) did complete the interview and were similar to those included in the sample on all characteristics except for being more likely to be Islamic or have no religion). The missing & unknown respondents combined did not differ significantly on urban/rural residence (though slightly more were rural) but were significantly more likely to be female (75% vs 48%, unweighted) and differed significantly on marital status (70% currently married vs. 56%). Respondents did not differ significantly in age (mean age 63.3 vs 64.3).

In the South Africa sample, those missing or unknown on q1020 and q1021 (n=663) did not differ from those who were not missing in terms of urban/rural residence (33% rural for both). Those with missing residency information were also mostly missing on religion and any education. There were some significant differences between missing and non-missing for characteristics, particularly gender (45% female among missing vs. 60% female in non-missing, unweighted), and they were also more likely to be married and less likely to be widowed. Other characteristics, such as employment information were more likely to also be missing. The proportion responding affirmatively to the 3 depression screener questions were similar between those with and without residency information. However, those without residency information had a higher proportion

missing on these questions (11% vs 3%). Observations that were missing on residency information did not differ significantly in age from those who were not (mean 63.0 vs. 62.7).

Appendix B: Depression Status Outcome Definition

Criteria	Ghana (n=4209)	South Africa (n=3148)
Ever diagnosed with depression (q4040)	**66 (1.57%)** Missing: 14 (0.33%)	**93 (2.95%)** Missing: 103 (3.27%)
Treated in 12 months (q4041b)	**27 (0.64%)** Missing: 14 (0.33%)	**58 (1.84%)** [3 of whom were never diagnosed] Don't know: 5 (0.16%) Missing: 103 (3.27%)
Treated in 2 weeks (q4041a)	**13 total (0.31%),** [2 of whom weren't counted in 12 mo treatment] Don't know: 1 (0.02%) Missing: 14 (0.33%)	**47: (1.49%),** [2 of whom not diagnosed] Don't know 4 (0.13%) Missing: 103 (3.27%)
Total meeting depression treatment criteria (treated within 12 months)	***29 (0.69%)*** *Don't know: 1 (0.02%)* *Missing: 14 (0.33%)*	***61 (1.94%)*** *Don't know: 5 (0.16%)* *Missing: 103 (3.27%)*
12-month symptom-based criteria (satisfying at least mild depression according to ICD-I0)		
At least 2 of 3 basic symptoms: depressed mood, lack of energy, loss of interest (q4042-q4044)	**638 (15.16%)** Missing: 14 (0.33%)	**274 (8.70%)** Don't know: 2 (0.06%) Missing: 103 (3.27%)
At least 2 week duration (q4045)	**402 (9.55%)** Don't know: 1 (0.02%) Missing: 14 (0.33%) [excludes those missing because of skip pattern]	**130 (4.13%)** Don't know: 5 (0.16%) Missing: 103 (3.27%) [excludes those missing because of skip pattern]
Nearly every day (q4046)	**353 (8.39%)** Don't know: 1 (0.02%) Missing: 14 (0.33%)	**111 (3.53%)** Don't know: 4 (0.13%) Missing: 103 (3.27%)
At least 1 or 2 additional symptoms (for a total of 4):		
Low confidence/ self-esteem (q4055)	**309 (7.34%)** Don't know: 3 (0.07%)	**104 (3.30%)** Don't know: 4 (0.13%) Missing: 103 (3.27%)

Criteria	Ghana (n=4209)	South Africa (n=3148)
	Not applicable: 1 (0.02%) Missing: 14 (0.33%)	
Hopelessness (q4056)	**310 (7.37%)** Don't know: 3 (0.07%) Not applicable: 1 (0.02%) Missing: 14 (0.33%)	**101 (3.21%)** Don't know: 5 (0.16%) Missing: 103 (3.27%)
Suicide (q4058: thoughts or q4059: attempts)	**170 (4.04%)** Don't know: 3 (0.07%) Not applicable: 1 (0.02%) Missing: 14 (0.33%)	**66 (2.10%)** Don't know: 4 (0.13%) Missing: 103 (3.27%)
Impaired concentration (q4048: slowed thinking or q4051: difficulty concentrating)	**359 (8.53%)** Don't know: 3 (0.07%) Missing: 14 (0.33%)	**123 (3.91%)** Don't know: 4 (0.13%) Missing: 103 (3.27%)
Change in psychomotor activity: retardation (q4048: slow thinking or q4052: slow moving around) or agitation (q4053: anxious/worried or q4054: restless/jittery)	**381 (9.05%)** Don't know: 3 (0.07%) Missing: 14 (0.33%)	**126 (4.00%)** Don't know: 4 (0.13%) Missing: 103 (3.27%)
Sleep disturbance (q4049: problems falling asleep or q4050: waking too early)	**373 (8.86%)** Don't know: 3 (0.07%) Missing: 14 (0.33%)	**122 (3.87%)** Don't know: 4 (0.13%) Missing: 103 (3.27%)
Appetite (q4047: loss of appetite)	**355 (8.43%)** Don't know: 3 (0.07%) Missing: 14 (0.33%)	**103 (3.27%)** Don't know: 4 (0.13%) Missing: 103 (3.27%)
Total meeting all symptom criteria	***308 (7.32%)*** *Missing: 14 (0.33%)*	***96 (3.05%)*** *Missing: 103 (3.27%)*
Total Depressed (symptom & treatment based)	**317 (7.53%)** **Missing: 14 (0.33%)**	**132 (4.19%)** **Missing: 105 (3.34%)** [includes 2 who had 2 of the 3 basic

Criteria	Ghana (n=4209)	South Africa (n=3148)
		symptoms but responded don't know to all other questions]

*Based on Kulkarni & Shinde (2012) algorithm for ICD-10 definition of depression using SAGE questions. The symptom of guilt was modified and redefined as hopelessness as the ICD-10 mentions bleak & pessimistic views of the future, and the WHO CIDI depression questionnaire on which the SAGE depression survey questions are based includes a question on hopelessness. Loss of interest in sex (q4057) was excluded since it is a form of anhedonia/loss of interest and is already covered in the initial criterion. Furthermore, the loss of interest in sex item was explored but did not make a difference in the depression assignment as everyone who reported that item already met the depression criteria.

Appendix C: Description of Independent Variables

Operationalization of Independent Variables from Survey Items

Current Residence (q0104) 0 rural 1 urban
Sex: (q1009) 0 male 1 female
Marital Status (combined married & cohabiting categories of original question q1012) 1 never married 2 currently married/cohabiting 3 separated/divorced 4 widowed 8 don't know*
Educational Attainment (highest education: combined q1015: ever schooled & q1016: highest level of schooling) 0 no formal education 1 some primary 2 primary completed 3 secondary completed 4 post-secondary complete 8 don't know* *19 people in South Africa reported having no schooling to q1015 but also had responses to the q1016 survey item on highest level of education (responses were distributed among less than primary to completed secondary). In these cases, the highest level of education was given precedence.*
Ethnicity (q1018) *Ghana: collapsed original categories into larger ethnic families* 1 Akan 2 Ewe 3 Ga-Adangbe 4 Gur (combining Gruma, Grusi, Mole-Dagbon) 87 Other 88 Don't know* *South Africa* 1 African/Black 2 White 3 Coloured 4 Indian/Asian 8 Don’t know* 87 Other
Religion (collapsed less common religious groups in original q1019 into “other” category) *Ghana*: 1 none 4 Christianity

6 islam
9 primal indigenous
87 other
88 don't know*
97 refused*
98 not applicable*

South Africa:
1 none
4 Christianity
5 Hinduism
6 Islam
9 primal indigenous
87 other
88 don't know*
97 refused*
98 not applicable*

Residential Mobility (Ever moved? based on q1020 always lived here question)
0 no
1 yes
8 don't know*

43 individuals in South Africa with a yes response to q1020 (have you always lived in this village/town/city) had responses to q1022-1024 (where were you living before/where have you lived most of your adult life (18+)/ where did you live for most of your childhood (before age 10 years)) that were inconsistent with having lived in the same locality. Responses to q1022-1024 were given precedence over q1020 in these cases and residential mobility was based on evidence of moving in responses to these questions.

Employment Status (combined q1501 ever worked, q1503 currently working, & q1504: reason for not working. Those not working due to vacation, temporary leave were considered as currently working)
0 currently working
1 never worked
2 not working
8 don't know*

Household income quintiles
Derived from 21 country-specific assets, including the household ownership of durable goods, dwelling characteristics (type of floors, walls and cooking stove), and access to services such as improved water, sanitation and cooking fuel.

Description of methodology for constructing variable from SAGE team:
"The results were recoded into dichotomous variables taking the value of 0 if the household did not possess or have access to the good or service, and 1 if it did. The data set was then reshaped, as though each household had multiple observations for wealth (each item being one observation), and was fit as a pure random effect model based on these multiple items per household. The result provides indicator specific thresholds on the latent income scale such that a household is more likely to respond affirmatively than not when its permanent income exceeds this threshold. This "asset ladder" was generated and it is country-specific. Using a Bayesian post-estimation (empirical Bayes) method, households were arranged on the asset ladder, where the raw continuous income estimates are transformed in the final step into quintiles. The resulting estimates of household permanent income can be compared to the

reported income and total household expenditure. Though the correlation coefficients are not very high (both the Pearson and Spearman correlations are less than 0.5) there is a systematic 'upper left triangular' relationship across all countries. Namely, as self-reported income or expenditure increases, our permanent income estimate increases as well. However, our estimates can be high even when self-reported income or expenditure is low, which supports the well-known under-reporting or inadequacies of using income or expenditure indicators as opposed to wealth based on permanent income."
Household deaths in 24 months (q0421) 0 no 1 yes 8 don't know*
Age (based on q1011 continuous age variable) 1 50-59 2 60-69 3 70-79 4 80+
Total household members (q0401): continuous integer values
Functional disability score (total sum score based on difficulty performing 12 items of the WHO Disability Assessment Schedule II, prorated for missing items): Q2011: Learning a new task Q2014: Making or maintaining friendships Q2015: Dealing with strangers Q2028: Standing for long periods Q2032: Taking care of household responsibilities Q2033: Participating in community activities in the same way as anyone else Q2035: Concentrating on doing something for 10 minutes Q2036: Walking a long distance Q2037: Bathing/washing body Q2038: Dressing Q2039: Daily work Q2047: Emotional effect
Cognitive Performance (composite z-score of 5 cognitive performance tests, prorated for missing tests) Q2525, q2528, q2531: Immediate verbal recall trials 1-3 Q2544: Delayed verbal recall Q2534: Forward digit span Q2535: Backward digit span Q2536: Verbal fluency

*Don't know, not applicable, & refused were set to missing for analysis. Not applicable for religion was set to none.

Summary of Responses Missing or Coded as Missing for Independent Variables

Variable	**Ghana (n=4209)**	**South Africa (n=3148)**
Age	Complete, used in sample definition	Complete, used in sample definition
Sex	Complete	Complete
Household setting: urban/rural (exposure variable)	Complete	Missing: 1 (0.03%)
Marital status	Don't know: 23 (0.55%)	Don't know: 55 (1.75%)
Highest education level	Don't know: 24 (0.57%)	Don't know: 1 (0.03%) Missing: 59 (1.87%)
Ethnic background	Don't know: 3 (0.07%) Missing: 72 (1.71%)	Don't know: 1 (0.03%) Missing: 10 (0.32%)
Religion	Don't know: 3 (0.07%) Refused: 8 (0.19%) Not applicable: 1 (0.02%)	Refused: 3 (0.10%) Missing: 11 (0.35%)
Work status	Don't know: 10 (0.24%)	Don't know: 7 (0.22%) Missing: 14 (0.44%)
Residential mobility	Don't know: 1 (0.02%)	Missing: 3 (0.10%)
Income quintile	Missing: 5 (0.12%)	Missing: 14 (0.44%)
Total household members	Missing: 2 (0.05%)	Missing: 4 (0.13%)
Deaths in household	Don't know: 11 (0.26%) Missing: 2 (0.05%)	Don't know: 1 (0.03%) Missing: 4 (0.13%)
Cognitive performance	Missing: 11 (0.26%)	Missing: 92 (2.92%)
Functional disability score	Missing: 1 (0.02%)	Missing: 20 (0.64%)

Appendix D: Distribution and Inefficiency Measurements of Individual Survey Weights

Distribution of Weights

	Range	Mean (SD)	Median	IQR (25%-75%)
Ghana	Min: 248.4 Max: 6,325.4	669.6 (387.6)	575.0	454.5-760.1
South Africa	Min: 38.2 Max: 30,414.7	1830.0 (2251.5)	1207.9	552.6 -2238.7

Inefficiency of Weights Based on Crude Analysis

	Coefficient, unweighted	**Standard Error (SE), unweighted**	**Coefficient, weighted**	**Standard Error (SE), weighted**	**Inefficiency***
South Africa:					
Logit model, clustered	0.38	0.23	-.01	0.36	59%
Ghana:					
Logit model, clustered	-.08	0.21	-.04	0.22	7%

* Korn & Graubard (1991) provide a formula for inefficiency that is 1-(SEunwt/SEwt)^2 and suggest applying weights in cases where the inefficiency introduced by the weights is less than 10% or the standard error is small relative to the coefficient's magnitude (Korn & Graubard 2011)

The results of this analysis indicate that the inefficiency is very large for South Africa models and moderate for the Ghana models. However, because standard errors are comparable to, if not larger than the magnitude of the coefficients and for the sake of consistency, unweighted estimates were used for the analytic models in both countries.

Appendix E: Test for Interaction by Sex

Logistic Regression Results for Odds of Depression in Ghana

	Model 1	**Model 2**	**Model 3**
Urban	0.92 (0.61 -1.39)	0.88 (0.59-1.34)	0.84 (0.50-1.41)
Sex	-	1.67 (1.31-2.13)***	1.62 (1.17-2.24)**
Urban*Sex	-	-	1.09 (0.67-1.77)

Logistic Regression Results for Odds of Depression in South Africa

	Model 1	**Model 2**	**Model 3**
Urban	1.46 (0.94 -2.28)	1.45 (0.93-1.42.26)	1.49 (0.72-3.07)
Sex	-	1.24 (0.85-1.81)	1.27 (0.62-2.60)
Urban*Sex	-	-	0.96 (0.41-2.26)

Results do not support significant interaction between sex and urbanicity of residence.

Appendix F: Weighted Regression Results for Odds of Depression

Ghana

	Unadjusted OR (CI)	Adjusted OR (CI): Model 1[a]	Adjusted OR (CI): Model 2[b]
Residence			
Rural	Ref	Ref	Ref
Urban	0.97 (0.63 - 1.48)	0.91 (0.59-1.40)	0.90 (0.59-1.37)
Sex			
Male	Ref	Ref	Ref
Female	1.64 (1.26-2.13)***	1.35 (1.00-1.83)*	1.35 (1.00-1.82)*
Age			
50-59	Ref	Ref	Ref
60-69	1.36 (1.00-1.85)*	1.16 (0.80-1.69)	1.17 (0.80-1.70)
70-79	1.65 (1.12-2.45)*	1.26 (0.76-2.10)	1.27 (0.76-2.12)
80+	2.94 (1.89-4.57)***	1.74 (0.86-3.51)	1.76 (0.87-3.55)
Marital Status			
Never married	Ref	-	-
Married/Cohabiting	1.23 (0.38-3.99)	-	-
Separated/Divorced	2.07 (0.62-6.91)	-	-
Widowed	2.29 (0.69-7.58)	-	-
Education Level			
None	Ref	Ref	Ref
Some Primary	0.82 (0.54-1.25)	1.24 (0.80-1.91)	1.23 (0.79-1.91)
Primary Completed	0.44 (0.27-0.75)**	0.71 (0.41-1.22)	0.71 (0.41-1.22)
Secondary Completed	0.66 (0.47-0.93)*	1.36 (0.84-2.19)	1.35 (0.84-2.19)
Post-Secondary Completed	0.66 (0.22-1.94)	1.70 (0.58-4.96)	1.71 (0.58-4.99)
Ethnicity			
Akan	Ref	Ref	Ref
Ewe	0.44 (0.21-0.94)*	0.45 (0.21-0.97)*	0.45 (0.21-0.96)*
Ga-Adangbe	0.67 (0.38-1.16)	0.66 (0.38-1.14)	0.66 (0.39-1.14)
Gur/Northern	1.13 (0.63-2.03)	1.34 (0.75-2.38)	1.32 (0.74-2.35)
Other	0.78 (0.49-1.24)	0.76 (0.45-1.29)	0.76 (0.45-1.29)
Religion			
None	Ref	-	-
Christianity	0.63 (0.34-1.19)	-	-

	Unadjusted OR (CI)	Adjusted OR (CI): Model 1[a]	Adjusted OR (CI): Model 2[b]
Islam	1.07 (0.55-2.10)	-	-
Primal indigenous	0.63 (0.26-1.54)	-	-
Other	Cd	-	-
Ever Moved			
No	Ref	Ref	Ref
Yes	0.49 (0.34-0.70)***	0.51 (0.35-0.76)**	0.52 (0.35-0.76)**
Employment Status			
Currently working	Ref	Ref	Ref
Never worked	0.98 (0.13-7.58)	0.62 (0.09-4.53)	0.62 (0.09-4.51)
Not working	2.00 (1.46-2.74)***	1.30 (0.88-1.93)	1.31 (0.89-1.94)
Permanent Income Quintile			
1	Ref	Ref	Ref
2	1.50 (1.03-2.19)*	1.60 (1.07-2.38)*	1.59 (1.07-2.37)*
3	1.00 (0.67-1.47)	0.96 (0.63-1.48)	0.96 (0.62-1.47)
4	1.17 (0.72-1.91)	1.19 (0.72-1.96)	1.20 (0.73-1.97)
5	0.75 (0.48-1.18)	0.85 (0.51-1.43)	0.86 (0.52-1.43)
Recent Household Deaths			
No	Ref	Ref	-
Yes	1.92 (0.88-4.19)	1.73 (0.66-4.50)	-
Total Household Members	1.03 (0.97-1.09)	-	-
Functional Disability	1.04 (1.02-1.05)***	1.02 (0.99-1.04)	1.02 (0.99-1.04)
Cognitive Performance	0.90 (0.87-0.92)***	0.94 (0.90-0.98)**	0.94 (0.90-0.98)**

*p<0.05, **p<0.01, ***p<0.001; Cd: category dropped out of analysis due to the absence of depression cases

[a]Model 1 contains age, sex, residential mobility, and the variables reported in the main adjusted analysis in the paper for the sake of comparison (variables significantly associated with the outcome in unweighted bivariate analyses).

[b]Model 2 contains age, sex, residential mobility, and only the covariates significantly associated with the outcome in weighted bivariate analyses.

South Africa

	Unadjusted OR (CI)	Adjusted OR (CI): Model 1[a]	Adjusted OR (CI): Model 2[b]
Residence			
Rural	Ref	Ref	Ref
Urban	0.99 (0.49 - 1.99)	0.89 (0.48-1.63)	1.09 (0.61-1.97)
Sex			
Male	Ref	Ref	Ref
Female	1.48 (0.76-2.88)	1.22 (0.65-2.28)	1.14 (0.59-2.22)
Age			
50-59	Ref	Ref	Ref
60-69	0.69 (0.37-1.29)	0.50 (0.25-1.01)	0.47 (0.24-0.91)*
70-79	0.75 (0.20-2.80)	0.39 (0.10-1.60)	0.42 (0.12-1.50)
80+	0.06 (0.01-0.25)***	0.03 (0.01-0.16)***	0.02 (0.00-0.12)***
Marital Status			
Never married	Ref	Ref	-
Married/Cohabiting	0.86 (0.27-2.76)	1.10 (0.40-2.98)	-
Separated/Divorced	1.47 (0.40-5.39)	1.57 (0.44-5.53)	-
Widowed	0.95 (0.30-3.05)	1.05 (0.31-3.51)	-
Education Level			
None	Ref	Ref	-
Some Primary	2.08 (0.98-4.43)	1.84 (0.73-4.66)	-
Primary Completed	2.21 (1.00-4.92)	2.00 (0.77-5.20)	-
Secondary Completed	2.27 (0.94-5.50)	2.75 (0.65-11.75)	-
Post-Secondary Completed	0.82 (0.28-2.42)	1.24 (0.22-7.07)	-
Ethnicity			
African/Black	Ref	Ref	-
White	0.76 (0.29-1.98)	0.70 (0.22-2.25)	-
Coloured	0.64 (0.33-1.23)	0.54(0.26-1.11)	-
Indian/Asian	1.03 (0.50-2.13)	0.68 (0.26-1.81)	-
Other	Cd	Cd	-
Religion			
None	Ref	-	Ref
Christianity	1.36 (0.38-4.94)	-	1.19 (0.33-4.31)
Hinduism	2.31 (0.54-9.99)	-	1.65 (0.38-7.18)
Islam	0.75 (0.11-5.02)	-	0.39 (0.05-3.26)
Primal indigenous	4.27 (1.02-17.89)*	-	3.44 (0.77-15.33)
Other	0.02 (0.00-0.18)**	-	0.01 (0.00-0.14)***
Ever Moved			
No	Ref	Ref	Ref

	Unadjusted OR (CI)	Adjusted OR (CI): Model 1[a]	Adjusted OR (CI): Model 2[b]
Yes	1.39 (0.73-2.62)	1.36 (0.70-2.66)	1.24 (0.67-2.29)
Employment Status			
Currently working	Ref	Ref	Ref
Never worked	3.18 (0.84-12.04)	3.10 (1.03-9.36)*	2.63 (0.78-8.94)
Not working	3.90 (1.95-7.81)***	5.11 (2.39-10.94)***	4.23 (1.83-9.74)**
Permanent Income Quintile			
1	Ref	Ref	-
2	0.47 (0.14-1.61)	0.45 (0.15-1.36)	-
3	0.84 (0.30-2.38)	0.88 (0.31-2.52)	-
4	0.71 (0.26-1.93)	0.73 (0.26-2.05)	-
5	0.84 (0.32-2.22)	0.96 (0.28-3.27)	-
Recent household deaths			
No	Ref	-	-
Yes	0.88 (0.06-12.10)	-	-
Total Household Members	0.88 (0.78-1.00)	-	-
Functional Disability	1.05 (1.03-1.08)***	1.06 (1.03-1.09)***	1.06 (1.04-1.09)***
Cognitive Performance	1.00 (0.93-1.06)	-	-

*p<0.05, **p<0.01, ***p<0.001; Cd: category dropped out of analysis due to the absence of depression cases

[a]Model 1 contains age, sex, residential mobility, and the covariates reported in the main adjusted analysis of the paper (variables significantly associated with the outcome in unweighted bivariate analyses) for the sake of comparison.

[b]Model 2 includes age, sex, residential mobility, and only the covariates significantly associated with the outcome in weighted bivariate analyses.

Appendix G: Results for Alternate Depressive Outcomes

Ghana

Unadjusted results for affect variable:
OR (urban vs. rural) = 0.75 (95% CI: 0.59-0.96)*; weighted = 0.70 (95% CI: 0.55-0.91)**

Unadjusted results for at least 2 of the main depressive symptoms:
OR (urban vs. rural) = 1.12 (95% CI: 0.86-1.47); weighted = 1.09 (95% CI: 0.82-1.45)

Unadjusted results for main outcome (as reported previously):
OR (urban vs. rural) = 0.92 (95% CI: 0.61-1.39), weighted = 0.97 (95% CI: 0.63 -1.48)

Adjusted Odds Ratios and 95% CIs Comparing Depressive Outcomes

	Main Depression Outcome	**30 Day Depressed Affect**	**At Least 2 Major Diagnostic Symptoms**
Residence			
Rural	Ref	Ref	Ref
Urban	0.85 (0.55-1.31)	0.99 (0.76-1.29)	1.21 (0.90-1.63)
Sex			
Male	Ref	Ref	Ref
Female	1.39 (1.05-1.84)*	0.91 (0.78-1.06)	1.23 (1.00-1.52)
Age			
50-59	Ref	Ref	Ref
60-69	1.25 (0.86-1.93)	0.97 (0.82-1.13)	0.96 (0.75-1.23)
70-79	1.27 (0.81-1.99)	0.68 (0.55-0.85)**	0.84 (0.62-1.13)
80+	1.48 (0.84-2.61)	0.50 (0.36-.69)***	0.69 (0.46—1.04)
Education Level			
None	Ref	Ref	Ref
Some Primary	1.27 (0.84-1.93)	1.10 (0.84-1.45)	1.01 (0.73-1.39)
Primary Completed	0.81 (0.48-1.34)	1.11 (0.86-1.42)	0.94 (0.68-1.30)
Secondary Completed	1.60 (1.03-2.47)*	1.01 (0.78-1.31)	0.99 (0.71-1.36)
Post-Secondary Completed	1.27 (0.48-3.38)	0.81 (0.54-1.21)	0.91 (0.47-1.77)
Ethnicity			
Akan	Ref	Ref	Ref
Ewe	0.52 (0.27-0.99)*	0.99 (0.70-1.39)	0.38 (0.23-0.63)***
Ga-Adangbe	0.60 (0.34-1.06)	0.87 (0.63-1.21)	0.59 (0.41-0.85)**

	Main Depression Outcome	30 Day Depressed Affect	At Least 2 Major Diagnostic Symptoms
Gur/Northern	1.22 (0.71-2.09)	1.03 (0.72-1.47)	0.83 (0.53-1.28)
Other	0.78 (0.46-1.30)	1.03 (0.77-1.37)	0.79 (0.56-1.11)
Ever Moved			
No	Ref	Ref	Ref
Yes	0.54 (0.36-0.80)**	0.83 (0.66-1.03)	0.85 (0.67-1.08)
Employment Status			
Currently working	Ref	Ref	Ref
Never worked	0.19 (0.03-1.48)	1.20 (0.62-2.31)	0.50 (0.21-1.21)
Not working	1.61 (1.18-2.18)**	0.78 (0.64-0.96)*	1.05 (0.81-1.35)
Permanent Income Quintile			
1	Ref	Ref	Ref
2	1.65 (1.14-2.38)**	1.08 (0.85-1.37)	1.52 (1.13-2.05)**
3	1.06 (0.69-1.64)	1.06 (0.83-1.34)	1.32 (0.95-1.84)
4	1.10 (0.70-1.75)	0.67 (0.52-0.87)**	1.08 (0.76-1.53)
5	0.83 (0.52-1.34)	0.63 (0.47-0.85)**	0.91 (0.63-1.33)
Recent Household Deaths			
No	Ref	Ref	Ref
Yes	2.38 (0.94-6.06)	1.53 (0.77-3.03)	1.62 (0.71-3.70)
Functional Disability	1.00 (0.98-1.02)	1.14 (1.12-1.16)***	1.04 (1.03-1.06)***
Cognitive Performance	0.93 (0.89-0.96)***	0.96 (0.94-0.99)*	0.93 (0.89-0.96)***

*p<0.05, **p<0.01, ***p<0.001
All models are complete case analyses using the same covariates as the main depression outcome model for the sake of comparison regardless of the significance of individual variables in bivariate analyses with the alternate outcomes

South Africa

Unadjusted results for affect variable:
OR (urban vs. rural) = 1.13 (95% CI: 0.88-1.45); weighted: 1.05 (95% CI: 0.78-1.41)

Unadjusted results for at least 2 of the main depressive symptoms:
OR (urban vs. rural) = 1.12 (95% CI: 0.73-1.72); weighted =1.05 (95% CI: 0.58-1.92)

Unadjusted results for main outcome (as reported previously):
OR (urban vs. rural) =1.46 (95% CI: 0.94 -2.28); weighted =0.99 (95% CI: 0.49-1.99)

Adjusted Odds Ratios and 95% CIs Comparing Depressive Outcomes

	Main Depression Outcome	30 Day Depressed Affect	At Least 2 Major Diagnostic Symptoms
Residence			
Rural	Ref	Ref	Ref
Urban	1.13 (0.71-1.79)	1.00 (0.73-1.38)	0.97 (0.63-1.48)
Sex			
Male	Ref	Ref	Ref
Female	0.96 (0.65-1.42)	0.98 (0.81-1.18)	1.54 (1.16-2.05)**
Age			
50-59	Ref	Ref	Ref
60-69	0.36 (0.23-0.56)***	0.62 (0.51-0.75)***	0.46 (0.33-0.63)***
70-79	0.24 (0.12-0.45)***	0.38 (0.29-0.50)***	0.33 (0.21-0.51)***
80+	0.08 (0.02-0.32)**	0.18 (0.10-0.30)***	0.19 (0.09-0.40)***
Marital Status			
Never married	Ref	Ref	Ref
Married/Cohabiting	1.26 (0.67-2.37)	0.94 (0.72-1.23)	0.94 (0.62-1.42)
Separated/Divorced	2.46 (1.07-5.65)*	1.39 (0.95-2.06)	1.27 (0.68-2.37)
Widowed	2.09 (1.03-4.22)*	1.18 (0.90-1.55)	1.41 (0.87-2.28)
Education Level			
None	Ref	Ref	Ref
Some Primary	1.23 (0.70-2.16)	0.70 (0.53-0.92)*	0.92 (0.61-1.38)
Primary Completed	1.21 (0.68-2.15)	0.78 (0.59-1.04)	0.85 (0.56-1.29)
Secondary Completed	0.97 (0.49-1.91)	0.66 (0.48-0.90)**	0.83 (0.52-1.34)
Post-Secondary Completed	0.77 (0.23-2.56)	0.68 (0.42-1.10)	0.64 (0.30-1.38)
Ethnicity			
African/Black	Ref	Ref	Ref
White	1.48 (0.65-3.37)	0.85 (0.53-1.37)	1.30 (0.67-2.52)
Coloured	1.16 (0.76-1.78)	1.04 (0.76-1.42)	0.83 (0.55-1.24)

	Main Depression Outcome	30 Day Depressed Affect	At Least 2 Major Diagnostic Symptoms
Indian/Asian	1.34 (0.71-2.56)	1.61 (1.06-2.45)*	1.36 (0.88-2.12)
Other	Cd	1.22 (0.14-10.46)	2.34 (0.28-19.86)
Ever Moved			
No	Ref	Ref	Ref
Yes	1.09 (0.74-1.60)	1.72 (1.34-2.20)***	1.39 (1.05-1.85)
Employment Status			
Currently working	Ref	Ref	Ref
Never worked	2.18 (1.02-4.67)*	0.95 (0.63-1.44)	1.04 (0.60-1.79)
Not working	3.07 (1.71-5.51)***	0.93 (0.74-1.17)	1.56 (1.05-2.30)*
Permanent Income Quintile			
1	Ref	Ref	Ref
2	0.87 (0.43-1.77)	1.06 (0.79-1.43)	0.93 (0.53-1.62)
3	1.74 (0.99-3.03)	1.20 (0.85-1.69)	1.27 (0.78-2.06)
4	1.59 (0.82-3.09)	1.29 (0.91-1.81)	1.27 (0.75-2.17)
5	2.13 (1.10-4.15)*	1.37 (0.90-2.08)	1.56 (0.90-2.69)
Functional Disability	1.04 (1.02-1.06)***	1.17 (1.15-1.19)***	1.05 (1.04-1.06)***

*p<0.05, **p<0.01, ***p<0.001

Cd: category dropped out of analysis due to the absence of depression cases

All models are complete case analyses using the same covariates as the main depression outcome model for the sake of comparison regardless of the significance of individual variables in bivariate analyses with the alternate outcomes.

Appendix H: Description of Exposure Variables for Manuscript 2

Survey Questions Used to Define Exposure Variables:

Q1020: Have you always lived in this village/town/city? Yes/No (if yes, skip to q1025)
Q1021: How long have you been living (continuously) in this area?
Q1022: Where were you living before?
Q1023: Where have you lived for most of your adult life (18+ years)?
Q1024: Where did you live for most of your childhood (before age 10 years)?

Original Response Options for Q1022-Q1024 and Corresponding Definitions for Study Variables:

1 in same community/locality/neighborhood: *(coded as rural or urban based on current household location)*
2 in another city in this region: *(coded as urban)*
3 in another rural area in this region: *(coded as rural)*
4 in another city outside this region but in country: *(coded as urban)*
5 in another rural area outside this region but in country: *(coded as rural)*
6 outside the country: *(coded as don't know & converted to missing)*

Appendix I: Comparison of Weighted & Unweighted Regression Results for Manuscript 2

Part 1: Urbanicity of Residence at Different Life Stages

Unadjusted Odds of Depression

	Ghana		South Africa	
	Unweighted	**Weighted**	**Unweighted**	**Weighted**
Primary Childhood Residence				
Rural	Ref	Ref	Ref	Ref
Urban	0.91 (0.61-1.35)	0.93 (0.61-1.42)	1.18 (0.83-1.69)	0.85 (0.47-1.52)
Primary Adulthood Residence				
Rural	Ref	Ref	Ref	Ref
Urban	0.87 (0.59-1.29)	0.87 (0.58-1.32)	1.28 (0.87-1.88)	0.85 (0.47-1.56)

All analyses take into account the clustered and stratified design.

Adjusted Odds of Depression: Ghana

	Primary Childhood Residence		Primary Adulthood Residence	
	Unweighted	**Weighted**	**Unweighted**	**Weighted**
Rural	Ref	Ref	Ref	Ref
Urban	0.80 (0.53-1.20)	0.82 (0.53-1.26)	0.80 (0.53-1.20)	0.81 (0.53-1.23)
Sex				
Male	Ref	Ref	Ref	Ref
Female	1.44 (1.09-1.91)*	1.39 (1.03-1.87)*	1.43 (1.08-1.90)*	1.39 (1.03-1.88)*
Age				
50-59	Ref	Ref	Ref	Ref
60-69	1.27 (0.87-1.86)	1.15 (0.78-1.69)	1.26 (0.87-1.84)	1.16 (0.80-1.69)
70-79	1.27 (0.81-2.00)	1.27 (0.77-2.11)	1.26 (0.81-1.96)	1.25 (0.75-2.07)
80+	1.52 (0.87-2.65)	1.79 (0.89-3.58)	1.49 (0.85-2.59)	1.74 (0.87-3.49)
Education Level				
None	Ref	Ref	Ref	Ref
Some Primary	1.24 (0.82-1.90)	1.22 (0.78-1.69)	1.22 (0.80-1.84)	1.20 (0.77-1.85)
Primary Completed	0.84 (0.51-1.39)	0.77 (0.45-1.30)	0.84 (0.51-1.38)	0.76 (0.45-1.29)

	Primary Childhood Residence		Primary Adulthood Residence	
	Unweighted	Weighted	Unweighted	Weighted
Secondary Completed	1.63 (1.04-2.55)*	1.37 (.84-2.23)	1.61 (1.03-2.50)*	1.36 (0.84-2.20)
Post-Secondary Completed	1.25 (0.47-3.37)	1.68 (0.57-4.95)	1.27 (0.47-3.42)	1.75 (0.60-5.12)
Ethnicity				
Akan	Ref	Ref	Ref	Ref
Ewe	0.50 (0.26-0.97)	0.44 (0.21-0.95)	0.50 (0.26-0.97)	0.44 (0.21-0.94)
Ga-Adangbe	0.61 (0.35-1.06)	0.69 (0.41-1.16)	0.61 (0.35-1.06)	0.69 (0.41-1.16)
Gur/Northern	1.19 (0.69-2.03)	1.32 (0.74-2.34)	1.18 (0.69-2.01)	1.30 (0.73-2.32)
Other	0.77 (0.46-1.29)	0.74 (0.43-1.25)	0.78 (0.47-1.30)	0.76 (0.45-1.28)
Ever Moved				
No	Ref	Ref	Ref	Ref
Yes	0.55 (0.37-0.83)**	0.52 (0.35-0.76)**	0.59 (0.40-0.86)**	0.55 (0.38-0.80)**
Employment Status				
Currently working	Ref	Ref	Ref	Ref
Never worked	0.19 (0.03-1.47)	0.63 (0.09-4.48)	0.19 (0.03-1.46)	0.64 (0.09-4.51)
Not working	1.61 (1.19-2.18)**	1.30 (0.88-1.92)	1.62 (1.20-2.19)**	1.33 (0.90-1.95)
Permanent Income Quintile				
1	Ref	Ref	Ref	Ref
2	1.58 (1.08-2.30)*	1.57 (1.05-2.34)*	1.55 (1.07-2.25)*	1.55 (1.04-2.31)*
3	1.03 (0.67-1.60)	0.93 (0.60-1.45)	1.03 (0.67-1.60)	0.96 (0.62-1.48)
4	1.10 (0.70-1.72)	1.12 (0.73-1.97)	1.08 (0.69-1.70)	1.20 (0.73-1.96)
5	0.83 (0.52-1.34)	0.89 (0.54-1.49)	0.82 (0.51-1.32)	0.89 (0.54-1.48)
Recent Household Deaths				
No	Ref	Ref	Ref	Ref
Yes	2.30 (0.91-5.83)	1.69 (0.65-4.37)	2.25 (0.89-5.72)	2.25 (0.89-5.72)
Functional Disability	1.00 (0.99-1.02)	1.02 (0.99-1.03)	1.00 (0.99-1.02)	1.00 (0.99-1.02)

	Primary Childhood Residence		Primary Adulthood Residence	
	Unweighted	**Weighted**	**Unweighted**	**Weighted**
Cognitive Performance	0.93 (0.89-0.96)***	0.94 (090-0.98)**	0.93 (0.90-0.97)***	0.93 (0.90-0.97)***

* p< 0.05, ** p<0.01, *** p<0.001. All analyses take into account the clustered and stratified design. The adjusted models include variables significantly associated with the outcome in unweighted bivariate analyses.

Adjusted Odds of Depression: South Africa

	Primary Childhood Residence		Primary Adulthood Residence	
	Unweighted	**Weighted**	**Unweighted**	**Weighted**
Rural	Ref	Ref	Ref	Ref
Urban	1.00 (0.66-1.53)	1.01 (0.55-1.86)	1.01 (0.65-1.56)	0.92 (0.50-1.70)
Sex				
Male	Ref	Ref	Ref	Ref
Female	0.95 (0.64-1.41)	1.18 (0.64-2.18)	0.96 (0.65-1.42)	1.19 (0.65-2.20)
Age				
50-59	Ref	Ref	Ref	Ref
60-69	0.38 (0.24-0.61)***	0.51 (0.25-1.05)	0.39 (0.24-0.61)***	0.52 (0.25-1.05)
70-79	0.24 (0.12-0.45)***	0.39 (0.09-1.61)	0.24 (0.12-0.45)***	0.38 (0.09-1.56)
80+	0.07(0.02-0.29)***	0.02 (0.00-0.11)***	0.07 (0.02-0.29)***	0.02 (0.00-0.11)***
Marital Status				
Never married	Ref	Ref	Ref	Ref
Married/Cohabiting	1.31 (0.70-2.45)	1.20 (0.44-3.21)	1.30 (0.69-2.44)	1.18 (0.44-3.20)
Separated/Divorced	2.49 (1.08-5.75)*	1.57 (0.43-5.72)	2.47 (1.07-5.71)*	1.54 (0.42-5.61)
Widowed	2.09 (1.05-4.19)*	1.05 (0.32-3.45)	2.07 (1.03-4.17)*	1.03 (0.31-3.42)
Education Level				
None	Ref	Ref	Ref	Ref
Some Primary	1.26 (0.72-2.19)	1.74 (0.72-4.22)	1.25 (0.72-2.17)	1.75 (0.72-4.26)
Primary Completed	1.17 (0.66-2.08)	1.73 (0.68-4.37)	1.17 (0.66-2.06)	1.78 (0.70-4.57)
Secondary Completed	1.01 (0.52-1.97)	2.54 (0.61-10.54)	1.00 (0.51-1.95)	2.59 (0.62-10.83)

	Primary Childhood Residence		Primary Adulthood Residence	
	Unweighted	Weighted	Unweighted	Weighted
Post-Secondary Completed	0.81 (0.24-2.72)	1.24 (0.21-7.23)	0.78 (0.23-2.62)	1.25 (0.21-7.30)
Ethnicity				
African/Black	Ref	Ref	Ref	Ref
White	1.47 (0.63-3.39)	0.71 (0.22-2.32)	1.46 (0.63-3.40)	0.71 (0.22-2.33)
Coloured	1.18 (0.76-1.83)	0.53 (0.25-1.13)	1.18 (0.76-1.82)	0.54 (0.26-1.15)
Indian/Asian	1.41 (0.75-2.64)	0.78 (0.29-2.07)	1.40 (0.73-2.69)	0.80 (0.30-2.12)
Other [a]	-	-	-	-
Ever Moved				
No	Ref	Ref	Ref	Ref
Yes	1.09 (0.75-1.59)	1.35 (0.70-2.62)	1.10 (0.76-1.58)	1.36 (0.71-2.60)
Employment Status				
Currently working	Ref	Ref	Ref	Ref
Never worked	1.98 (0.93-4.21)	2.62 (0.81-8.43)	1.98 (0.93-4.19)	2.56 (0.80-8.12)
Not working	2.84 (1.59-5.07)***	4.37 (2.04-9.33)***	2.84 (1.59-5.07)***	4.36 (2.05-9.28)***
Permanent income quintile				
1	Ref	Ref	Ref	Ref
2	0.99 (0.50-1.97)	0.52 (0.19-1.43)	0.99 (0.50-1.96)	0.52 (0.19-1.44)
3	1.71 (0.97-3.01)	0.86 (0.30-2.45)	1.72 (0.98-3.03)	0.87 (0.30-2.48)
4	1.68 (0.86-3.30)	0.74 (0.26-2.15)	1.69 (0.86-3.30)	0.75 (0.26-2.17)
5	2.21 (1.12-4.37)*	0.93 (0.27-3.20)	2.22 (1.13-4.38)*	0.95 (0.28-3.26)
Functional disability	1.04 (1.02-1.07)***	1.07 (1.04-1.10)***	1.05 (1.02-1.07)***	1.07 (1.04-1.10)***

* p< 0.05, ** p<0.01, *** p<0.001; [a] category dropped out of analysis due to the absence of depression cases.

All analyses take into account the clustered and stratified design. The adjusted models include variables significantly associated with the outcome in unweighted bivariate analyses.

Adjusted ORs and Confidence Intervals for Models Controlling for Current Residence

	Ghana		South Africa	
	Unweighted	**Weighted**	**Unweighted**	**Weighted**
Childhood Residence				
Rural	Ref	Ref	Ref	Ref
Urban	0.75 (0.43-1.32)	0.74 (0.40-1.37)	0.98 (0.56-1.72)	1.29 (0.69-2.40)
Adulthood Residence				
Rural	Ref	Ref	Ref	Ref
Urban	0.66 (0.35-1.23)	0.58 (0.30-1.11)	0.99 (0.57-1.70)	1.13 (0.60-2.16)

In the childhood residence adjusted models, the OR for the current residence control variable was 1.03 (95% CI: 0.57-1.85) unweighted and 0.69 (95% CI: 0.37-1.26) weighted for South Africa and 1.07 (95% CI: 0.59-1.95) unweighted and 1.15 (95% CI: 0.62-2.10) weighted for Ghana. In adulthood residence models, the ORs for current residence were 1.03 (95% CI: 0.59-1.80) unweighted and 0.74 (95% CI: 0.41-1.37) weighted in South Africa and 1.26 (95% CI: 0.64-2.49) unweighted and 1.49 (95% CI: 0.77-2.88) weighted in Ghana.

Part 2: Urbanicity of Residence across the Life Course

Unadjusted Odds of Depression for Life-Course Urban/Rural Residence

	Ghana		South Africa	
	Unweighted	**Weighted**	**Unweighted**	**Weighted**
Rural-Rural-Rural	Ref	Ref	Ref	Ref
Rural-Rural-Urban	1.01 (0.51-2.01)	1.07 (0.52-2.20)	0.93 (0.35-2.43)	0.68 (0.18-2.59)
Rural-Urban-Urban	0.42 (0.18-0.99)*	0.43 (0.17-1.08)	2.06 (0.67-6.32)	0.79 (0.17-3.64)
Rural-Urban-Rural	0.38 (0.09-1.64)	0.22 (0.05-0.98)*	2.29 (0.29-18.36)	0.82 (0.09-7.54)
Urban-Rural-Rural	0.59 (0.17-1.99)	0.74 (0.21-2.57)	2.29 (0.90-18.17)	0.60 (0.07-5.37)
Urban-Urban-Rural	0.66 (0.29-1.49)	0.58 (0.23-1.42)	0.30 (0.04-1.97)	0.17 (0.02-1.29)
Urban-Rural-Urban[a]	-	-	-	-
Urban-Urban-Urban	0.92 (0.59-1.42)	0.94 (0.59-1.48)	1.29 (0.85-1.95)	0.84 (0.43-1.62)

All analyses take into account the clustered and stratified design. *p<0.05
[a]category dropped out of analysis due to the absence of depression cases.

Adjusted Odds of Depression for Life-Course Residence: Ghana

	Unweighted	Weighted
Life-Course Residence		
Rural-Rural-Rural	Ref	Ref
Rural-Rural-Urban	1.76 (0.75-4.16)	1.93 (0.83-4.53)
Rural-Urban-Urban	0.75 (0.28-2.03)	0.82 (0.29-2.38)
Rural-Urban-Rural	0.62 (0.13-2.88)	0.40 (0.08-1.89)
Urban-Rural-Rural	1.01 (0.27-3.77)	1.48 (0.39-5.70)
Urban-Urban-Rural	1.09 (0.51-2.32)	0.99 (0.38-2.60)
Urban-Rural-Urban[a]	-	-
Urban-Urban-Urban	0.80 (0.50-1.26)	0.82 (0.52-1.31)
Sex		
Male	Ref	Ref
Female	1.43 (1.09-1.90)*	1.39 (1.03-1.86)*
Age		
50-59	Ref	Ref
60-69	1.27 (0.87-1.87)	1.16 (0.79-1.70)
70-79	1.29 (0.82-2.03)	1.29 (0.78-2.15)
80+	1.52 (0.86-2.68)	1.79 (0.89-3.60)
Education Level		
None	Ref	Ref
Some Primary	1.25 (0.82-1.91)	1.23 (0.79-1.91)
Primary Completed	0.85 (0.51-1.40)	0.77 (0.46-1.31)
Secondary Completed	1.65 (1.06-2.58)*	1.40 (.86-2.28)
Post-Secondary Completed	1.28 (0.47-3.48)	1.80 (0.61-5.31)
Ethnicity		
Akan	Ref	Ref
Ewe	0.51 (0.26-0.98)	0.45 (0.21-0.96)*
Ga-Adangbe	0.62 (0.36-1.07)	0.69 (0.41-1.17)
Gur/Northern	1.18 (0.69-2.02)	1.29 (0.73-2.29)
Other	0.77 (0.46-1.29)	0.73 (0.43-1.25)
Ever Moved		
No	Ref	Ref
Yes	0.52 (0.33-0.83)**	0.48 (0.30-0.75)**
Employment Status		
Currently working	Ref	Ref
Never worked	0.19 (0.03-1.47)	0.63 (0.09-4.46)
Not working	1.62 (1.19-2.20)**	1.31 (0.89-1.94)
Permanent Income Quintile		
1	Ref	Ref
2	1.58 (1.08-2.30)*	1.57 (1.05-2.34)*
3	1.02 (0.66-1.58)	0.92 (0.59-1.43)
4	1.08 (0.69-1.70)	1.18 (0.72-1.94)
5	0.82 (0.51-1.30)	0.87 (0.52-1.45)
Recent Household Deaths		

	Unweighted	Weighted
No	Ref	Ref
Yes	2.30 (0.91-5.79)	1.67 (0.65-4.30)
Functional Disability	1.00 (0.98-1.02)	1.02 (0.99-1.04)
Cognitive Performance	0.93 (0.89-0.96)***	0.94 (090-0.98)**

* p< 0.05, ** p<0.01, *** p<0.001.
[a] category dropped out of analysis due to the absence of depression cases.
All analyses take into account the clustered and stratified design. The adjusted models include variables significantly associated with the outcome in unweighted bivariate analyses.

Adjusted Odds of Depression for Life-Course Residence: South Africa

	Unweighted	Weighted
Life-Course Residence		
Rural-Rural-Rural	Ref	Ref
Rural-Rural-Urban	0.55 (0.19-1.60)	0.28 (0.07-1.06)
Rural-Urban-Urban	1.04 (0.29-3.75)	0.28 (0.04-2.00)
Rural-Urban-Rural[a]	-	-
Urban-Rural-Rural	1.62 (0.15-17.50)	0.58 (0.06-5.75)
Urban-Urban-Rural	0.24 (0.04-1.66)	0.11 (0.01-0.99)*
Urban-Rural-Urban[a]	-	-
Urban-Urban-Urban	0.97 (0.61-1.54)	0.80 (0.43-1.52)
Sex		
Male	Ref	Ref
Female	0.97 (0.65-1.44)	1.17 (0.64-2.14)
Age		
50-59	Ref	Ref
60-69	0.38 (0.24-0.61)***	0.49 (0.24-0.99)*
70-79	0.24 (0.13-0.46)***	0.37 (0.10-1.43)
80+	0.07(0.02-0.30)***	0.02 (0.00-0.10)***
Marital Status		
Never married	Ref	Ref
Married/Cohabiting	1.32 (0.71-2.46)	1.14 (0.42-3.10)
Separated/Divorced	2.43 (1.06-5.59)*	1.54 (0.43-5.53)
Widowed	2.02 (1.01-4.06)*	0.98 (0.31-3.15)
Education Level		
None	Ref	Ref
Some Primary	1.25 (0.72-2.16)	1.87 (0.77-4.50)
Primary Completed	1.18 (0.67-2.09)	1.94 (0.75-5.05)
Secondary Completed	1.01 (0.52-1.98)	2.76 (0.66-11.53)
Post-Secondary Completed	0.79 (0.23-2.69)	1.32 (0.23-7.49)
Ethnicity		
African/Black	Ref	Ref
White	1.47 (0.62-3.44)	0.71 (0.21-2.38)
Coloured	1.17 (0.75-1.82)	0.51 (0.23-1.09)
Indian/Asian	1.38 (0.74-2.59)	0.67 (0.25-1.83)

	Unweighted	Weighted
Other [a]	-	-
Ever Moved		
No	Ref	Ref
Yes	1.30 (0.83-2.01)	1.97 (0.95-4.11)
Employment Status		
Currently working	Ref	Ref
Never worked	1.97 (0.93-4.18)	2.83 (0.86-9.24)
Not working	2.81 (1.57-5.02)**	4.72 (2.24-9.95)***
Permanent Income Quintile		
1	Ref	Ref
2	1.01 (0.51-2.00)	0.57 (0.22-1.47)
3	1.72 (0.98-3.03)	0.94 (0.34-2.64)
4	1.71 (0.88-3.32)	0.86 (0.31-2.38)
5	2.19 (1.11-4.31)*	1.09 (0.34-3.52)
Functional Disability	1.05 (1.02-1.07)***	1.07 (1.04-1.10)***

* p< 0.05, ** p<0.01, *** p<0.001.

[a] category dropped out of analysis due to the absence of depression cases.

All analyses take into account the clustered and stratified design. The adjusted models include variables significantly associated with the outcome in unweighted bivariate analyses.

Appendix J: Cross-Tabulations of Social Capital Items with Exposure and Outcome Variables

Distribution of Social Capital Items by Current Residence

Ghana

	Rural			Urban			Total			
	N	**%**	***W%***	**N**	**%**	***W%***	**N**	**%**	***W%***	
meet										**P <0.001** (P=0.071)
never	1123	45.4	*44.7*	892	52.1	*51.2*	2015	48.1	*47.4*	
1/2x per yr	886	35.8	*36.0*	542	31.6	*32.5*	1428	34.1	*34.6*	
1/2x per mo	362	14.6	*14.7*	212	12.4	*12.3*	574	13.7	*13.7*	
1/2x per wk	92	3.7	*4.0*	65	3.8	*3.9*	157	3.7	*3.9*	
daily	11	0.4	*0.5*	2	0.1	*0.1*	13	0.3	*0.4*	
lead										**P <0.001**
never	690	27.9	*26.8*	745	43.5	*45.1*	1435	34.3	*34.3*	
1/2x per yr	401	16.2	*16.9*	402	23.5	*23.6*	803	19.2	*19.7*	
1/2x per mo	697	28.2	*28.8*	320	18.7	*17.5*	1017	24.3	*24.2*	
1/2x per wk	511	20.7	*20.2*	215	12.6	*11.8*	726	17.3	*16.7*	
daily	175	7.1	*7.3*	31	1.8	*2.0*	206	4.9	*5.1*	
club										P=0.095 (P=0.663)
never	999	40.4	*39.1*	643	37.6	*38.4*	1642	39.3	*38.8*	
1/2x per yr	409	16.5	*17.2*	285	16.7	*17.1*	694	16.6	*17.1*	
1/2x per mo	624	25.2	*25.3*	423	24.7	*23.5*	1047	25.0	*24.6*	
1/2x per wk	419	16.9	*17.0*	345	20.2	*19.9*	764	18.3	*18.2*	
daily	21	0.8	*1.5*	15	0.9	*1.1*	36	0.9	*1.3*	
neigh										**P <0.001**
never	1034	41.8	*39.6*	881	51.5	*51.0*	1915	45.7	*44.3*	
1/2x per yr	543	21.9	*23.2*	391	22.9	*24.5*	934	22.3	*23.7*	
1/2x per mo	512	20.7	*21.3*	272	15.9	*14.9*	784	18.7	*18.7*	
1/2x per wk	363	14.7	*14.8*	159	9.3	*9.0*	522	12.5	*12.4*	
daily	23	0.9	*1.1*	8	0.5	*0.7*	31	0.7	*1.0*	
guest										**P <0.001 (P=0.002)**
never	266	10.8	*10.5*	227	13.3	*13.6*	493	11.8	*11.8*	
1/2x per yr	201	8.2	*8.8*	219	12.8	*13.3*	420	10.1	*10.6*	
1/2x per mo	474	19.3	*19.8*	389	22.8	*23.1*	863	20.7	*21.2*	
1/2x per wk	706	28.7	*28.6*	481	28.2	*27.7*	1187	28.5	*28.3*	
daily	812	33.0	*32.2*	390	22.9	*22.2*	1202	28.9	*28.1*	
visit										**P <0.001 (P=0.009)**

	Rural			Urban			Total			
	N	**%**	***W%***	**N**	**%**	***W%***	**N**	**%**	***W%***	
never	425	17.2	*15.8*	325	19.0	*19.5*	750	17.9	*17.3*	
1/2x per yr	302	12.2	*12.0*	291	17.0	*17.5*	593	14.2	*14.2*	
1/2x per mo	620	25.0	*26.9*	424	24.8	*24.4*	1044	24.9	*25.9*	
1/2x per wk	655	26.5	*26.6*	419	24.5	*24.4*	1074	25.7	*25.7*	
daily	474	19.1	*18.7*	251	14.7	*14.2*	725	17.3	*16.9*	
cowrk										**P <0.001**
never	999	40.4	*38.3*	737	43.3	*44.2*	1736	41.6	*40.7*	
1/2x per yr	219	8.9	*9.1*	207	12.2	*12.0*	426	10.2	*10.3*	
1/2x per mo	355	14.4	*14.4*	279	16.4	*16.6*	634	15.2	*15.3*	
1/2x per wk	599	24.2	*25.4*	320	18.8	*17.7*	919	22.0	*22.3*	
daily	299	12.1	*12.8*	158	9.3	*9.5*	457	11.0	*11.4*	
relig										**P <0.001** (P=0.083)
never	397	16.1	*14.4*	190	11.1	*11.1*	587	14.1	*13.1*	
1/2x per yr	127	5.1	*4.7*	98	5.7	*5.9*	225	5.4	*5.2*	
1/2x per mo	455	18.4	*18.5*	264	15.5	*15.9*	719	17.2	*17.4*	
1/2x per wk	1197	48.5	*50.8*	918	53.8	*52.6*	2115	50.6	*51.5*	
daily	294	11.9	*11.6*	237	13.9	*14.5*	531	12.7	*12.8*	
out										**P=0.006** (P=0.155)
never	354	14.3	*13.3*	240	14.1	*14.8*	594	14.2	*13.9*	
1/2x per yr	383	15.5	*15.3*	333	19.5	*19.9*	716	17.1	*17.2*	
1/2x per mo	628	25.4	*25.9*	441	25.8	*25.3*	1069	25.6	*25.7*	
1/2x per wk	704	28.5	*29.9*	452	26.5	*26.6*	1156	27.7	*28.5*	
daily	405	16.4	*15.5*	240	14.1	*13.4*	645	15.4	*14.6*	
adequate										**P=0.004** P=0.060
go out more	269	10.9	*10.4*	244	14.2	*14.7*	513	12.3	*12.1*	
satisfied	1946	78.8	*79.9*	1313	76.6	*75.7*	3259	77.9	*78.2*	
go out less	253	10.3	*9.7*	157	9.2	*9.6*	410	9.8	*9.7*	
trust										**P<0.001**
can't be trusted	787	32.0	*31.8*	803	47.1	*48.5*	1590	38.2	*38.7*	
can be trusted	1674	68.0	*68.2*	903	52.9	*51.5*	2577	61.8	*61.3*	
support										**P<0.001 (P=0.019)**
no	476	19.5	*18.9*	417	24.6	*24.0*	893	21.6	*21.0*	
yes	1964	80.5	*81.1*	1278	75.4	*76.0*	3242	78.4	*79.0*	
revtrstn										**P<0.001**
To a very great extent	378	15.3	*14.4*	184	10.7	*10.6*	562	13.4	*12.9*	
To a great extent	1127	45.5	*46.8*	616	36.0	*35.2*	1743	41.6	*42.1*	

	Rural			Urban			Total			
	N	**%**	***W%***	**N**	**%**	***W%***	**N**	**%**	***W%***	
Neither great nor small extent	576	23.3	*22.7*	427	24.9	*25.7*	1003	23.9	*23.9*	
To a small extent	314	12.7	*12.6*	281	16.4	*16.6*	595	14.2	*14.3*	
To a very small extent	80	3.2	*3.4*	205	12.0	*11.9*	285	6.8	*6.9*	
revtrstw										**P<0.001**
To a very great extent	290	11.7	*11.1*	166	9.7	*10.0*	456	10.9	*10.7*	
To a great extent	894	36.1	*35.7*	478	28.1	*27.1*	1372	32.8	*32.2*	
Neither great nor small extent	617	24.9	*25.3*	462	27.1	*26.3*	1079	25.8	*25.7*	
To a small extent	545	22.0	*22.3*	386	22.7	*24.4*	931	22.3	*23.2*	
To a very small extent	129	5.2	*5.6*	212	12.4	*12.1*	341	8.2	*8.2*	
revtrsts										**P<0.001**
To a very great extent	94	3.8	*4.1*	64	3.7	*4.0*	158	3.8	*4.1*	
To a great extent	434	17.5	*18.5*	227	13.3	*13.2*	661	15.8	*16.3*	
Neither great nor small extent	776	31.3	*29.8*	414	24.2	*22.9*	1190	28.4	*27.0*	
To a small extent	576	23.3	*22.5*	440	25.7	*25.0*	1016	24.3	*23.5*	
To a very small extent	596	24.1	*25.0*	568	33.2	*34.9*	1164	27.8	*29.1*	

W% denotes weighted proportions accounting for survey design weights.
P-values in parentheses are based on Pearson design-based F statistics for weighted results. Where no second p-value is listed, the p-value is also <0.001 as in the chi-square results

This output shows that interpersonal interactions and social activities (such as having guests over) are more common than community activities (attending public meetings, meeting with leaders, etc). In addition, it appears that rural residents are more active in their communities and social interactions based on the lower proportion responding never or less frequent activity (this isn't really the case for religious attendance or club membership). Rural residents also appear to be more trusting, more likely to have a confidant, and feel slightly more satisfied with the frequency of their outings. When the data is weighted, significance is lost for the public meetings, club participation, religious attendance, and social outings, and the adequacy of outings becomes borderline significant.

South Africa

Current Residence	Rural			Urban			Total			
	N	**%**	***W%***	**N**	**%**	***W%***	**N**	**%**	***W%***	
meet										**P<0.001**
never	392	39.9	*39.4*	1258	61.7	*58.0*	1650	54.6	*51.7*	
1/2x per yr	282	28.7	*31.6*	478	23.4	*24.3*	760	25.1	*26.7*	
1/2x per mo	258	26.2	*25.3*	276	13.5	*16.1*	534	17.7	*19.2*	
1/2x per wk	50	5.1	*3.7*	25	1.2	*1.6*	75	2.5	*2.3*	
daily	1	0.1	*0.1*	2	0.1	*0.1*	3	0.1	*0.1*	
lead										**P<0.001**
never	422	42.9	*41.8*	1244	61.1	*58.5*	1666	55.2	*52.9*	
1/2x per yr	239	24.3	*29.0*	436	21.4	*24.2*	675	22.4	*25.8*	
1/2x per mo	274	27.9	*25.9*	309	15.2	*15.2*	583	19.3	*18.8*	
1/2x per wk	43	4.4	*2.9*	39	1.9	*1.8*	82	2.7	*2.2*	
daily	5	0.5	*0.4*	9	0.4	*0.3*	14	0.5	*0.3*	
club										**P<0.001** (P=0.053)
never	446	45.4	*44.1*	1143	56.2	*48.4*	1589	52.7	*46.9*	
1/2x per yr	168	17.1	*18.0*	319	15.7	*17.1*	487	16.1	*17.4*	
1/2x per mo	323	32.9	*32.9*	488	24.0	*29.1*	811	26.9	*30.4*	
1/2x per wk	44	4.5	*3.9*	82	4.0	*5.3*	126	4.2	*4.9*	
daily	2	0.2	*1.1*	3	0.1	*0.1*	5	0.2	*0.4*	
neigh										**P<0.001 (P=0.038)**
never	483	49.3	*44.8*	1215	60.0	*51.5*	1698	56.5	*49.2*	
1/2x per yr	231	23.6	*28.1*	333	16.4	*19.2*	564	18.8	*22.2*	
1/2x per mo	192	19.6	*20.4*	386	19.1	*22.3*	578	19.2	*21.7*	
1/2x per wk	68	6.9	*6.3*	78	3.9	*6.4*	146	4.9	*6.4*	
daily	6	0.6	*0.3*	13	0.6	*0.5*	19	0.6	*0.5*	
guest										**P<0.001 P=0.006**
never	155	15.8	*12.3*	219	10.8	*10.6*	374	12.4	*11.2*	
1/2x per yr	169	17.2	*16.7*	204	10.0	*8.5*	373	12.4	*11.3*	
1/2x per mo	275	28.0	*24.9*	601	29.6	*31.3*	876	29.1	*29.1*	
1/2x per wk	284	28.9	*34.7*	734	36.2	*39.1*	1018	33.8	*37.6*	
daily	100	10.2	*11.4*	272	13.4	*10.5*	372	12.3	*10.8*	
visit										**P<0.001** P=0.054
never	205	20.9	*17.7*	301	14.8	*13.4*	506	16.8	*14.9*	
1/2x per yr	205	20.9	*21.3*	352	17.3	*16.9*	557	18.5	*18.4*	
1/2x per mo	313	31.9	*34.7*	677	33.4	*35.1*	990	32.9	*34.9*	
1/2x per wk	226	23.0	*23.0*	598	29.5	*31.4*	824	27.4	*28.6*	
daily	33	3.4	*3.3*	101	5.0	*3.2*	134	4.5	*3.2*	
cowrk										**P=0.008**

Current Residence	**Rural**			**Urban**			**Total**			
	N	**%**	***W%***	**N**	**%**	***W%***	**N**	**%**	***W%***	
										(P=0.063)
never	451	50.8	*49.2*	1039	57.0	*54.1*	1490	55.0	*52.4*	
1/2x per yr	116	13.1	*11.4*	209	11.5	*10.3*	325	12.0	*10.7*	
1/2x per mo	148	16.7	*14.5*	274	15.0	*14.8*	422	15.6	*14.7*	
1/2x per wk	132	14.9	*20.4*	204	11.2	*12.7*	336	12.4	*15.4*	
daily	40	4.5	*4.5*	98	5.4	*8.1*	138	5.1	*6.9*	
relig										**P<0.001** (P=0.062)
never	166	17.0	*17.3*	249	12.3	*11.3*	415	13.8	*13.3*	
1/2x per yr	69	7.1	*6.9*	178	8.8	*8.1*	247	8.2	*7.7*	
1/2x per mo	187	19.1	*18.3*	527	26.0	*26.7*	714	23.7	*23.9*	
1/2x per wk	539	55.2	*55.0*	1013	49.9	*51.3*	1552	51.6	*52.6*	
daily	16	1.6	*2.4*	63	3.1	*2.6*	79	2.6	*2.5*	
out										**P<0.001** (P=0.552)
never	237	24.1	*21.3*	469	23.1	*21.5*	706	23.4	*21.4*	
1/2x per yr	265	27.0	*26.2*	436	21.5	*22.9*	701	23.3	*24.0*	
1/2x per mo	313	31.8	*28.9*	589	29.0	*29.8*	902	29.9	*29.5*	
1/2x per wk	124	12.6	*15.4*	380	18.7	*19.8*	504	16.7	*18.3*	
daily	44	4.5	*8.3*	158	7.8	*6.0*	202	6.7	*6.8*	
adequate										**P<0.001** (P=0.118)
go out more	142	14.5	*16.0*	288	14.2	*14.7*	430	14.3	*15.2*	
satisfied	683	69.9	*70.4*	1553	76.3	*75.6*	2236	74.2	*73.9*	
go out less	152	15.6	*13.6*	194	9.5	*9.7*	346	11.5	*11.0*	
trust										P=0.736 (P=0.973)
can't be trusted	767	78.2	*76.3*	1591	78.7	*76.1*	2358	78.5	*76.2*	
can be trusted	214	21.8	*23.7*	430	21.3	*23.9*	644	21.5	*23.8*	
support										**P<0.001**
no	228	23.6	*28.2*	338	17.0	*16.5*	566	19.1	*20.4*	
yes	739	76.4	*71.8*	1656	83.0	*83.5*	2395	80.9	*79.6*	
revtrstn										**P<0.001 (P=0.016)**
To a very great extent	70	7.1	*6.8*	73	3.6	*3.7*	143	4.7	*4.7*	
To a great extent	163	16.6	*18.0*	456	22.4	*23.7*	619	20.5	*21.8*	
Neither great nor small extent	241	24.6	*29.2*	489	24.0	*25.9*	730	24.2	*27.0*	

Current Residence	Rural			Urban			Total			
	N	%	*W%*	N	%	*W%*	N	%	*W%*	
To a small extent	289	29.5	*28.3*	676	33.2	*35.5*	965	32.0	*33.1*	
To a very small extent	218	22.2	*17.8*	343	16.8	*11.2*	561	18.6	*13.4*	
revtrstw										**P<0.001 (P=0.026)**
To a very great extent	25	2.8	*3.5*	38	2.1	*2.2*	63	2.3	*2.6*	
To a great extent	122	13.5	*12.4*	350	19.2	*21.0*	472	17.3	*18.0*	
Neither great nor small extent	199	22.0	*27.1*	513	28.2	*29.8*	712	26.1	*28.9*	
To a small extent	347	38.3	*38.6*	562	30.9	*33.5*	909	33.4	*35.2*	
To a very small extent	213	23.5	*18.4*	356	19.6	*13.5*	569	20.9	*15.2*	
revtrsts										**P<0.001** (P=0.055)
To a very great extent	7	0.7	*0.9*	13	0.6	*0.5*	20	0.7	*0.6*	
To a great extent	58	6.0	*5.3*	88	4.3	*3.7*	146	4.9	*4.3*	
Neither great nor small extent	171	17.6	*19.4*	492	24.2	*25.3*	663	22.1	*23.3*	
To a small extent	212	21.8	*21.6*	486	24.0	*26.7*	698	23.2	*25.0*	
To a very small extent	526	54.0	*52.8*	950	46.8	*43.8*	1476	49.2	*46.8*	

W% denotes weighted proportions accounting for survey design weights.
P-values in parentheses are based on Pearson design-based F statistics for weighted results. Where no second p-value is listed, the p-value is also <0.001 as in the chi-square results

South African urban residents appear to be less socially integrated than rural residents when it comes to community activities, but equally if not more active when it comes to having guests over, visiting another person, attending religious functions or getting out of the house, and having someone to confide in. Urban residents are also more satisfied with how much they go out mostly because rural residents are more likely to want to go out less. The distribution of trust variables also differs by residence.

Distribution of Social Capital Items by Depression Status

Ghana

Depression Status	**No**			**Yes**			**Total**			
	N	**%**	***W%***	**N**	**%**	***W%***	**N**	**%**	***W%***	
meet										**P<0.001**
never	1846	47.7	*47.0*	169	53.3	*52.4*	2015	48.1	*47.4*	
1/2x per yr	1291	33.4	*33.8*	137	43.2	*43.8*	1428	34.1	*34.6*	
1/2x per mo	563	14.5	*14.5*	11	3.5	*3.8*	574	13.7	*13.7*	
1/2x per wk	157	4.1	*4.3*	0	0.0	*0.0*	157	3.7	*3.9*	
daily	13	0.3	*0.4*	0	0.0	*0.0*	13	0.3	*0.4*	
lead										**P<0.001 (P=0.029)**
never	1326	34.3	*34.2*	109	34.4	*35.7*	1435	34.3	*34.3*	
1/2x per yr	755	19.5	*20.1*	48	15.1	*14.7*	803	19.2	*19.7*	
1/2x per mo	898	23.2	*23.3*	119	37.5	*34.9*	1017	24.3	*24.2*	
1/2x per wk	690	17.8	*17.1*	36	11.4	*11.7*	726	17.3	*16.7*	
daily	201	5.2	*5.3*	5	1.6	*2.9*	206	4.9	*5.1*	
club										**P<0.001**
never	1530	39.6	*39.2*	112	35.3	*33.6*	1642	39.3	*38.8*	
1/2x per yr	668	17.3	*17.7*	26	8.2	*9.9*	694	16.6	*17.1*	
1/2x per mo	988	25.6	*25.1*	59	18.6	*17.7*	1047	25.0	*24.6*	
1/2x per wk	651	16.8	*16.8*	113	35.6	*35.0*	764	18.3	*18.2*	
daily	29	0.8	*1.1*	7	2.2	*3.8*	36	0.9	*1.3*	
neigh										**P<0.001**
never	1768	45.7	*44.2*	147	46.4	*45.0*	1915	45.7	*44.3*	
1/2x per yr	905	23.4	*24.9*	29	9.1	*9.9*	934	22.3	*23.7*	
1/2x per mo	746	19.3	*19.2*	38	12.0	*12.2*	784	18.7	*18.7*	
1/2x per wk	423	10.9	*11.0*	99	31.2	*30.1*	522	12.5	*12.4*	
daily	27	0.7	*0.8*	4	1.3	*2.7*	31	0.7	*1.0*	
guest										**P<0.001**
never	468	12.2	*12.2*	25	7.9	*7.4*	493	11.8	*11.8*	
1/2x per yr	404	10.5	*11.1*	16	5.1	*5.0*	420	10.1	*10.6*	
1/2x per mo	816	21.2	*21.8*	47	14.9	*13.9*	863	20.7	*21.2*	
1/2x per wk	1134	29.5	*29.0*	53	16.8	*19.2*	1187	28.5	*28.3*	
daily	1027	26.7	*26.0*	175	55.4	*54.5*	1202	28.9	*28.1*	
visit										**P<0.001 (P=0.001)**
never	691	17.9	*17.2*	59	18.6	*18.6*	750	17.9	*17.3*	
1/2x per yr	552	14.3	*14.2*	41	12.9	*14.7*	593	14.2	*14.2*	
1/2x per mo	986	25.5	*26.6*	58	18.3	*17.0*	1044	24.9	*25.9*	
1/2x per wk	947	24.5	*24.6*	127	40.1	*39.0*	1074	25.7	*25.7*	
daily	693	17.9	*17.4*	32	10.1	*10.7*	725	17.3	*16.9*	
cowrk										**P<0.001**

Depression Status	**No**			**Yes**			**Total**			
	N	**%**	***W%***	**N**	**%**	***W%***	**N**	**%**	***W%***	
										(P=0.001)
never	1579	41.0	*39.9*	157	49.5	*50.5*	1736	41.6	*40.7*	
1/2x per yr	406	10.5	*10.5*	20	6.3	*7.0*	426	10.2	*10.3*	
1/2x per mo	582	15.1	*15.2*	52	16.4	*16.2*	634	15.2	*15.3*	
1/2x per wk	845	21.9	*22.3*	74	23.3	*21.3*	919	22.0	*22.3*	
daily	443	11.5	*11.9*	14	4.4	*5.0*	457	11.0	*11.4*	
relig										**P=0.015** (P=0.314)
never	542	14.0	*13.1*	45	14.2	*13.2*	587	14.1	*13.1*	
1/2x per yr	207	5.4	*5.2*	18	5.7	*5.0*	225	5.4	*5.2*	
1/2x per mo	671	17.4	*17.5*	48	15.1	*16.9*	719	17.2	*17.4*	
1/2x per wk	1932	50.1	*51.1*	183	57.7	*56.7*	2115	50.6	*51.5*	
daily	508	13.2	*13.2*	23	7.3	*8.2*	531	12.7	*12.8*	
out										**P<0.001**
never	559	14.5	*14.2*	35	11.0	*10.9*	594	14.2	*13.9*	
1/2x per yr	677	17.5	*17.4*	39	12.3	*14.5*	716	17.1	*17.2*	
1/2x per mo	1020	26.4	*26.6*	49	15.5	*14.6*	1069	25.6	*25.7*	
1/2x per wk	982	25.4	*26.5*	174	54.9	*53.2*	1156	27.7	*28.5*	
daily	625	16.2	*15.3*	20	6.3	*6.8*	645	15.4	*14.6*	
adequate										**P<0.001**
go out more	436	11.3	*11.0*	77	24.4	*26.1*	513	12.3	*12.1*	
satisfied	3052	78.9	*79.3*	207	65.5	*64.3*	3259	77.9	*78.2*	
go out less	378	9.8	*9.7*	32	10.1	*9.6*	410	9.8	*9.7*	
trust										**P<0.001**
can't be trusted	1502	39.0	*39.7*	88	27.8	*26.1*	1590	38.2	*38.7*	
can be trusted	2348	61.0	*60.3*	229	72.2	*73.9*	2577	61.8	*61.3*	
support										P=0.796 (P=0.605)
no	827	21.6	*21.1*	66	21.0	*19.5*	893	21.6	*21.0*	
yes	2994	78.4	*78.9*	248	79.0	*80.5*	3242	78.4	*79.0*	
revtrstn										**P<0.001**
To a very great extent	516	13.3	*12.4*	46	14.5	*18.6*	562	13.4	*12.9*	
To a great extent	1567	40.5	*41.2*	176	55.5	*52.5*	1743	41.6	*42.1*	
Neither great nor small extent	945	24.4	*24.5*	58	18.3	*17.4*	1003	23.9	*23.9*	
To a small extent	571	14.8	*14.9*	24	7.6	*6.9*	595	14.2	*14.3*	
To a very small extent	272	7.0	*7.1*	13	4.1	*4.6*	285	6.8	*6.9*	

Depression Status	No			Yes			Total			
	N	%	*W%*	N	%	*W%*	N	%	*W%*	
revtrstw										**P<0.001**
To a very great extent	388	10.0	*9.5*	68	21.5	*25.0*	456	10.9	*10.7*	
To a great extent	1220	31.6	*31.1*	152	47.9	*45.2*	1372	32.8	*32.2*	
Neither great nor small extent	1024	26.5	*26.4*	55	17.4	*17.0*	1079	25.8	*25.7*	
To a small extent	907	23.5	*24.5*	24	7.6	*7.1*	931	22.3	*23.2*	
To a very small extent	323	8.4	*8.5*	18	5.7	*5.6*	341	8.2	*8.2*	
revtrsts										**P<0.001**
To a very great extent	130	3.4	*3.4*	28	8.8	*12.7*	158	3.8	*4.1*	
To a great extent	551	14.2	*15.0*	110	34.7	*32.7*	661	15.8	*16.3*	
Neither great nor small extent	1116	28.8	*27.4*	74	23.3	*21.2*	1190	28.4	*27.0*	
To a small extent	966	24.9	*24.2*	50	15.8	*15.1*	1016	24.3	*23.5*	
To a very small extent	1109	28.6	*30.0*	55	17.4	*18.3*	1164	27.8	*29.1*	

W% denotes weighted proportions accounting for survey design weights.
P-values in parentheses are based on Pearson design-based F statistics for weighted results. Where no second p-value is listed, the p-value is also <0.001 as in the chi-square results

Depressed Ghanaians are less likely to attend public meetings and meet with coworkers outside of work, and somewhat less likely to meet with community leaders, but are more likely to participate in organizations, work with neighbors to fix something, and have daily guests. They also appear more trusting but are less satisfied with how much they get out of the house. Results for the frequency of visiting people in other neighborhoods and going out are mixed, and the amount with a confidant or trusted individual is about the same

South Africa

Depression Status	No			Yes			Total			
	N	**%**	***W%***	**N**	**%**	***W%***	**N**	**%**	***W%***	
meet										**P=0.035** (P=0.887)
never	1579	54.7	*51.7*	71	53.8	*51.6*	1650	54.6	*51.7*	
1/2x per yr	734	25.4	*26.7*	26	19.7	*27.4*	760	25.2	*26.7*	
1/2x per mo	503	17.4	*19.1*	31	23.5	*19.7*	534	17.7	*19.2*	
1/2x per wk	71	2.5	*2.4*	3	2.3	*1.1*	74	2.4	*2.3*	
daily	2	0.1	*0.1*	1	0.8	*0.2*	3	0.1	*0.1*	
lead										P=0.409 (P=0.520)
never	1590	55.1	*52.8*	76	57.6	*56.3*	1666	55.2	*52.9*	
1/2x per yr	649	22.5	*25.9*	26	19.7	*24.5*	675	22.4	*25.8*	
1/2x per mo	557	19.3	*18.9*	25	18.9	*16.8*	582	19.3	*18.8*	
1/2x per wk	79	2.7	*2.2*	3	2.3	*1.2*	82	2.7	*2.2*	
daily	12	0.4	*0.3*	2	1.5	*1.3*	14	0.5	*0.3*	
club										P=0.876 (P=0.648)
never	1516	52.5	*47.0*	71	54.6	*45.5*	1587	52.6	*46.9*	
1/2x per yr	470	16.3	*17.7*	17	13.1	*9.8*	487	16.1	*17.4*	
1/2x per mo	776	26.9	*30.1*	36	27.7	*38.4*	812	26.9	*30.4*	
1/2x per wk	120	4.2	*4.8*	6	4.6	*6.4*	126	4.2	*4.9*	
daily	5	0.2	*0.4*	0	0.0	*0.0*	5	0.2	*0.4*	
neigh										P=0.543 (P=0.223)
never	1630	56.7	*49.5*	67	51.5	*42.8*	1697	56.5	*49.2*	
1/2x per yr	537	18.7	*21.7*	27	20.8	*34.6*	564	18.8	*22.2*	
1/2x per mo	551	19.2	*21.8*	27	20.8	*18.4*	578	19.2	*21.7*	
1/2x per wk	137	4.8	*6.5*	9	6.9	*4.1*	146	4.9	*6.4*	
daily	19	0.7	*0.5*	0	0.0	*0.0*	19	0.6	*0.5*	
guest										P=0.178 (P=0.416)
never	353	12.3	*11.1*	20	15.2	*14.3*	373	12.4	*11.2*	
1/2x per yr	359	12.5	*11.4*	13	9.8	*8.1*	372	12.4	*11.3*	
1/2x per mo	847	29.4	*29.4*	29	22.0	*23.2*	876	29.1	*29.1*	
1/2x per wk	971	33.7	*37.7*	48	36.4	*36.7*	1019	33.8	*37.6*	
daily	350	12.2	*10.5*	22	16.7	*17.7*	372	12.4	*10.8*	
visit										P=0.703 (P=0.429)
never	480	16.7	*14.5*	26	20.0	*23.4*	506	16.8	*14.9*	
1/2x per yr	536	18.6	*18.6*	19	14.6	*13.2*	555	18.4	*18.4*	
1/2x per mo	947	32.9	*34.9*	43	33.1	*36.0*	990	32.9	*34.9*	
1/2x per wk	790	27.4	*28.8*	35	26.9	*22.9*	825	27.4	*28.6*	

Depression Status	**No**			**Yes**			**Total**			
	N	**%**	***W%***	**N**	**%**	***W%***	**N**	**%**	***W%***	
daily	127	4.4	*3.2*	7	5.4	*4.5*	134	4.5	*3.2*	
cowrk										P=0.451 (P=0.420)
never	1425	54.8	*52.2*	64	59.3	*58.1*	1489	55.0	*52.4*	
1/2x per yr	308	11.8	*10.5*	16	14.8	*16.2*	324	12.0	*10.7*	
1/2x per mo	411	15.8	*14.9*	11	10.2	*9.6*	422	15.6	*14.7*	
1/2x per wk	323	12.4	*15.4*	13	12.0	*13.4*	336	12.4	*15.4*	
daily	134	5.2	*7.0*	4	3.7	*2.7*	138	5.1	*6.9*	
relig										P=0.524 (P=0.883)
never	395	13.7	*13.3*	20	15.5	*13.1*	415	13.8	*13.3*	
1/2x per yr	232	8.1	*7.8*	15	11.6	*4.3*	247	8.2	*7.7*	
1/2x per mo	683	23.7	*23.8*	31	24.0	*25.9*	714	23.8	*23.9*	
1/2x per wk	1492	51.9	*52.5*	59	45.7	*53.9*	1551	51.6	*52.6*	
daily	75	2.6	*2.5*	4	3.1	*2.8*	79	2.6	*2.5*	
out										**P=0.027** (P=0.281)
never	674	23.4	*21.6*	31	23.7	*17.4*	705	23.4	*21.4*	
1/2x per yr	682	23.7	*24.4*	19	14.5	*15.1*	701	23.3	*24.0*	
1/2x per mo	860	29.8	*29.5*	42	32.1	*29.5*	902	29.9	*29.5*	
1/2x per wk	481	16.7	*17.9*	23	17.6	*28.1*	504	16.7	*18.3*	
daily	186	6.5	*6.6*	16	12.2	*10.0*	202	6.7	*6.8*	
adequate										**P=0.018** (P=0.226)
go out more	401	13.9	*15.1*	29	22.0	*16.7*	430	14.3	*15.2*	
satisfied	2150	74.7	*74.3*	85	64.4	*64.3*	2235	74.2	*73.9*	
go out less	328	11.4	*10.6*	18	13.6	*19.0*	346	11.5	*11.0*	
trust										P=0.951 (P=0.584)
can't be trusted	2254	78.6	*76.3*	104	78.8	*72.5*	2358	78.6	*76.2*	
can be trusted	615	21.4	*23.7*	28	21.2	*27.5*	643	21.4	*23.8*	
support										P=0.062 (P=0.601)
no	532	18.8	*20.3*	33	25.4	*23.5*	565	19.1	*20.4*	
yes	2298	81.2	*79.7*	97	74.6	*76.5*	2395	80.9	*79.6*	
revtrstn										**P<0.001** (P=0.066)
To a very great extent	138	4.8	*4.7*	5	3.8	*4.7*	143	4.7	*4.7*	
To a great extent	596	20.7	*21.7*	24	18.2	*22.5*	620	20.6	*21.8*	

Depression Status	**No**			**Yes**			**Total**			
	N	**%**	***W%***	**N**	**%**	***W%***	**N**	**%**	***W%***	
Neither great nor small extent	699	24.2	*27.1*	31	23.5	*24.0*	730	24.2	*27.0*	
To a small extent	935	32.4	*33.6*	28	21.2	*21.3*	963	31.9	*33.1*	
To a very small extent	517	17.9	*12.8*	44	33.3	*27.5*	561	18.6	*13.4*	
revtrstw										**P<0.001** (P=0.114)
To a very great extent	61	2.3	*2.6*	2	1.9	*2.5*	63	2.3	*2.6*	
To a great extent	459	17.5	*18.0*	13	12.3	*17.7*	472	17.3	*18.0*	
Neither great nor small extent	679	25.9	*28.8*	33	31.1	*30.3*	712	26.1	*28.9*	
To a small extent	888	33.9	*35.8*	20	18.9	*19.9*	908	33.3	*35.2*	
To a very small extent	531	20.3	*14.7*	38	35.8	*29.6*	569	20.9	*15.2*	
revtrsts										P=0.457 (P=0.780)
To a very great extent	18	0.6	*0.6*	2	1.5	*1.3*	20	0.7	*0.6*	
To a great extent	142	4.9	*4.3*	4	3.1	*2.0*	146	4.9	*4.3*	
Neither great nor small extent	633	22.1	*23.2*	29	22.1	*26.4*	662	22.1	*23.3*	
To a small extent	672	23.4	*25.1*	26	19.8	*22.3*	698	23.3	*25.0*	
To a very small extent	1405	49.0	*46.8*	70	53.4	*47.9*	1475	49.2	*46.8*	

W% denotes weighted proportions accounting for survey design weights.
P-values in parentheses are based on Pearson design-based F statistics for weighted results. Where no second p-value is listed, the p-value is also <0.001 as in the chi-square results

Based on the sample data, South Africans with depression appear to be less trusting, go out more frequently, but are less satisfied with how much they get out. They also appear to differ from non-depressed individuals in terms of meeting with community members, but the pattern is unclear. After weighting, no significant differences exist between depressed and non-depressed individuals for these variables; however, there do appear to be some differences in the level of trust, adequacy of going out, and, to some extent, interactions with coworkers and neighbors.

Appendix K: Sample Correlation Matrix for Social Capital Items

Ghana

	Meet	Lead	Club	Neigh	Guest	Visit	Cowrk	Relig	Out	Adequate	Trust	Support	Revtrstn	Revtrstw	Revtrsts
Meet															
Lead	0.542														
Club	0.483	0.506													
Neigh	0.612	0.557	0.624												
Guest	0.068	0.319	0.323	0.266											
Visit	0.090	0.295	0.296	0.246	0.749										
Cowrk	0.352	0.373	0.335	0.495	0.329	0.432									
Relig	0.168	0.227	0.299	0.183	0.288	0.332	0.273								
Out	0.213	0.508	0.409	0.327	0.362	0.428	0.315	0.389							
Adequate	0.106	0.060	0.057	0.089	-0.076	-0.005	0.068	0.046	0.023						
Trust	0.173	0.219	0.213	0.259	0.181	0.105	0.067	0.118	0.131	-0.098					
Support	0.130	0.042	0.057	0.131	0.104	0.023	-0.013	0.109	-0.061	-0.082	0.542				
Revtrstsn	0.103	0.141	0.041	0.122	0.122	0.069	-0.004	0.102	0.133	-0.005	0.581	0.496			
Revtrstw	0.145	0.213	0.150	0.191	-0.027	-0.094	-0.051	0.048	0.194	0.024	0.470	0.356	0.757		
Revtrsts	0.205	0.243	0.248	0.277	0.003	-0.056	0.077	-0.048	0.103	-0.047	0.372	0.096	0.453	0.610	

South Africa

	Meet	Lead	Club	Neigh	Guest	Visit	Cowrk	Relig	Out	Adequate	Trust	Support	Revtrstn	Revtrstw	Revtrsts
Meet															
Lead	0.733														
Club	0.554	0.561													
Neigh	0.481	0.507	0.596												
Guest	0.061	0.084	0.097	0.143											
Visit	0.126	0.144	0.192	0.221	0.684										
Cowrk	0.270	0.235	0.406	0.497	0.208	0.278									
Relig	0.224	0.209	0.264	0.177	0.205	0.238	0.155								
Out	0.217	0.219	0.286	0.232	0.455	0.395	0.246	0.401							
Adequate	0.044	0.052	-0.003	0.009	0.064	0.034	-0.114	-0.001	-0.020						
Trust	-0.045	0.035	0.129	0.257	0.025	0.056	0.164	-0.088	-0.039	-0.079					
Support	-0.052	0.010	0.057	0.069	-0.082	0.034	-0.082	0.081	-0.083	-0.038	0.262				
Revtrstsn	0.042	0.002	0.040	0.082	0.118	0.108	0.002	0.026	0.120	0.024	0.195	0.180			
Revtrstw	0.011	-0.009	0.051	0.069	0.167	0.157	0.039	0.043	0.181	-0.025	0.147	0.213	0.742		
Revtrsts	-0.003	0.034	0.006	0.042	0.143	0.149	0.020	0.043	0.239	0.038	0.087	0.067	0.499	0.593	

Appendix L: Description of Missingness in Social Capital Items

Proportion of Social Capital Items with Missing or Unusable Responses

	Ghana (n=4209)		South Africa (n=3148)	
	N	Col %	N	Col %
Q6001: Public Meeting (meet)				
Don't Know	8	0.2	8	0.3
Missing	14	0.3	117	3.7
Q6002: Meet Leader (lead)				
Don't Know	8	0.2	10	0.3
Missing	14	0.3	117	3.7
Q6003: Club (club)				
Don't Know	12	0.3	12	0.4
Missing	14	0.3	117	3.7
Q6004: Neighborhood (neigh)				
Don't Know	9	0.2	21	0.7
Not Applicable			4	0.1
Missing	14	0.3	117	3.7
Q6005: Friends Over (guest)				
Don't Know	30	0.7	16	0.5
Not Applicable			1	0.0
Missing	14	0.3	117	3.7
Q6006: In Other Home (visit)				
Don't Know	8	0.2	18	0.6
Not Applicable	1	0.0	1	0.0
Missing	14	0.3	117	3.7
Q6007: Socialize with Coworkers (cowrk)				
Don't Know	19	0.5	246	7.8
Not Applicable	4	0.1	74	2.4
Missing	14	0.3	117	3.7
Q6008: Religious Services (relig)				
Don't Know	18	0.4	22	0.7
Not Applicable			1	0.0
Missing	14	0.3	117	3.7
Q6009: How Often Go Out? (out)				
Don't Know	15	0.4	15	0.5
Missing	14	0.3	117	3.7
Q6010: Want To Get Out More? (adequate)				
Don't Know	13	0.3	18	0.6
Missing	14	0.3	117	3.7
Q6012: General Trust (trust)				
Don't Know	28	0.7	28	0.9

	Ghana (n=4209)		South Africa (n=3148)	
	N	Col %	N	Col %
Missing	14	0.3	117	3.7
Q6013: Have Someone To Trust (support)				
Don't Know	60	1.4	69	2.2
Missing	14	0.3	117	3.7
Q6014: Trust Neighbors (trustn)				
Don't Know	6	0.1	11	0.3
Not Applicable	1	0.0	1	0.0
Missing	14	0.3	117	3.7
Q6015: Trust Coworkers (trustw)				
Don't Know	12	0.3	243	7.7
Not Applicable	4	0.1	63	2.0
Missing	14	0.3	117	3.7
Q6016: Trust Strangers (trusts)				
Don't Know	5	0.1	26	0.8
Not Applicable	1	0.0	2	0.1
Missing	14	0.3	117	3.7

The 14 missing in the Ghana sample were the same 14 individuals in the sample missing on the depression outcome. The 117 missing in the South Africa sample included the same 103 individuals in the sample missing on depression. In particular, responses to the questions relating to coworkers have high levels of nonresponse for South Africa, which may be due to the higher rate of unemployment in this age group in that country.

Responses to the coworker questions were examined based on employment status. Of the 4,209 respondents in the Ghana sample, 71.7% were currently working, 1.5% never worked, and 26.6% were not currently working (10 individuals had missing data). In South Africa, 27.1% were currently working, 12.9% never worked, and 59.3% were not currently working (21 individuals were missing). The output below explores the responses to these questions among the unemployed. Among those who never worked (Ghana: n=63; S. Afr.: n=407) and were not currently working (Ghana: n=1,118; S. Afr.: n=1,867), the distribution of responses to the item on socializing with coworkers outside of work and trusting coworkers were as follows:

	Ghana		South Africa	
	Freq	*%*	*Freq*	*%*
Q6007: Socialize with Coworkers				
never	761	64.4	1248	54.9
1/2x per yr	103	8.7	209	64.1
1/2x per mo	128	10.8	248	10.9
1/2x per wk	140	11.9	187	8.2
daily	36	3.1	17	0.8
don’t know	7	0.6	233	9.8
not applicable	3	0.3	71	3.1

	Ghana		South Africa	
	Freq	*%*	*Freq*	*%*
missing	3	0.3	71	3.1
Q6015: Trust Coworkers				
To a very great extent	114	9.7	42	1.9
To a great extent	330	27.9	303	13.3
Neither great nor small extent	330	27.9	547	24.1
To a small extent	276	23.4	605	26.6
To a very small extent	117	9.9	429	18.9
Don't know	8	0.7	219	9.6
Not applicable	3	0.3	58	2.6
missing	3	0.3	71	3.1

Because current employment was based on the question "Have you worked for at least 2 days during the last 7 days?", the not working category could have a range of people who stopped working more or less than a year ago and thus still be applicable to the socializing with coworkers item. Responses among only those who reported never working are below.

	Ghana		South Africa	
	Freq	*%*	*Freq*	*%*
Q6007: Socialize with Coworkers				
never	57	90.5	227	57.6
1/2x per yr	-	-	41	10.4
1/2x per mo	2	3.2	56	14.2
1/2x per wk	4	6.4	38	9.6
daily	-	-	1	0.3
don't know	-	-	24	6.1
not applicable	-	-	7	1.8
missing	-	-	-	-
Q6015: Trust Coworkers				
To a very great extent	3	4.8	3	0.8
To a great extent	10	15.9	40	10.2
Neither great nor small extent	41	65.1	124	31.5
To a small extent	6	9.5	118	30.0
To a very small extent	3	4.8	66	16.8
Don't know	-	-	34	8.6
Not applicable	-	-	9	2.3
missing	-	-	-	-

Even among the never employed, respondents still have recorded answers to these questions (although the majority respond never to q6007). This may indicate some inaccurate recording or responding, particularly for q6007. Since q6015 is about trust of coworkers, that may be answered based on experience when formerly employed and is less problematic than the item on socializing with coworkers. However, responses were used as reported and were not changed based on employment status to avoid making assumptions that may or may not be true.

Appendix M: Assessment of Number of Factors to Retain in EFA

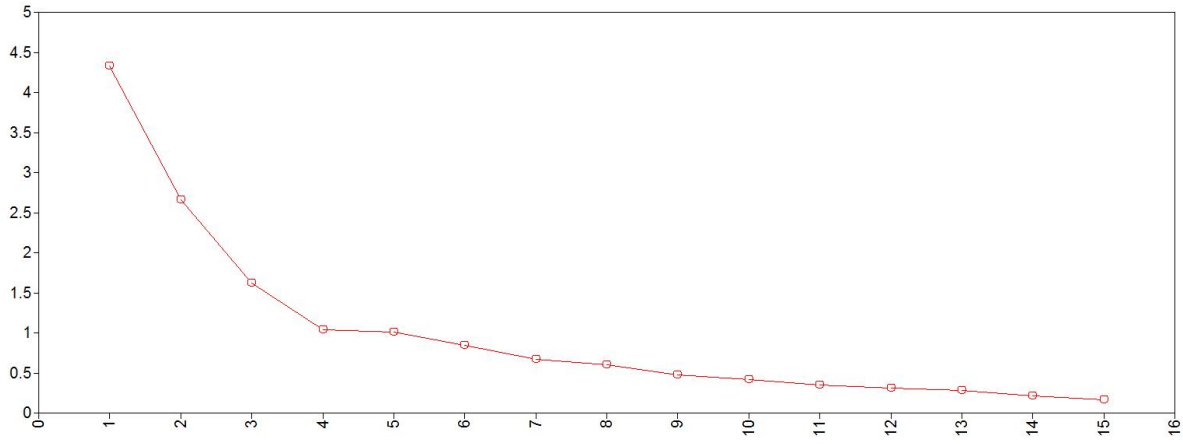
Ghana:

Eigenvalues for Initial Exploratory Factor Analysis

Factor	Eigenvalue
1	4.330
2	2.659
3	1.617
4	1.040
5	1.011
6	0.845
7	0.670
8	0.599
9	0.477
10	0.421
11	0.347
12	0.311
13	0.286
14	0.217
15	0.169

5 eigenvalues exceed 1

Scree Plot of Eigenvalues

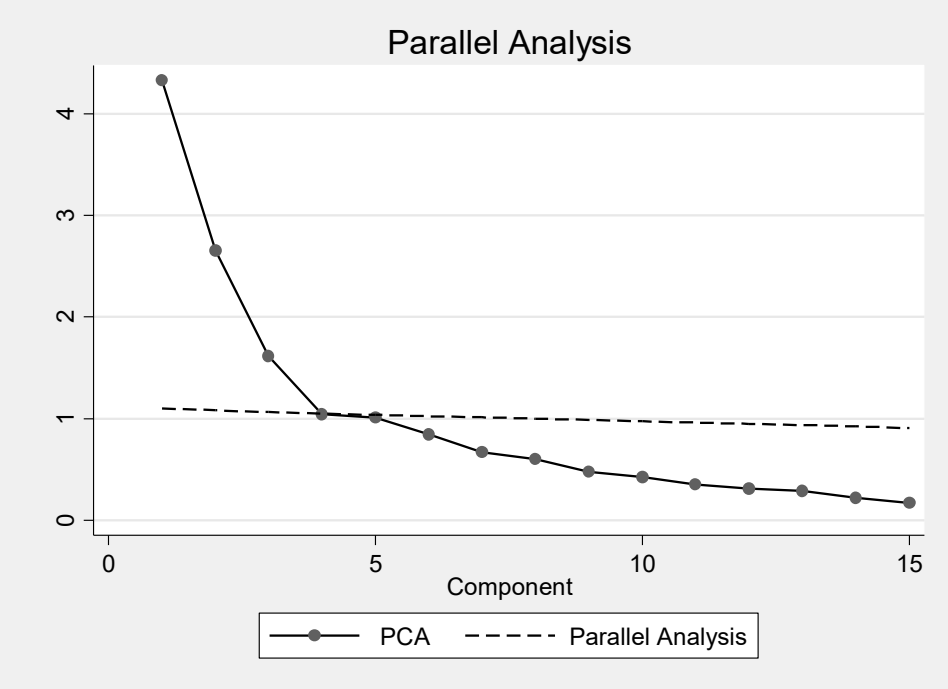


3 points are above the break in the plot

Parallel Analysis for Principal Components: Ghana

Component	PCA Eigenvalue	PA Eigenvalue	Difference
1	4.33	1.10	3.23
2	2.66	1.08	1.58
3	1.62	1.06	0.55
4	1.04	1.05	-0.01
5	1.01	1.04	-0.03
6	0.84	1.02	-0.18
7	0.67	1.01	-0.34
8	0.60	1.00	-0.40
9	0.48	0.99	-0.51
10	0.42	0.97	-0.55
11	0.35	0.96	-0.61
12	0.31	0.95	-0.64
13	0.29	0.94	-0.65
14	0.22	0.92	-0.71
15	0.17	0.91	-0.74

PCA: Principal components analysis; PA: Parallel Analysis
PA eigenvalues averaged over 10 replications



3 components have eigenvalues greater than those produced through parallel analysis of random data.

Based on this assessment as well as the results for exploratory factor analyses comparing 1- to 5- factor solutions, 3 factors were chosen as the optimal structure based on fit statistics and results (i.e. not having any high cross-loading, negative residual

variance, or factor loadings greater than 1). Fit statistics for the initial 3-factor solution were: RMSEA=0.053, SRMR=0.052, $\chi 2$=815.281 (df=63, p<0.001).

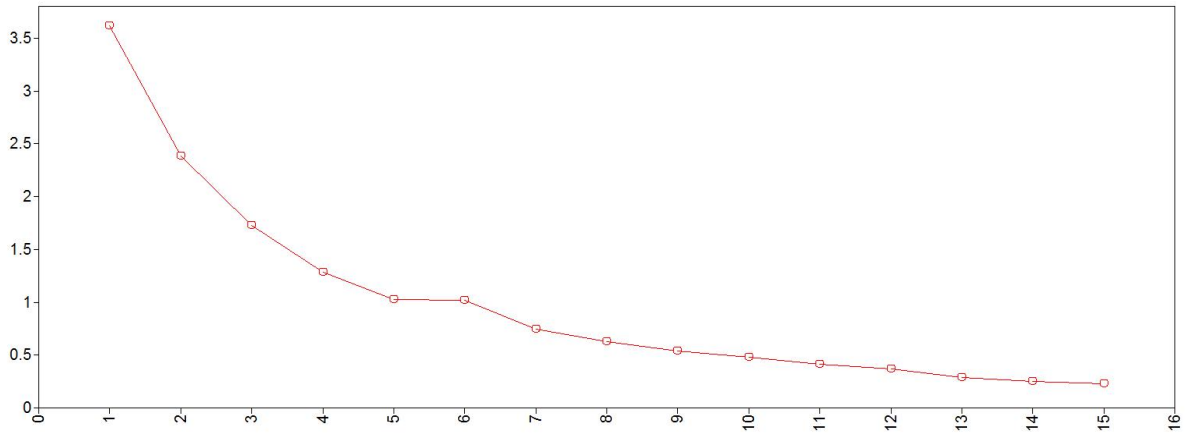
South Africa:

Eigenvalues for Initial Exploratory Factor Analysis

Factor	Eigenvalue
1	3.620
2	2.386
3	1.728
4	1.283
5	1.027
6	1.019
7	0.747
8	0.624
9	0.537
10	0.478
11	0.411
12	0.372
13	0.289
14	0.248
15	0.232

6 eigenvalues exceed 1

Scree Plot of Eigenvalues

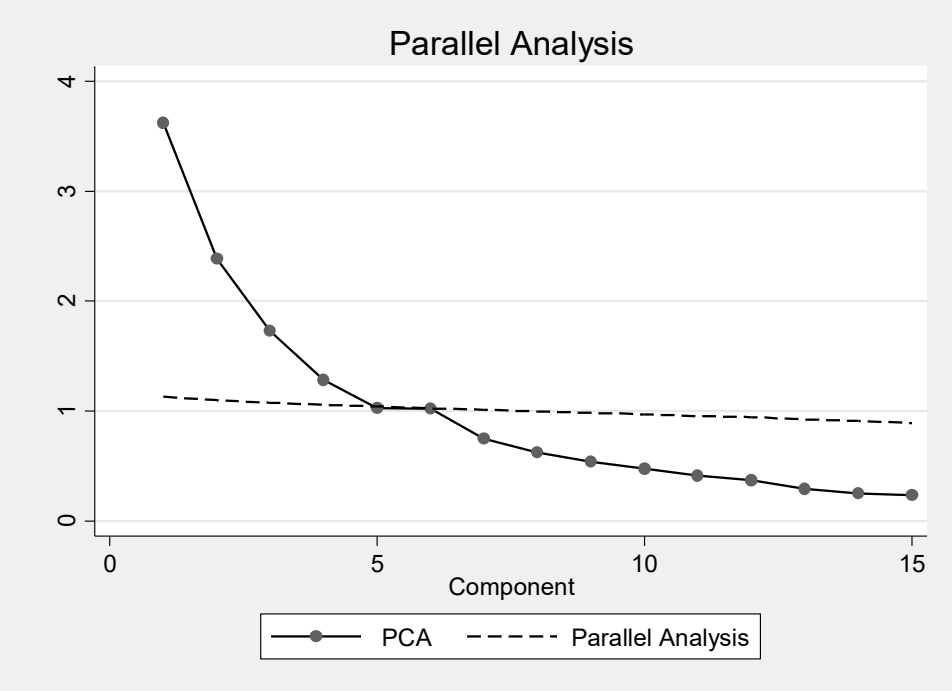


4 points are above the break in plot

Parallel Analysis for Principal Components: South Africa

Component	PCA Eigenvalue	PA Eigenvalue	Difference
1	3.62	3	2.50
2	2.38	1.10	1.29
3	1.73	1.07	0.65
4	1.28	1.05	0.23
5	1.03	1.04	-0.02
6	1.02	1.02	-0.00
7	0.75	1.01	-0.26
8	0.62	1.00	-0.37
9	0.54	0.98	-0.45
10	0.48	0.97	-0.49
11	0.41	0.95	-0.54
12	0.37	0.94	-0.57
13	0.29	0.92	-0.63
14	0.25	0.91	-0.66
15	0.23	0.89	-0.65

PCA: Principal components analysis; PA: Parallel Analysis
PA eigenvalues averaged over 10 replications



4 components have eigenvalues exceeding those produced from random data in parallel analysis.

Based on this assessment as well as the results for exploratory factor analyses comparing 1- to 6- factor solutions, 3 factors were chosen as the optimal structure based on fit statistics and results, including the absence of high cross-loading, negative residual variances, or factor loadings greater than 1. Fit statistics for the initial 3-factor solution were: RMSEA=0.053, SRMR=0.058, $\chi 2$=601.792, (df : 63, $p<0.001$)

Appendix N: Determination of Final EFA

Ghana

Factor Loadings for EFA Item Reduction Process

	EFA 1: Initial EFA (All Items)			**EFA 2: Adequate Removed**			**EFA 3: Out Removed (Final)**		
	Factor 1	*Factor 2*	*Factor 3*	*Factor 1*	*Factor 2*	*Factor 3*	*Factor 1*	*Factor 2*	*Factor 3*
Meet	0.812	-0.195	-0.014	0.821	-0.218	-0.028	0.810	-0.183	-0.024
Lead	0.654	0.134	0.061	0.669	0.110	0.051	0.656	0.090	0.051
Club	0.666	0.117	-0.009	0.683	-0.092	-0.020	0.677	0.103	-0.015
Neigh	0.837	-0.028	0.015	0.854	-0.056	0.000	0.847	-0.012	0.007
Guest	-0.081	0.850	0.033	-0.057	0.834	0.039	-0.019	0.831	0.046
Visit	-0.084	0.945	-0.066	-0.075	0.949	-0.051	-0.030	0.920	-0.045
Cowrk	0.450	0.276	-0.143	0.461	0.260	-0.145	0.466	0.276	-0.141
Relig	0.159	0.357	0.014	0.164	0.352	0.018	0.164	0.320	0.019
Out	0.315	0.381	0.060	0.327	0.368	0.060	-	-	-
Adequate	0.169	-0.084	-0.090	-	-	-	-	-	-
Trust	0.033	0.126	0.632	0.043	0.117	0.629	0.051	0.135	0.630
Support	-0.088	0.085	0.537	-0.080	0.080	0.535	-0.068	0.107	0.535
Revtrstn	-0.154	0.115	0.891	-0.166	0.128	0.900	-0.157	0.128	0.900
Revtrstw	0.087	-0.156	0.886	0.077	-0.151	0.884	0.068	-0.164	0.884
Revtrsts	0.256	-0.195	0.555	0.260	-0.204	0.548	0.255	-0.195	0.547

Final EFA Structure Matrix of Correlations Between Items and Factors

	Factor 1	**Factor 2**	**Factor 3**
Meet	0.732	0.133	0.177
Lead	0.705	0.351	0.229
Club	0.713	0.368	0.170
Neigh	0.844	0.321	0.229
Guest	0.320	0.827	0.095
Visit	0.319	0.905	0.007
Cowrk	0.537	0.450	0.000
Relig	0.295	0.386	0.083
Trust	0.270	0.196	0.652
Support	0.115	0.116	0.524
Revtrstn	0.130	0.125	0.867
Revtrstw	0.236	-0.079	0.891
Revtrsts	0.322	-0.059	0.602

Estimated Residual Variances for Final EFA

Item	**Residual Variance**	**Item**	**Residual Variance**	**Item**	**Residual Variance**
MEET	0.436	**GUEST**	0.315	**TRUST**	0.549
LEAD	0.494	**VISIT**	0.178	**SUPPORT**	0.715
CLUB	0.482	**COWRK**	0.625	**REVTRSTN**	0.224
NEIGH	0.287	**RELIG**	0.826	**REVTRSTW**	0.184
				REVTRSTS	0.577

South Africa

Factor Loadings for EFA Item Reduction Process

	EFA 1: Initial			**EFA 2: Adequate Removed**			**EFA 3: Trust Removed**			**EFA 4: Support Removed**			**EFA 5: Relig Removed (Final)**		
	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3
Meet	0.837	-0.164	-0.024	0.871	-0.144	-0.021	0.875	-0.151	-0.013	0.881	-0.164	0.007	0.869	-0.144	-0.003
Lead	0.865	-0.127	-0.036	0.868	-0.134	-0.037	0.870	-0.143	-0.010	0.867	-0.138	-0.012	0.863	-0.131	-0.002
Club	0.751	0.021	0.008	0.751	0.020	0.008	0.750	0.024	0.002	0.748	0.029	-0.004	0.745	0.034	-0.003
Neigh	0.673	0.068	0.036	0.674	0.068	0.036	0.670	0.076	0.021	0.668	0.082	0.015	0.668	0.103	0.010
Guest	-0.188	0.918	-0.014	-0.185	0.916	-0.014	-0.189	0.918	-0.020	-0.192	0.916	-0.025	-0.160	0.936	-0.033
Visit	-0.054	0.798	-0.001	-0.053	0.798	-0.002	-0.058	0.803	-0.010	-0.066	0.812	-0.022	-0.023	0.786	-0.018
Cowrk	0.388	0.226	-0.044	0.388	0.228	-0.045	0.382	0.234	-0.054	0.381	0.234	-0.050	0.391	0.242	-0.054
Relig	0.213	0.291	-0.015	0.214	0.291	-0.015	0.215	0.286	-0.005	0.212	0.293	-0.015	-	-	-
Out	0.165	0.505	0.081	0.166	0.505	0.080	0.168	0.501	0.088	0.167	0.499	0.091	0.164	0.456	0.101
Adequate	0.001	0.033	-0.007	-	-	-	-	-	-		-	-	-	-	-
Trust	0.084	-0.059	0.213	0.084	-0.055	0.212	-	-	-	-	-	-	-	-	-
Support	0.046	-0.118	0.241	0.045	-0.116	0.240	0.043	-0.110	0.229	-	-	-	-	-	-
Revtrstn	0.006	-0.040	0.804	0.007	-0.039	0.804	0.015	-0.043	0.801	0.212	-0.056	0.804	0.017	-0.057	0.805
Revtrstw	-0.029	0.013	0.932	-0.029	0.015	0.931	-0.016	0.006	0.937	-0.010	-0.008	0.938	-0.012	-0.013	0.940
Revtrsts	-0.034	0.084	0.617	-0.034	0.084	0.616	-0.025	0.077	0.618	-0.020	0.066	0.621	-0.018	0.060	0.622

Final EFA Structure Matrix of Correlations Between Items and Factors

	Factor 1	Factor 2	Factor 3
MEET	0.818	0.158	0.020
LEAD	0.817	0.170	0.024
CLUB	0.756	0.293	0.057
NEIGH	0.705	0.338	0.081
GUEST	0.164	0.872	0.191
VISIT	0.250	0.774	0.177
COWRK	0.472	0.365	0.033
OUT	0.330	0.538	0.226
REVTRSTN	0.052	0.150	0.791
REVTRSTW	0.048	0.218	0.936
REVTRSTS	0.046	0.210	0.636

Estimated Residual Variances for Final EFA

Item	Residual Variance	Item	Residual Variance	Item	Residual Variance
MEET	0.312	**GUEST**	0.217	**REVTRSTN**	0.371
LEAD	0.317	**VISIT**	0.401	**REVTRSTW**	0.124
CLUB	0.427	**COWRK**	0.729	**REVTRSTS**	0.592
NEIGH	0.493	**OUT**	0.677		

Appendix O: Application of Identification Rules for Structural Equation Models

Unadjusted Ghana SEM:

Identification of Measurement Model/CFA

2-indicator rule (sufficient, not necessary): Met
-At least 2 factors: yes
-At least 2 indicators per factor: yes
-Each indicator is connected to one latent variable: yes
-Errors are not correlated: yes
-Factors are correlated: yes

3-indicator rule (sufficient, not necessary): Met
-At least one factor: yes
-At least three indicators per factor: yes
-Each indicator is connected to one latent variable: yes
-Errors are not correlated: yes

Identification of Overall/Structural Model

T-rule (necessary, not sufficient): Met
-Unknown parameters to estimate are less than number of equations
# of parameters to estimate:
-variances of errors of endogenous variables (indicators & outcome): 14
-variances of exogenous variables: 0 (fixed at one for identification)
-Direct effects & double-headed arrows/undirected paths: 19
Total: 33 parameters

-Number of equations/variances and covariances: n(n+1)/2 where n=# observed exogenous & endogenous variables
14(15)/2=105
105>33

Null-B Rule (sufficient, not necessary): Met
-No endogenous variable is linked by a direct path to another endogenous variable: yes

Recursive Rule (sufficient, not necessary): Met
-No bidirectional paths: yes
-No correlated errors: yes

Adjusted Ghana SEM with Sex & Age Predicting Latent Factors & Depression:

Identification of Measurement Model/CFA:

2-indicator rule: met (see above)

3-indicator rule: met (see above)

Identification of Structural/Overall Model

T-rule: met
-Variances of exogenous variables: 2 (sex & age)
-variances of residual errors of endogenous variables: 17 (indicators, factors, & outcome)
-Direct paths & double headed arrows: 25
Total parameters=44

N(n+1)/2= 16(17)/2=136
136>44

Null-B Rule: not met (endogenous factors lead to endogenous depression outcome)

Recursive Rule: not met (residual factor errors correlated with each other)

Unadjusted South Africa SEM

Identification of Measurement Model/CFA

2-indicator rule (sufficient, not necessary): Met
-At least 2 factors: yes
-At least 2 indicators per factor: yes
-Each indicator is connected to one latent variable: yes
-Errors are not correlated: yes
-Factors are correlated: yes

3-indicator rule (sufficient, not necessary): Met
-At least one factor: yes
-At least three indicators per factor: yes
-Each indicator is connected to one latent variable: yes
-Errors are not correlated: yes

Identification of Overall/Structural Model

T-rule (necessary, not sufficient): Met
-Unknown parameters to estimate are less than number of equations

# of parameters to estimate:
-variances of errors of endogenous variables (indicators & outcome): 12
-variances of exogenous variables: 0 (fixed at one for identification)
-Direct effects & Double-headed arrows/undirected paths: 17
Total: 29 parameters

-Number of equations/variances and covariances: n(n+1)/2 where n=# observed exogenous & endogenous variables
12(13)/2=78
78>29

Null-B Rule (sufficient, not necessary): Met

-No endogenous variable is linked by a direct path to another endogenous variable: yes

Recursive Rule (sufficient, not necessary): Met
-No bidirectional paths: yes
-No correlated errors: yes

Adjusted South Africa SEM with Sex & Age Predicting Latent Factors & Depression:

Identification of Measurement Model/CFA:

2-indicator rule: met (see above)

3-indicator rule: met (see above)

Identification of Structural/Overall Model

T-rule: met
-Variances of exogenous variables: 2 (sex & age)
-variances of residual errors of endogenous variables: 15 (indicators, factors, & outcome)
-Direct paths & double headed arrows: 23
Total parameters=41

N(n+1)/2= 14(15)/2=105
105>41

Null-B Rule: not met (endogenous factors lead to endogenous depression outcome)

Recursive Rule: not met (residual factor errors correlated with each other)

Appendix P: Results of Structural Equation Models Comparing Urban to Rural Residents with Constrained Structural Paths

Ghana (Corresponding to Model 5 & 7 of Manuscript 3 Table 5) [a]

	Unadjusted						Adjusted					
	Rural			Urban			Rural			Urban		
	Est	S.E.	p-value	Est	S.E.	p-value	Est	S.E.	p-value	Est	S.E.	p-value
Factor Loadings												
F1 (Community Engagement) BY												
Neigh	1.252	0.039	<0.001	1.252	0.039	<0.001	1.281	0.042	<0.001	1.281	0.042	<0.001
Meet	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--
Lead*	1.025	0.036	<0.001	1.149	0.057	<0.001	1.026	0.037	<0.001	1.162	0.060	<0.001
Club*	1.179	0.038	<0.001	1.034	0.060	<0.001	1.182	0.041	<0.001	1.047	0.062	<0.001
Cowrk	0.840	0.037	<0.001	0.840	0.037	<0.001	0.824	0.038	<0.001	0.824	0.038	<0.001
F2 (Sociability) BY												
Guest	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--
Visit	0.953	0.039	<0.001	0.953	0.039	<0.001	0.942	0.041	<0.001	0.942	0.041	<0.001
Relig*	0.551	0.038	<0.001	0.549	0.052	<0.001	0.548	0.039	<0.001	0.528	0.052	<0.001
F3 (Trust) BY												
*Revtrstw**	*1.548*	*0.054*	*<0.001*	*1.168*	*0.063*	*<0.001*	*1.547*	*0.054*	*<0.001*	*1.179*	*0.062*	*<0.001*
Revtrstn	1.319	0.038	<0.001	1.319	0.038	<0.001	1.323	0.038	<0.001	1.323	0.038	<0.001
Revtrsts	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--
Trust	1.082	0.056	<0.001	1.082	0.056	<0.001	1.077	0.057	<0.001	1.077	0.057	<0.001
Support*	0.910	0.065	<0.001	0.637	0.061	<0.001	0.911	0.065	<0.001	0.639	0.062	<0.001
Factor Variances/Covariances[b]												
CE WITH S	0.240	0.019	<0.001	0.301	0.030	<0.001	0.230	0.020	<0.001	0.289	0.031	<0.001
CE WITH T	0.095	0.015	<0.001	0.131	0.025	<0.001	0.089	0.015	<0.001	0.135	0.024	<0.001
S WITH T	-0.002	0.022	0.850	0.065	0.029	0.020	-0.003	0.022	0.835	0.068	0.029	0.016
CE VARIANCE	0.442	0.025	<0.001	0.456	0.047	<0.001	0.420	0.025	<0.001	0.422	0.044	<0.001
S VARIANCE	0.740	0.033	<0.001	0.699	0.086	<0.001	0.748	0.035	<0.001	0.719	0.094	<0.001
T VARIANCE	0.354	0.022	<0.001	0.567	0.063	<0.001	0.353	0.022	<0.001	0.553	0.060	<0.001

	Unadjusted						Adjusted					
	Rural			Urban			Rural			Urban		
	Est	S.E.	p-value	Est	S.E.	p-value	Est	S.E.	p-value	Est	S.E.	p-value
Predictors												
CE→DEP	*-0.203*	*0.067*	*0.003*	*-0.203*	*0.067*	*0.003*	-0.067	0.069	0.334	-0.067	0.069	0.334
S→DEP	*0.187*	*0.047*	*<0.001*	*0.187*	*0.047*	*<0.001*	*0.153*	*0.043*	*<0.001*	*0.153*	*0.043*	*<0.001*
T→DEP	*0.435*	*0.059*	*<0.001*	*0.435*	*0.059*	*<0.001*	*0.413*	*0.058*	*<0.001*	*0.413*	*0.058*	*<0.001*
SEX→DEP							*0.247*	*0.080*	*0.002*	*0.267*	*0.095*	*0.005*
AGE→DEP							*0.010*	*0.005*	*0.024*	*0.017*	*0.004*	*<0.001*
SEX→CE							*-0.261*	*0.033*	*<0.001*	*-0.312*	*0.039*	*<0.001*
AGE→CE							*-0.017*	*0.002*	*<0.001*	*-0.018*	*0.002*	*<0.001*
SEX→S							*0.003*	*0.046*	*0.940*	*-0.117*	*0.050*	*0.019*
AGE→S							*-0.009*	*0.002*	*<0.001*	*-0.006*	*0.002*	*0.002*
SEX→T							-0.092	0.029	0.002	-0.074	0.041	0.072
AGE→T							*-0.001*	*0.001*	*0.318*	*0.004*	*0.002*	*0.035*
Factor Means[c]												
CE	0.000	0.000	--	*-0.193*	*0.045*	*<0.001*	0.000	0.000	--	*-0.154*	*0.052*	*0.003*
S	0.000	0.000	--	*-0.207*	*0.065*	*0.002*	0.000	0.000	--	*-0.169*	*0.076*	*0.027*
T	0.000	0.000	--	*-0.290*	*0.048*	*<0.001*	0.000	0.000	--	*-0.302*	*0.054*	*<0.001*

CE: Community Engagement; S: Sociability; T: Trust

[a] Results correspond to the constrained structural invariance models (Model 5 & 7 of Table 5) in Manuscript 3. Factor loadings fixed to 1 represent the reference variable used to scale the factor. Significant structural path coefficients and factor means are in italics.

[b] In the adjusted model with age and sex predicting the factors, these values represent residual variances or covariances/correlations in residual errors

[c] In the adjusted model including sex and age as predictors, these values represent intercepts for the factors. The rural group served as the reference for comparison of factor means

* Factor loadings freed between urban and rural groups to establish partial measurement invariance

South Africa (Corresponding to Model 5 & 7 of Manuscript 3 Table 5)[a]

	Unadjusted[b]						Adjusted[b]					
	Rural			Urban			Rural			Urban		
	Est	S.E.	p-value	Est	S.E.	p-value	Est	S.E.	p-value	Est	S.E.	p-value
Factor Loadings												
F1 (Community Engagement) BY												
Meet*	1.248	0.053	<0.001	0.926	0.055	<0.001	1.303	0.055	<0.001	0.975	0.059	<0.001
Lead*	1.162	0.044	<0.001	0.960	0.057	<0.001	1.221	0.051	<0.001	1.012	0.062	<0.001
Club	1.000	0.000	--	1.000	0.000	--	1.060	0.045	<0.001	1.060	0.045	<0.001
Neigh	0.957	0.039	<0.001	0.957	0.039	<0.001	1.000	0.000	--	1.000	0.000	--
Cowrk	0.720	0.051	<0.001	0.720	0.051	<0.001	0.737	0.057	<0.001	0.737	0.057	<0.001
F2 (Sociability) BY												
Visit	1.000	0.000	--	1.000	0.000	--	1.210	0.063	<0.001	1.210	0.063	<0.001
Guest	0.990	0.048	<0.001	0.990	0.048	<0.001	1.191	0.062	<0.001	1.191	0.062	<0.001
Out	0.831	0.041	<0.001	0.831	0.041	<0.001	1.000	0.000	--	1.000	0.000	--
F3 (Trust) BY												
Revtrstw	1.568	0.068	<0.001	1.568	0.068	<0.001	1.537	0.066	<0.001	1.537	0.066	<0.001
Revtrstn	1.162	0.040	<0.001	1.162	0.040	<0.001	1.171	0.039	<0.001	1.171	0.039	<0.001
Revtrsts	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--
Factor Variances/Covariances[c]												
CE WITH S	0.239	0.021	<0.001	0.226	0.035	<0.001	0.188	0.018	<0.001	0.174	0.027	<0.001
CE WITH T	0.000	0.020	0.989	0.043	0.026	0.090	0.002	0.019	0.897	0.046	0.025	0.069
S WITH T	0.071	0.022	0.001	0.129	0.019	<0.001	0.062	0.019	0.001	0.108	0.016	<0.001
CE VARIANCE	0.475	0.037	<0.001	0.708	0.085	<0.001	0.430	0.034	<0.001	0.620	0.077	<0.001
S VARIANCE	0.606	0.034	<0.001	0.634	0.075	<0.001	0.411	0.040	<0.001	0.431	0.049	<0.001
T VARIANCE	0.371	0.028	<0.001	0.337	0.032	<0.001	0.377	0.028	<0.001	0.342	0.034	<0.001
Predictors												
CE→DEP	0.021	0.056	0.713	0.021	0.056	0.713	-0.031	0.058	0.592	-0.031	0.058	0.592
S→DEP	0.077	0.067	0.254	0.077	0.067	0.254	0.101	0.082	0.218	0.101	0.082	0.218
T→DEP	*-0.215*	*0.070*	*0.002*	*-0.215*	*0.070*	*0.002*	*-0.225*	*0.071*	*0.002*	*-0.225*	*0.071*	*0.002*
SEX→DEP							0.123	0.164	0.453	0.082	0.108	0.446
AGE→DEP							-0.010	0.009	0.231	*-0.024*	*0.006*	*<0.001*

	Unadjusted[b]						Adjusted[b]					
	Rural			Urban			Rural			Urban		
	Est	S.E.	p-value	Est	S.E.	p-value	Est	S.E.	p-value	Est	S.E.	p-value
SEX→CE							-0.055	0.041	0.183	*-0.219*	*0.054*	*<0.001*
AGE→CE							*-0.007*	*0.002*	*0.006*	*-0.021*	*0.003*	*<0.001*
SEX→S							0.004	0.052	0.932	0.041	0.034	0.226
AGE→S							*-0.009*	*0.002*	*<0.001*	*-0.007*	*0.002*	*<0.001*
SEX→T							0.017	0.040	0.677	-0.035	0.027	0.186
AGE→T							0.003	0.002	0.182	0.001	0.002	0.585
Factor Means[d]												
CE	0.000	0.000	--	*-0.275*	*0.085*	*0.001*	0.000	0.000	--	-0.163	0.094	0.085
S	0.000	0.000	--	*0.239*	*0.064*	*<0.001*	0.000	0.000	--	*0.180*	*0.055*	*0.001*
T	0.000	0.000	--	*0.097*	*0.045*	*0.032*	0.000	0.000	--	*0.123*	*0.052*	*0.017*

CE: Community Engagement; S: Sociability; T: Trust

[a] Results correspond to the constrained structural invariance models (Model 5 & 7 of Table 5 in Paper 3). Factor loadings fixed to 1 represent the reference variable used to scale the factor. Significant structural path coefficients and factor means are in italics

[b] Due to failure of the model to converge, different reference variables were used to scale the factors in the adjusted model than in the unadjusted model

[c] In the adjusted model with age and sex predicting the factors, these values represent residual variances or covariances/correlations in residual errors

[d] In the adjusted model including sex and age as predictors, these values represent intercepts for the factors. The rural group served as the reference for comparison of factor means

***** Factor loadings freed between urban and rural groups to establish partial measurement invariance

Appendix Q: Weighted Results of Manuscript 3 EFA, CFA, and SEM

Determination of Final EFA

Ghana

Weighted Factor Loadings for EFA Item Reduction Process

	EFA 1: All Items			**EFA 2: Adequate Removed**			**EFA 3: Out Removed**		
	Factor 1	*Factor 2*	*Factor 3*	*Factor 1*	*Factor 2*	*Factor 3*	*Factor 1*	*Factor 2*	*Factor 3*
Meet	0.804	-0.175	-0.025	0.810	-0.194	-0.037	0.801	-0.161	-0.035
Lead	0.676	0.118	0.058	0.689	0.098	0.050	0.675	0.082	0.050
Club	0.659	0.126	0.006	0.674	0.105	-0.003	0.668	0.120	0.000
Neigh	0.835	-0.022	0.027	0.847	-0.045	0.015	0.844	-0.006	0.0019
Guest	-0.061	0.844	0.048	-0.040	0.830	0.054	0.000	0.819	0.056
Visit	-0.075	0.946	-0.062	-0.063	0.946	-0.050	-0.021	0.926	-0.045
Cowrk	0.440	0.282	-0.137	0.450	0.269	-0.138	0.455	0.276	-0.136
Relig	0.144	0.365	-0.004	0.147	0.362	0.001	0.149	0.334	0.003
Out	0.321	0.372	0.048	0.334	0.359	0.046	-	-	-
Adequate	0.142	-0.068	-0.080	-	-	-	-	-	-
Trust	0.022	0.101	0.643	0.028	0.097	0.642	0.035	0.111	0.641
Support	-0.123	0.104	0.541	-0.119	0.104	0.541	-0.104	0.122	0.539
Revtrstn	-0.146	0.126	0.883	-0.154	0.136	0.890	-0.147	0.134	0.891
Revtrstw	0.098	-0.145	0.879	0.094	-0.144	0.876	0.082	-0.155	0.878
Revtrsts	0.286	-0.201	0.576	0.292	-0.211	0.569	0.283	-0.202	0.568

Final Weighted EFA Structure Matrix of Correlations Between Items and Factors

	Factor 1	**Factor 2**	**Factor 3**
MEET	0.728	0.158	0.147
LEAD	0.720	0.356	0.219
CLUB	0.717	0.388	0.170
NEIGH	0.846	0.334	0.221
GUEST	0.343	0.823	0.114
VISIT	0.340	0.914	0.014
COWRK	0.533	0.449	-0.007
RELIG	0.283	0.394	0.062
TRUST	0.234	0.170	0.657
SUPPORT	0.075	0.117	0.522
REVTRSTN	0.121	0.137	0.865
REVTRSTW	0.231	-0.061	0.887
REVTRSTS	0.339	-0.049	0.622

Estimated Residual Variances for Final Weighted EFA

Item	**Residual Variance**	**Item**	**Residual Variance**	**Item**	**Residual Variance**
MEET	0.448	**GUEST**	0.320	**TRUST**	0.551
LEAD	0.474	**VISIT**	0.161	**SUPPORT**	0.712
CLUB	0.474	**COWRK**	0.633	**REVTRSTN**	0.229
NEIGH	0.284	**RELIG**	0.826	**REVTRSTW**	0.193
				REVTRSTS	0.541

South Africa

Weighted Factor Loadings for EFA Item Reduction Process

	EFA 1: Initial			**EFA 2: Adequate Removed**			**EFA 3: Trust Removed**		
	Factor 1	*Factor 2*	*Factor 3*	*Factor 1*	*Factor 2*	*Factor 3*	*Factor 1*	*Factor 2*	*Factor 3*
Meet	0.882	-0.183	0.032	0.872	-0.168	0.016	0.870	-0.163	-0.022
Lead	0.885	-0.152	0.029	0.894	-0.165	0.040	0.895	-0.165	-0.041
Club	0.676	0.090	-0.028	0.675	0.091	-0.024	0.675	0.090	0.026
Neigh	0.579	0.161	0.010	0.579	0.161	0.014	0.580	0.159	-0.008
Guest	-0.192	0.908	0.016	-0.190	0.904	0.013	-0.192	0.906	-0.018
Visit	-0.083	0.810	0.012	-0.085	0.813	0.012	-0.086	0.812	-0.015
Cowrk	0.294	0.298	-0.080	0.293	0.299	-0.075	0.293	0.297	0.078
Relig	0.194	0.325	-0.070	0.193	0.326	-0.069	0.192	0.327	0.063
Out	0.151	0.517	0.013	0.151	0.518	0.017	0.150	0.518	-0.020
Adequate	0.029	0.056	0.103	-	-	-	-	-	-
Trust	0.001	0.083	0.122	0.002	-0.059	0.127	-	-	-
Support	0.020	-0.059	0.319	0.020	-0.062	0.318	0.023	-0.062	-0.307
Revtrstn	0.059	-0.063	0.761	0.059	0.010	0.756	0.059	-0.055	-0.752
Revtrstw	0.012	0.009	0.920	0.013	0.010	0.926	0.015	0.018	-0.931
Revtrsts	-0.047	0.167	0.558	-0.047	0.168	0.557	-0.046	0.172	-0.556

	EFA 4: Cowrk Removed			**EFA 5: Support Removed**			**EFA 6: Relig Removed**		
	Factor 1	*Factor 2*	*Factor 3*	*Factor 1*	*Factor 2*	*Factor 3*	*Factor 1*	*Factor 2*	*Factor 3*
Meet	0.855	-0.135	0.018	0.857	-0.137	0.013	0.850	-0.129	0.012
Lead	0.880	-0.129	0.010	0.879	-0.129	0.029	0.866	-0.098	0.011
Club	0.676	0.089	-0.027	0.674	0.094	-0.035	0.673	0.094	-0.035
Neigh	0.579	0.135	0.013	0.577	0.140	0.007	0.581	0.153	-0.002
Guest	-0.163	0.919	-0.003	-0.163	0.917	-0.004	-0.126	0.922	-0.027
Visit	-0.047	0.775	0.008	-0.051	0.779	-0.001	-0.010	0.769	-0.019
Cowrk	-	-	-	-	-	-	-	-	-
Relig	0.208	0.326	-0.071	0.205	0.330	-0.077	-	-	-
Out	0.175	0.516	0.008	0.174	0.517	0.008	0.179	0.469	0.019
Adequate	-	-	-		-	-	-	-	-
Trust	-	-	-	-	-	-	-	-	-
Support	0.019	-0.065	0.308	-	-	-	-	-	-
Revtrstn	0.045	-0.061	0.749	0.051	-0.070	0.753	0.039	-0.076	0.753
Revtrstw	-0.003	0.000	0.938	0.003	-0.008	0.937	-0.009	-0.026	0.940
Revtrsts	-0.040	0.166	0.551	-0.038	0.161	0.550	-0.037	0.152	0.548

Final Weighted EFA Structure Matrix of Correlations Between Items and Factors

	Factor 1	Factor 2	Factor 3
MEET	0.803	0.189	0.006
LEAD	0.830	0.225	0.011
CLUB	0.707	0.336	-0.001
NEIGH	0.637	0.368	0.043
GUEST	0.215	0.870	0.159
VISIT	0.275	0.762	0.139
OUT	0.353	0.550	0.119
REVTRSTN	0.029	0.092	0.738
REVTRSTW	0.003	0.164	0.939
REVTRSTS	0.032	0.250	0.578

Estimated Residual Variances for Final Weighted EFA:

Item	Residual Variance	Item	Residual Variance	Item	Residual Variance
MEET	0.342	**GUEST**	0.229	**REVTRSTN**	0.450
LEAD	0.303	**VISIT**	0.419	**REVTRSTW**	0.117
CLUB	0.492	**OUT**	0.681	**REVTRSTS**	0.646
NEIGH	0.574				

Factor Loadings of Social Capital Dimensions by Country for Weighted EFA & CFA

	Ghana						South Africa					
	Final EFA			CFA			Final EFA			CFA		
Item	**Factor 1 (CE)**	**Factor 2 (S)**	**Factor 3 (T)**	**Factor 1 (CE)**	**Factor 2 (S)**	**Factor 3 (T)**	**Factor 1 (CE)**	**Factor 2 (S)**	**Factor 3 (T)**	**Factor 1 (CE)**	**Factor 2 (S)**	**Factor 3 (T)**
Meet	0.801	-0.161	-0.035	0.674			0.850	-0.129	0.012	0.796		
Lead	0.675	0.082	0.050	0.738			0.866	-0.098	0.011	0.821		
Club	0.668	0.120	0.000	0.731			0.673	0.094	-0.035	0.718		
Neigh	0.844	-0.006	0.0019	0.838			0.581	0.153	-0.002	0.657		
Guest	0.000	0.819	0.056		0.863		-0.126	0.922	-0.027		0.810	
Visit	-0.021	0.926	-0.045		0.855		-0.010	0.769	-0.019		0.798	
Cowrk	0.455	0.276	-0.136	0.564			-	-	-	-		
Relig	0.149	0.334	0.003		0.455		-	-	-	-	-	-
Out	-	-	-	-	-	-	0.179	0.469	0.019		0.579	
Trust	0.022	0.101	0.643			0.674	-	-	-	-	-	-
Support	-0.123	0.104	0.541			0.513	-	-	-	-	-	-
Revtrstn	-0.146	0.126	0.883			0.824	-	-	-			0.733
Revtrstw	0.098	-0.145	0.879			0.891	0.039	-0.076	0.753			0.938
Revtrsts	0.286	-0.201	0.576			0.653	-0.009	-0.026	0.940			0.589
Factor Correlations												
CE with S	0.402			0.494			0.371			0.351		
CE with T	0.241			0.257			0.023			0.019		
S with T	0.070			0.074			0.205			0.194		

Reported CFA parameter estimates are standardized with factor variances fixed to 1 for ease of comparison to EFA results
CE: Community Engagement; S: Sociability; T: Trust

Weighted Structural Equation Model Results for Ghana[a]

	Unadjusted			Adjusted		
	Est	**Std. Error**	**p-value**	**Est**	**Std. Error**	**p-value**
Factor Loadings						
F1 (Community Engagement) BY						
Neigh	1.000 (0.838)	0.000 (0.014)	-- (<0.001)	1.000 (0.880)	0.000 (0.016)	-- (<0.001)
Meet	0.803 (0.674)	0.024 (0.017)	<0.001	0.792 (0.697)	0.025 (0.019)	<0.001
Lead	0.880 (0.737)	0.019 (0.015)	<0.001	0.866 (0.762)	0.020 (0.016)	<0.001
Club	0.873 (0.732)	0.024 (0.017)	<0.001	0.859 (0.755)	0.024 (0.018)	<0.001
Cowrk	0.672 (0.564)	0.025 (0.021)	<0.001	0.648 (0.570)	0.026 (0.022)	<0.001
F2 (SOCIABILITY) BY						
Guest	1.000 (0.872)	0.000 (0.017)	-- (<0.001)	1.000 (0.883)	0.000 (0.017)	-- (<0.001)
Visit	0.972 (0.848)	0.035 (0.017)	<0.001	0.959 (0.847)	0.035 (0.017)	<0.001
Relig	0.519 (0.453)	0.028 (0.024)	<0.001	0.506 (0.447)	0.028 (0.025)	<0.001
F3 (Trust) BY						
Revtrstw	1.000 (0.894)	0.000 (0.008)	-- (<0.001)	1.000 (0.896)	0.000 (0.009)	-- (<0.001)
Revtrstn	0.917 (0.821)	0.015 (0.011)	<0.001	0.917 (0.821)	0.015 (0.011)	<0.001
Revtrsts	0.733 (0.656)	0.019 (0.017)	<0.001	0.732 (0.656)	0.019 (0.017)	<0.001
Trust	0.753 (0.673)	0.022 (0.020)	<0.001	0.753 (0.675)	0.022 (0.020)	<0.001
Support	0.566 (0.507)	0.035 (0.032)	<0.001	0.565 (0.507)	0.035 (0.032)	<0.001
Factor Variances/Covariances [b]						
CE WITH S	0.361 (0.494)	0.022 (0.027)	<0.001	0.353 (0.483)	0.023 (0.028)	<0.001
CE WITH T	0.193 (0.257)	0.024 (0.031)	<0.001	0.199 (0.268)	0.025 (0.032)	<0.001
S WITH T	0.058 (0.074)	0.025 (0.033)	0.023	0.059 (0.075)	0.026 (0.033)	0.022
CE VARIANCE	0.703 (1.000)	0.020 (0.000)	<0.001 --	0.693 (0.879)	0.023 (0.013)	<0.001
S VARIANCE	0.760 (1.000)	0.031 (0.000)	<0.001 --	0.771 (0.990)	0.030 (0.004)	<0.001
T VARIANCE	0.800 (1.000)	0.015 (0.000)	<0.001 --	0.800 (0.994)	0.015 (0.003)	<0.001
Predictors						
CE→DEP	*-0.181 (-0.151)*	*0.071 (0.059)*	*0.011 (0.010)*	-0.082 (-0.073)	0.070 (0.061)	0.237 (0.236)
S→DEP	*0.218 (0.190)*	*0.057 (0.049)*	*<0.001*	*0.198 (0.175)*	*0.051 (0.045)*	*<0.001*

	Unadjusted			Adjusted		
	Est	**Std. Error**	**p-value**	**Est**	**Std. Error**	**p-value**
T→DEP	*0.361 (0.323)*	*0.053 (0.048)*	*<0.001*	*0.343 (0.308)*	*0.050 (0.045)*	*<0.001*
SEX→DEP				*0.271*	*0.066*	*<0.001*
AGE→DEP				*0.014*	*0.004*	*<0.001*
SEX→CE				*-0.372 (-0.423)*	*0.034 (0.036)*	*<0.001*
AGE→CE				*-0.020 (-0.023)*	*0.002*	*<0.001*
SEX→S				*-0.098 (-0.111)*	*0.039 (0.044)*	*0.011*
AGE→S				*-0.007 (-0.008)*	*0.002*	*<0.001*
SEX→T				*-0.100 (-0.111)*	*0.035 (0.038)*	*0.004*
AGE→T				0.003	0.002	0.160 (0.159)

CE: Community Engagement; S: Sociability; T: Trust

[a]Values in parentheses represent standardized values. Where not present, standardized estimates are the same. (Standardization uses only the variances of the latent factors and not the outcome or covariates because of their binary nature which would not result in meaningful interpretation. Significant structural path coefficients are in italics

[b] In the adjusted model with age and sex predicting the factors, these values represent residual variances or covariances/correlations in residual errors

Weighted Structural Equation Model Results for South Africa[a]

	Unadjusted			Adjusted		
	Est	**Std. Error**	**p-value**	**Est**	**Std. Error**	**p-value**
Factor Loadings						
F1 (Community Engagement) BY						
Lead	1.000 (0.821)	0.000 (0.017)	-- (<0.001)	1.000 (0.828)	0.000 (0.018)	-- (<0.001)
Meet	0.970 (0.796)	0.035 (0.019)	<0.001	0.965 (0.799)	0.034 (0.019)	<0.001
Club	0.875 (0.718)	0.028 (0.019)	<0.001	0.878 (0.727)	0.028 (0.020)	<0.001
Neigh	0.801 (0.657)	0.033 (0.023)	<0.001	0.803 (0.665)	0.032 (0.024)	<0.001
F2 (Sociability) BY						
Guest	1.000 (0.811)	0.000 (0.028)	-- (<0.001)	1.000 (0.819)	0.000 (0.028)	-- (<0.001)
Visit	0.984 (0.798)	0.056 (0.022)	<0.001	0.980 (0.802)	0.055 (0.022)	<0.001
Out	0.715 (0.580)	0.043 (0.027)	<0.001	0.707 (0.579)	0.042 (0.027)	<0.001
F3 (Trust) BY						
Revtrstw	1.000 (0.938)	0.000 (0.024)	-- (<0.001)	1.000 (0.934)	0.000 (0.023)	-- (<0.001)
Revtrstn	0.782 (0.734)	0.042 (0.023)	<0.001	0.792 (0.740)	0.041 (0.022)	<0.001
Revtrsts	0.628 (0.589)	0.037 (0.026)	<0.001	0.633 (0.591)	0.035 (0.025)	<0.001
Factor Variances/Covariances [b]						
CE WITH S	0.233 (0.351)	0.023 (0.031)	<0.001	0.229 (0.343)	0.023 (0.031)	<0.001
CE WITH T	0.015 (0.019)	0.034 (0.044)	0.666	0.022 (0.028)	0.034 (0.045)	0.526 (0.525)
S WITH T	0.147 (0.194)	0.030 (0.041)	<0.001	0.153 (0.202)	0.030 (0.040)	<0.001
CE VARIANCE	0.673 (1.000)	0.029 (0.000)	<0.001 --	0.672 (0.961)	0.028 (0.010)	<0.001
S VARIANCE	0.657 (1.000)	0.045 (0.000)	<0.001 --	0.663 (0.985)	0.045 (0.005)	<0.001
T VARIANCE	0.879 (1.000)	0.046 (0.000)	<0.001 --	0.868 (0.999)	0.044 (0.001)	<0.001
Predictors						
CE→DEP	-0.031 (-0.025)	0.111 (0.091)	0.779	-0.034 (-0.028)	0.079 (0.066)	0.668
S→DEP	0. 090 (0.073)	0.080 (0.064)	0.257 (0.256)	0.077 (0.063)	0.065 (0.053)	0.236 (0.235)
T→DEP	-0.103 (-0.096)	0.073 (0.068)	0.159 (0.155)	-0.093 (-0.086)	0.072 (0.067)	0.199 (0.196)
SEX→DEP				0.170	0.150	0.257
AGE→DEP				-0.010	0.011	0.349
SEX→CE				*-0.165 (-0.199)*	*0.061 (0.073)*	*0.007 (0.006)*
AGE→CE				*-0.009 (-0.011)*	*0.003*	*0.001*
SEX→S				0.007 (0.008)	0.061 (0.075)	0.910

	Unadjusted			Adjusted		
	Est	**Std. Error**	**p-value**	**Est**	**Std. Error**	**p-value**
AGE→S				*-0.009 (-0.011)*	*0.003*	*0.001 (<0.001)*
SEX→T				-0.023 (-0.024)	0.051 (0.055)	0.656 (0.657)
AGE→T				*0.008*	*0.003*	*0.004 (0.003)*

CE: Community Engagement; S: Sociability; T: Trust

[a]Values in parentheses represent standardized values. Where not present, standardized estimates are the same. (Standardization uses only the variances of the latent factors and not the outcome or covariates because of their binary nature which would not result in meaningful interpretation. Significant structural path coefficients are in italics

[b] In the adjusted model with age and sex predicting the factors, these values represent residual variances or covariances/correlations in residual errors

*Model Fit Statistics for Invariance Testing Using Weighted Data**

Model	χ^2	df	p-value	RMSEA (95% CI)	CFI	TLI	χ^2 Difference Test
Ghana							
1: Measurement non-invariance (configural model/unconstrained loadings & thresholds)	806.404	124	<0.001	0.051 (0.048-0.055)	0.934	0.917	
2: Measurement invariance (Scalar model/constrained loadings & thresholds)	892.141	164	<0.001	0.046 (0.043-0.049)	0.930	0.933	2 vs 1: 160.049 (df: 40, p<0.001)
3: Partial measurement invariance (selected loadings & thresholds unconstrained)	806.963	147	<0.001	0.046 (0.043-0.049)	0.936	0.932	3 vs. 1: 30.483 (df: 23, p=0.1360)
4: Structural non-invariance (unconstrained structural paths between factors & depression)	913.211	167	<0.001	0.046 (0.043-0.049)	0.926	0.919	
5: structural invariance (constrained structural paths between factors & depression)	867.854	170	<0.001	0.044 (0.041-0.044)	0.931	0.926	5 vs. 4: 6.029 (df: 3, p=0.1102)
6: structural non-invariance w/ covariates	1016.204	207	<0.001	0.043 (0.041-0.046)	0.919	0.907	
7: structural invariance w/ covariates	972.452	210	<0.001	0.042 (0.039-0.044)	0.923	0.913	7 vs. 6: 5.266 (df: 3, p=0.1533)
South Africa							
1: Measurement non-invariance (configural model/unconstrained loadings & thresholds)	312.129	64	<0.001	0.051 (0.045-0.056)	0.954	0.936	
2: Measurement invariance (Scalar model/constrained loadings & thresholds)	364.444	98	<0.001	0.042 (0.038-0.047)	0.951	0.955	2 vs 1: 86.227 (df: 34, p<0.001)
3: Partial measurement invariance (selected loadings & thresholds unconstrained)	326.762	86	<0.001	0.043 (0.038-0.048)	0.956	0.954	3 vs. 1: 30.643 (df: 22, p=0.1036)
4: Structural non-invariance (unconstrained structural paths between factors & depression)	352.656	100	<0.001	0.041 (0.036-0.045)	0.951	0.947	
5: structural invariance (constrained structural paths between factors & depression)	328.224	103	<0.001	0.038 (0.033-0.043)	0.957	0.954	5 vs. 4: 6.066 (df: 3, p=0.1085)
6: structural non-invariance w/ covariates	407.002	128	<0.001	0.038 (0.034-0.042)	0.949	0.939	
7: structural invariance w/ covariates	403.337	131	<0.001	0.037 (0.033-0.041)	0.951	0.942	7 vs. 6: 8.462 (df: 3, p=0.0374)

*Chi-square difference testing for WLSMV estimation is not calculated from chi-square values in the same manner as standard difference testing. Additionally, the behavior of other fit statistics for WLSMV estimation with categorical indicators can be irregular, limiting direct comparison of their magnitudes between. For this reason, constrained model fit statistics may not always appear to have worse values than their unconstrained counterparts.

Results of Weighted Structural Equation Models Comparing Urban to Rural Residents: Ghana[a]

	Unadjusted[b]						Adjusted[b]					
	Rural			Urban			Rural			Urban		
	Est	S.E.	p-value	Est	S.E.	p-value	Est	S.E.	p-value	Est	S.E.	p-value
Factor Loadings												
F1 (Community Engagement) BY												
Neigh	1.000	0.000	--	1.000	0.000	--	1.591	0.077	<0.001	1.591	0.077	<0.001
Meet	0.788	0.027	<0.001	0.788	0.027	<0.001	1.224	0.060	<0.001	1.224	0.060	<0.001
Lead*	0.822	0.025	<0.001	0.919	0.048	<0.001	1.280	0.067	<0.001	1.435	0.081	<0.001
Club*	0.955	0.027	<0.001	0.799	0.047	<0.001	1.487	0.080	<0.001	1.250	0.085	<0.001
Cowrk	0.654	0.031	<0.001	0.654	0.031	<0.001	1.000	0.000	--	1.000	0.000	--
F2 (Sociability) BY												
Guest	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--
Visit	0.964	0.037	<0.001	0.964	0.037	<0.001	0.944	0.040	<0.001	0.944	0.040	<0.001
Relig*	0.565	0.038	<0.001	0.541	0.049	<0.001	0.561	0.039	<0.001	0.498	0.049	<0.001
F3 (Trust) BY												
Revtrstw*	1.463	0.049	<0.001	1.121	0.064	<0.001	1.461	0.048	<0.001	1.134	0.065	<0.001
Revtrstn	1.248	0.035	<0.001	1.248	0.035	<0.001	1.248	0.035	<0.001	1.248	0.035	<0.001
Revtrsts	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--
Trust	1.038	0.053	<0.001	1.038	0.053	<0.001	1.033	0.054	<0.001	1.033	0.054	<0.001
Support*	0.823	0.070	<0.001	0.628	0.058	<0.001	0.825	0.070	<0.001	0.633	0.058	<0.001
Factor Variances/Covariances[c]												
CE WITH S	0.315	0.028	<0.001	0.436	0.047	<0.001	0.195	0.022	<0.001	0.274	0.032	<0.001
CE WITH T	0.115	0.023	<0.001	0.166	0.035	<0.001	0.071	0.015	<0.001	0.113	0.022	<0.001
S WITH T	0.007	0.024	0.782	0.078	0.033	0.018	0.005	0.024	0.846	0.082	0.033	0.013
CE VARIANCE	0.686	0.029	<0.001	0.766	0.084	<0.001	0.270	0.028	<0.001	0.300	0.034	<0.001
S VARIANCE	0.725	0.030	<0.001	0.772	0.098	<0.001	0.738	0.033	<0.001	0.797	0.107	<0.001
T VARIANCE	0.392	0.025	<0.001	0.616	0.074	<0.001	0.392	0.025	<0.001	0.603	0.072	<0.001
Predictors												
CE→DEP	-0.061	0.087	0.484	*-0.307*	*0.099*	*0.002*	0.048	0.130	0.711	-0.296	0.156	0.057
S→DEP	*0.216*	*0.074*	*0.003*	*0.227*	*0.093*	*0.014*	*0.189*	*0.062*	*0.002*	*0.195*	*0.090*	*0.029*
T→DEP	*0.453*	*0.096*	*<0.001*	*0.483*	*0.090*	*<0.001*	*0.441*	*0.085*	*<0.001*	*0.452*	*0.090*	*<0.001*

	Unadjusted[b]						Adjusted[b]					
	Rural			Urban			Rural			Urban		
	Est	S.E.	p-value	Est	S.E.	p-value	Est	S.E.	p-value	Est	S.E.	p-value
SEX→DEP							*0.249*	*0.081*	*0.002*	*0.310*	*0.111*	*0.005*
AGE→DEP							*0.014*	*0.006*	*0.017*	*0.015*	*0.005*	*0.002*
SEX→CE							*-0.214*	*0.028*	*<0.001*	*-0.276*	*0.034*	*<0.001*
AGE→CE							-0.013	0.002	<0.001	-0.014	0.002	<0.001
SEX→S							-0.065	0.050	0.195	-0.134	0.060	0.025
AGE→S							-0.008	0.002	<0.001	-0.007	0.003	0.008
SEX→T							-0.083	0.035	0.018	-0.059	0.043	0.177
AGE→T							-0.001	0.002	0.699	0.006	0.002	0.013
Factor Means[d]												
CE	0.000	0.000	--	*-0.295*	*0.062*	*<0.001*	0.000	0.000	--	*-0.162*	*0.047*	*<0.001*
S	0.000	0.000	--	*-0.226*	*0.068*	*0.001*	0.000	0.000	--	*-0.221*	*0.084*	*0.008*
T	0.000	0.000	--	*-0.324*	*0.052*	*<0.001*	0.000	0.000	--	*-0.343*	*0.060*	*<0.001*

CE: Community Engagement; S: Sociability; T: Trust

[a] For purposes of comparison between the two groups, results presented are for models without equality constraints on the social capital-depression paths between urban and rural groups (Models 4 & 6 in the table of model fit statistics for invariance testing). Significant structural path coefficients and factor means are in italics. Factor loadings fixed to 1 represent the reference variable used to scale the factor.

[b] Different reference variables were used to scale the factors in the adjusted model than in the unadjusted model due to failure of the model to converge

[c] In the adjusted model with age and sex predicting the factors, these values represent residual variances or covariances/correlations in residual errors

[d] In the adjusted model with sex and age as predictors, these values represent factor intercepts. The rural group served as the reference for comparison of means

*Factor loadings freed between urban and rural groups to establish partial measurement invariance

Results of Weighted Structural Equation Models Comparing Urban to Rural Residents: South Africa[a]

	Unadjusted						Adjusted					
	Rural			Urban			Rural			Urban		
	Est	S.E.	p-value	Est	S.E.	p-value	Est	S.E.	p-value	Est	S.E.	p-value
Factor Loadings												
F1 (Community Engagement) BY												
Meet	0.982	0.044	<0.001	0.982	0.044	<0.001	0.976	0.045	<0.001	0.976	0.045	<0.001
Lead	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--
Club*	0.795	0.047	--	0.855	0.062	<0.001	0.804	0.048	<0.001	0.855	0.064	<0.001
Neigh*	0.730	0.045	<0.001	0.783	0.066	<0.001	0.733	0.044	<0.001	0.793	0.068	<0.001
F2 (Sociability) BY												
Visit	1.318	0.089	<0.001	1.318	0.089	<0.001	1.346	0.084	<0.001	1.346	0.084	<0.001
Guest*	1.636	0.161	<0.001	1.318	0.089	<0.001	1.682	0.157	<0.001	1.348	0.084	<0.001
Out	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--
F3 (Trust) BY												
Revtrstw	1.597	0.114	<0.001	1.597	0.114	<0.001	1.538	0.099	<0.001	1.538	0.099	<0.001
Revtrstn	1.106	0.052	<0.001	1.106	0.052	<0.001	1.097	0.051	<0.001	1.097	0.051	<0.001
Revtrsts	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--	1.000	0.000	--
Factor Variances/Covariances[b]												
CE WITH S	0.125	0.029	<0.001	0.228	0.035	<0.001	0.118	0.028	<0.001	0.221	0.033	<0.001
CE WITH T	0.009	0.030	0.765	0.016	0.029	0.589	0.015	0.031	0.639	0.023	0.029	0.440
S WITH T	0.071	0.019	<0.001	0.057	0.017	0.001	0.075	0.018	<0.001	0.058	0.016	<0.001
CE VARIANCE	0.690	0.038	<0.001	0.708	0.085	<0.001	0.691	0.039	<0.001	0.619	0.077	<0.001
S VARIANCE	0.282	0.034	<0.001	0.634	0.075	<0.001	0.271	0.036	<0.001	0.433	0.050	<0.001
T VARIANCE	0.361	0.040	<0.001	0.337	0.032	<0.001	0.375	0.040	<0.001	0.341	0.034	<0.001
Predictors												
CE→DEP	-0.230	0.226	0.309	0.098	0.108	0.368	-0.199	0.123	0.104	0.085	0.095	0.368
S→DEP	*0.455*	*0.193*	*0.019*	-0.081	0.140	0.563	*0.350*	*0.148*	*0.018*	-0.097	0.142	0.494
T→DEP	0.025	0.157	0.872	-0.271	0.155	0.082	0.082	0.135	0.544	-0.272	0.148	0.067
SEX→DEP							-0.018	0.202	0.928	0.279	0.196	0.153
AGE→DEP							0.009	0.016	0.580	*-0.025*	*0.010*	*0.011*
SEX→CE							-0.094	0.073	0.198	*-0.236*	*0.093*	*0.011*

	Unadjusted						Adjusted					
	Rural			Urban			Rural			Urban		
	Est	**S.E.**	**p-value**	**Est**	**S.E.**	**p-value**	**Est**	**S.E.**	**p-value**	**Est**	**S.E.**	**p-value**
AGE→CE							-0.007	0.005	0.125	*-0.014*	*0.004*	*0.001*
SEX→S							-0.071	0.051	0.166	0.052	0.059	0.378
AGE→S							*-0.006*	*0.003*	*0.018*	*-0.006*	*0.003*	*0.022*
SEX→T							0.017	0.056	0.764	-0.025	0.037	0.501
AGE→T							0.006	0.003	0.058	*0.005*	*0.002*	*0.021*
Factor Means[c]												
CE	0.000	0.000	--	*-0.488*	*0.094*	*0.001*	0.000	0.000	--	*-0.412*	*0.135*	*0.002*
S	0.000	0.000	--	0.106	0.056	0.060	0.000	0.000	--	0.038	0.067	0.574
T	0.000	0.000	--	*0.103*	*0.053*	*0.050*	0.000	0.000	--	0.119	0.070	0.089

CE: Community Engagement; S: Sociability; T: Trust

[a] For purposes of comparison between the two groups, results presented are for models without equality constraints on the social capital-depression relationships (Models 4 & 6 in the table of model fit statistics for invariance testing). Significant structural path coefficients and factor means are in italics. are in italics. Factor loadings fixed to 1 represent the reference variable used to scale the factor

[b] In the adjusted model with age and sex predicting the factors, these values represent residual variances or covariances/correlations in residual errors

[c] In the adjusted model with sex and age as predictors, these values represent factor intercepts. The rural group served as the reference for comparison of means

*Factor loadings freed between urban and rural groups to establish partial measurement invariance

Curriculum Vitae

Dzifa Adjaye-Gbewonyo

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Baltimore, MD 21205
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EDUCATION

Anticipated 2017	PhD in Social and Behavioral Sciences, Department of Health, Behavior & Society Certificate in Health Disparities and Health Inequality Johns Hopkins Bloomberg School of Public Health, Baltimore, MD Dissertation: *Urbanicity, Social Capital, and Depression in Older Adults: An Analysis of Two African Countries*
2011	MPH in Global Environmental Health Certificate in Socio-Contextual Determinants of Health Emory University, Atlanta, GA Thesis: *Exploring Racial Differences in Precocious Puberty among Girls: Implications for the Role of Environmental Factors*
2007	BA in Environmental Science & Public Policy, Cum Laude Honors, Foreign Language Citation in French Harvard University, Cambridge, MA

RESEARCH INTERESTS

My general research interests are in the social and structural determinants of global population health and their impact on psychological well-being—specifically depression and life satisfaction—as well as the development of non-communicable diseases (NCDs). My focus encompasses health transitions related to social change processes including globalization, urbanization, and economic development. In addition, I am interested in comparative research across societies to assess differences in health outcomes as they relate to socio-structural factors such as political economy, cultural values, social capital, lifestyle factors, and built environments.

EMPLOYMENT AND PROFESSIONAL EXPERIENCE

2014 **Research Assistant**
Johns Hopkins Center for Communication Programs, Baltimore, MD

- Designed household survey instruments and training materials; developed research protocols; entered, cleaned and analyzed data; and produced a report for evaluation of a safe motherhood education program in Zambia.

2011-2013 **Research Project Manager**
Kaiser Permanente Center for Health Research Southeast, Atlanta, GA

- Coordinated federally funded research projects including the Vaccine Safety Datalink, a data-based project with a local site team of 14 staff and students; and the Minority Health Genomics & Translational Research Biorepository Database project, a recruitment study with a 6-member team and over 130 patients providing clinical, questionnaire, and focus group data
- Prepared Institutional Review Board applications, Data Use Agreements, and contracts; developed and monitored budgets; scheduled and facilitated meetings; communicated with project sponsors; wrote progress reports and successful funding proposals; hired, oriented, and supervised staff; and enrolled participants

2009-2011 **Research Assistant**
Emory University Rollins School of Public Health, Atlanta, GA

- Studied racial differences in girls with precocious puberty by designing an electronic chart abstraction tool and performing medical chart review of over 100 patients at Emory Children's Center
- Performed literature reviews on environmental exposures and female fertility and on pubertal timing in girls

2009, 2010 **Project Assistant**
University of California Los Angeles School of Public Health, Kern County, CA

- Recruited controls for the Parkinson's Disease, Environment, and Genes (PEG) study
- Collected survey data and saliva samples from participants and coordinated data collection activities in Kern County
- Engaged in active surveillance through medical chart abstraction to identify cases for the creation of a state-wide database for the California Parkinson's Disease Registry Pilot Project

2008 **Intern**, Mt. Sinai School of Medicine International Exchange Program
University of Cape Town, Occupational and Environmental Health, Cape Town, South Africa

- Analyzed results of a study on the effectiveness of chemical hazard communication and drafted a policy brief
- Examined reports of local pesticide poisonings to evaluate follow-up by environmental health officers
- Prepared literature reviews on chemical hazard comprehensibility and on the toxicity of xanthates

2008 **Intern**, Secretariat of the Executive Director
Environmental Protection Agency**,** Accra, Ghana

- Prepared guidelines to assist in initiating a program to collect and dispose

of used mobile phones as hazardous waste
- Co-authored a report on the social and environmental impacts to communities resulting from gold mining

2006 **Undergraduate Researcher**, National Science Foundation Research Experiences for Undergraduates (REU) Program
University of Cape Coast, Department of Environmental Science, Cape Coast, Ghana
- Designed and conducted a field experiment on the use of West African black pepper as a natural pesticide alternative

2005, 2006 **Intern**, Environmental Group
EDAW, Inc., San Diego, CA
- Participated in biological, noise, and archaeological field surveys
- Prepared air quality and noise reports, environmental impact reports, & cultural and biological technical reports
- Geo-referenced historical maps using GIS and researched literature and legislation for proposed development projects

HONORS AND AWARDS

2015 P.E.O. Scholar Award recipient
2011 Finalist, Award for Research Excellence in Environmental Health, Emory University Rollins School of Public Health
2011 Delta Omega Honorary Society in Public Health
2009 Dean's Council Scholarship, Emory University Rollins School of Public Health
2007 Edward Eager Memorial Fund Prize for poetry, Harvard University Department of English
2006 National Scholars Honor Society
2005 Harvard College Scholar, Harvard University

GRANTS

F31 AG052288 Adjaye-Gbewonyo (PI) 2015-2017
Urbanicity, Social Connectedness, and Depression in Older Adults: An Analysis of Two African Countries
National Institute on Aging, National Institutes of Health F31 Ruth L. Kirschstein National Research Service Award (NRSA) Individual Predoctoral Fellowship
The goal of this project is to investigate the effects of urban-rural residence on the risk for depression in older adults using data from Ghana and South Africa in the WHO Study on Global AGEing and Adult Health (SAGE).
Role: Principal Investigator

PUBLICATIONS

Adjaye-Gbewonyo D, Bednarczyk RA, Davis RL, Omer SB. (2014). Using the Bayesian Improved Surname Geocoding Method (BISG) to Create a Working Classification of Race and Ethnicity in a Diverse Managed Care Population: A Validation Study. *Health Services Research*, 49(1): 268-83.

van Santen KL, Bednarczyk RA, **Adjaye-Gbewonyo D**, Orenstein WA, Davis R, Omer SB. (2013). Effectiveness of Pneumococcal Conjugate Vaccine in Infants by Maternal Influenza Vaccination Status. *The Pediatric Infectious Disease Journal*, 32(11): 1180-4.

Richards JL, Hansen C, Bredfeldt C, Bednarczyk RA, Steinhoff MC, **Adjaye-Gbewonyo D**, Ault K, Gallagher M, Orenstein W, Davis RL, Omer SB. (2013). Neonatal outcomes after antenatal influenza immunization during the 2009 H1N1 influenza pandemic: impact on preterm birth, birth weight, and small for gestational age birth. *Clinical Infectious Diseases*, 56(9):1216-22.

Bednarczyk RA, **Adjaye-Gbewonyo D**, Omer SB. (2012). Safety of influenza immunization during pregnancy for the fetus and the neonate. *American Journal of Obstetrics and Gynecology*, 207(3 Suppl):S38-46.

Adjaye-Gbewonyo D, Quaye EC, & Wubah DA. (2010). The effect of extracts of Piper guineense seeds on insect pest damage to cowpea plants. *The Journal of Young Investigators*, 20(1), http://www.jyi.org/research/re.php?id=3654

PRESENTATIONS

Adjaye-Gbewonyo D, Rebok G, Gallo JJ, Gross A, Ahmed S, Underwood C. Assessing Urban-Rural Differences in the Relationship Between Social Capital and Depression in Ghanaian and South African Older Adults. Poster Presentation: International Conference on Urban Health, September 26-29, 2017, Coimbra, Portugal (scheduled)

Adjaye-Gbewonyo D, Rebok G, Gallo JJ, Gross A, Ahmed S, Underwood C. Urbanicity of Residence and Depression among Older Adults in Ghana and South Africa. Oral Paper Presentation: IAGG World Congress of Gerontology & Geriatrics, July 23, 2017, San Francisco, CA (scheduled)

Adjaye-Gbewonyo D, Rebok G, Gallo JJ, Gross A, Ahmed S, Underwood C. Lifetime Residence in Urban vs. Rural Environments and Depression Among Ghanaian and South African Older Adults: An Analysis of the WHO Study on Global Ageing and Adult Health (SAGE). Poster Presentation: Population Association of America 2017 Annual Meeting, April 29, 2017, Chicago, IL

Adjaye-Gbewonyo D, Rebok G, Gallo JJ, Gross A, Ahmed S, Underwood C. Urban/Rural Residence over the Life Course and Depression among Older Adults in

Ghana and South Africa. Poster Presentation: Aging & Society Sixth Interdisciplinary Conference, October 7, 2016, Norrköping, Sweden

Adjaye-Gbewonyo D, Badik J, Muir A, Strickland M, Darrow L. Racial differences in characteristics of girls presenting with precocious puberty. Poster Presentation: American Public Health Association Annual Meeting, November 6, 2013, Boston, MA

Adjaye-Gbewonyo D, Bednarczyk RA, Davis RL, & Omer SB. Capturing Race and Ethnicity for Health Research. Poster Presentation: HMO Research Network Conference, May 1, 2012, Seattle, WA

Gbewonyo D. The effect of extracts of Piper guineense seeds on insect pest damage to cowpea plants. Poster Presentation: Harvard Undergraduate Research Symposium, November 11, 2006, Cambridge, MA

TEACHING

Teaching Assistant and Lecturer, *Policy Interventions for Health Behavior Change* (Second Term 2014 and 2015), Department of Health, Behavior & Society, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

Teaching Assistant, *Health, Poverty, & Public Policy in the United States* (Second Term 2015), Department of Health, Behavior & Society, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

Teaching Assistant, *Fundamentals of Health, Behavior & Society* (First Term 2015), Department of Health, Behavior & Society, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

Teaching Assistant, *Introduction to Bioethics in Public Health Practice and Research* (Summer Term 2015), Department of Health Policy and Management, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

LEADERSHIP AND SERVICE

2015-2016	President, JHSPH Black Graduate Student Association
2015-2016	Councilmember, Baltimore Council of Minority Professional and Graduate Students
2014-2015	Treasurer, JHSPH Black Graduate Student Association
2014	Faces of Africa Planning Committee, JHSPH African Public Health Network
2013-present	Research Chair, Youth Alliance for Leadership & Development in Africa-US
2011	Invited Speaker, Youth Motivation Day, South Atlanta School of Computer Animation and Design

2008-2009	Alumni Interviewer, Harvard College Office of Admissions & Financial Aid
2004-2006	Research Director, Founding Board Member and Chair of Partnerships & Professional Affiliates Committee, Youth Alliance for Leadership & Development in Africa
2003-2004	Eco-Representative, Resource Efficiency Program, Harvard University

CERTIFICATIONS

Certified in Public Health (CPH), National Board of Public Health Examiners, 2012-present
Collaborative Institutional Training Initiative (CITI) human subjects protection, 2010-2016
Environmental Health Specialist (EHS) Trainee, California Department of Public Health, 2008

SKILLS

Stata, SAS, Mplus, Epi Info, UCINet, ArcGIS, EndNote, Microsoft Office
Proficient in French; Conversational Akan (Twi and Fante)

PROFESSIONAL AFFILIATIONS

Population Association of America, 2017-present
Aging and Society Research Network, 2016-present
Young Professionals Chronic Disease Network, 2012-present
American Public Health Association, 2006-2007, 2013-2014
National Environmental Health Association, 2008-2009