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Mental Health Status and Participation in an Economic Livelihoods Intervention: A case study of the SHAZ! Project for adolescent orphan girls in Zimbabwe

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Mental Health Status and Participation in an Economic Livelihoods Intervention: A case study of the SHAZ! Project for adolescent orphan girls in Zimbabwe

By

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A dissertation submitted in partial satisfaction of the requirements for the degree of

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Of the

University of California, Berkeley

Committee in charge:

Nancy Padian, Chair
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Abstract

Mental Health Status and Participation in an Economic Livelihoods Intervention:
A case study of the SHAZ! Project for adolescent orphan girls in Zimbabwe

by

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Doctor of Philosophy in Epidemiology

University of California, Berkeley
Professor Nancy Padian, Chair

It is widely recognized that poverty is a driver of adverse health. Thus, programs that address economic status as a means to improve health and wellbeing have garnered increasing attention in recent years. These interventions, sometimes referred to as "livelihoods opportunities" interventions, encompass a range of strategies to improve economic status and earning potential. Research has demonstrated positive impacts of economic interventions on reproductive outcomes, the health and wellbeing of children and reductions in violence. However, not all findings from these interventions are positive. There is also a lack of rigorous evaluation of the health outcomes for many economically based interventions.

Populations suffering social and economic disadvantage are often populations also suffering from increased mental health morbidity. Mental health issues such as depression, anxiety and lack of hope for the future may prevent these populations from participating fully in interventions and may reduce intervention effectiveness, unless mental health care is incorporated into the interventions. Conversely, it may be that opportunities made available through intervention programs can create a sense of hope and self efficacy and, thus, lead to improvement in mental health status overall.

This dissertation uses the Shaping the Health of Adolescents in Zimbabwe (SHAZ!) project as a case study of the role mental health plays in intervention participation and the impact of economic livelihoods interventions on mental health. For this case study, several analyses were undertaken. First the characteristics of the instrument used to measure mental health in this population were described. Secondly an estimation of the potential for intervention to affect mental health was conducted using population intervention models based on the baseline data. Finally the longitudinal data were explored using causal inference based methods to estimate average treatment effects for each component of the intervention on mental health status and for each measure of mental health status over time on intervention completion.

The Shona Symptom Questionnaire, which was used to measure symptoms of common mental disorders, was found to have reasonable measurement characteristics in this population. Potential for intervention to impact mental health was demonstrated in the population intervention models. Using these models for the baseline and screening data, self efficacy, social support and general health had the largest estimates of potential changes in population mental health.

In this case study, as hypothesized, poor mental health had a negative impact on intervention participation and conversely, the livelihoods intervention had a positive impact on mental health status. There was not enough support in the data from this small case study to estimate all the parameters of interest. However, statistically significant results showed an average treatment effect on mental health of over 20 percent for participation in the Red Cross component of the intervention. Being symptomatic for mental health distress at baseline was also significantly associated with a reduction in completion of the Red Cross component of training.

Applying novel methods to intervention evaluations allows a more nuanced understanding of multi-component interventions. These results suggest that incorporating mental health support, particularly at baseline may have important benefits in terms of intervention impacts in disadvantaged populations. As always further research is needed to confirm these findings, but the results of these dissertation analyses are an exciting first step in understanding these relationships and improving future work in this field.

This dissertation is dedicated to my children Thomas Hyun-Kyu and Camille Jin-Mi

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Introduction

"The biggest enemy of health in the developing world is poverty."

-Kofi Annan

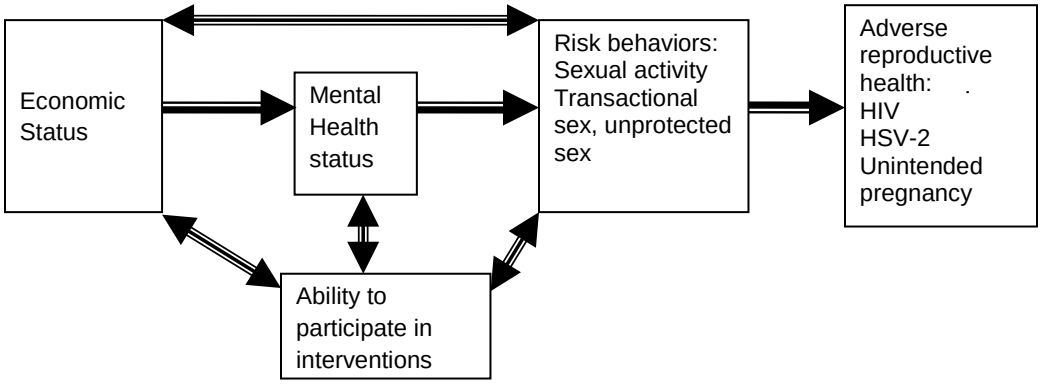
It is widely recognized that poverty is a driver of adverse health. Thus, programs that address economic status as a means to improve health and wellbeing have garnered increasing attention in recent years. These interventions, sometimes referred to as "livelihoods opportunities" interventions, encompass a range of strategies to improve economic status and earning potential. With the awarding of the Nobel Peace Prize to Muhammad Yunus and Grameen Bank in 2006[1], micro-credit, in particular, has received a great deal of attention as a possible intervention strategy to improve economic status and well-being. Other strategies such as conditional cash transfers, vocational training and support for staying in school also have been promoted for improving health and well-being among disadvantaged populations. Research has demonstrated positive impacts of economic interventions on reproductive outcomes,[2-5] the health and wellbeing of children[6] and reductions in violence[7]. However, not all findings from these interventions are positive[8, 9]. There is also a lack of rigorous evaluation of the health outcomes for many economically based interventions[10].

Populations suffering social and economic disadvantage are often populations also suffering from increased mental health morbidity. Mental health issues such as depression, anxiety and lack of hope for the future may prevent these populations from participating fully in interventions and may reduce intervention effectiveness, unless mental health care is incorporated into the interventions. Conversely, it may be that opportunities made available through intervention programs can create a sense of hope and self efficacy and, thus, lead to improvement in mental health status overall. One project in India suggested that micro-credit groups could buffer women from mental health distress[11].

This dissertation examines the relation between mental health and intervention participation using a randomized trial of an economic livelihoods intervention in Zimbabwe as a case study. In Zimbabwe, the leading cause of death in all ages is HIV. Youth are a key population in the epidemic, with the incidence of HIV infection peaking at adolescence in women; and young women experiencing up to three times the incidence of HIV compared to their male counterparts[12]. Shaping the Health of Adolescents in Zimbabwe (SHAZ!) was designed to compare reproductive health and HIV acquisition risks between participants randomized to a combined health education and vocational training intervention and those randomized to health education alone. Understanding the interrelations between a young woman's economic status, mental health and exposure to intervention is an important step towards optimizing the effectiveness of interventions. Exploring these issues in the SHAZ! project population serves as a case study for the role of mental health in economic interventions

generally. The diagram below (figure 1) is a conceptual diagram showing the main factors and relations of interest for this research. More formal directed acyclic graphs (DAGs) for each analysis are shown in the analysis chapters.

Figure 1. Conceptual diagram of research



In chapter 1, I describe the existing literature on economic livelihoods interventions and mental health as well as the background and context of the HIV epidemic among youth in Zimbabwe. In chapter 2, I give an short history of the SHAZ! project's work and describe the intervention phase of the project from which data for this dissertation are drawn. Chapter 2 also gives an overview of the study population at baseline. Analyses examining the measurement of mental health status in this population are presented in chapter 3. Chapter 4 assesses the prevalence and factors associated with mental health symptoms at baseline and uses population intervention models (PIMs) to describe the potential impacts of intervention on mental health status. Traditional methods of analysis are unable to account for inter-related factors which change and affect each other over time. Chapter 5 will describe the analytic approach to these data and the longitudinal methods used in this dissertation account for time-dependent confounding. Analyses using these methods to explore associations between mental health, economic status, intervention participation, and infection with either HIV or Herpes Simplex Virus-2 infection are presented in chapters 6, and 7. Chapter 8 discusses the conclusions of the dissertation analyses and the implications for future interventions and research.

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I benefited enormously from the mentorship I received at Berkeley, my advisors for this dissertation provided invaluable feedback on the research and on my development as a researcher. I thank my advisor Nancy Padian for giving me the opportunity to work on the SHAZ! project and for her support during my years as her employee at UCSF and her student at UC Berkeley. I am grateful for the mentorship and teaching of Alan Hubbard without whom I would have been unable to implement the methods used in this dissertation. I am grateful to Max Auffhammer for his fantastic teaching and willingness to take time to find methodological common ground between epidemiology and econometrics. I would especially like to thank Ira Tager for his dedication to the doctoral students and his insistence that we hold ourselves to the highest methodological and intellectual standards possible.

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I am grateful to my parents Han and Winnefred Kang who have encouraged and supported me throughout my life and my academic career.

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Chapter 1. Background

Economic livelihoods interventions to improve health and wellbeing

Several intervention strategies to improve economic status or earning potential, often referred to as "livelihoods interventions", have been proposed as ways to improve health and wellbeing. Two strategies that have been widely promoted are micro-credit such as the Grameen Bank in Bangladesh[1, 2], and conditional cash transfers such as the Opportunidades/Progressa program in Mexico[3-8]. Vocational training and support for staying in school have also been promoted for improving health and well-being among disadvantaged populations.). Research has demonstrated positive impacts of economic interventions on health knowledge[9-13], reproductive outcomes[3, 4, 14, 15] the health and wellbeing of children[6] and reductions in violence[16]. However not all findings from these interventions are positive[5, 17].

Economic status is an important constraint on young women's ability to avoid risky sexual behaviors[18]. HIV prevention interventions which incorporate economic livelihoods for women and girls are increasingly recognized as a priority[19, 20]. However, few interventions to improve socioeconomic status in youth have evaluated biological outcomes.

Micro-finance interventions have been shown to have impact on HIV risk behavior among adult women[16, 21]. In pilot work prior to the start of the SHAZ! project described here, we found that under the current economic circumstances, microfinance was not a viable strategy for young women in Zimbabwe but that livelihoods interventions might have potential in this population[22]. In Kenya the Tap and Reposition Youth study (TRY) also found that micro-credit was not an effective intervention strategy for youth[23]. Data presented at the International AIDs meeting in Vienna showed exciting preliminary results of a conditional cash transfer program in Malawi. The Malawi project supported young women to remain in or return to school and found a reduction in both HIV and HSV-2 prevalence among intervention participants who were in school at baseline[24].

A recent literature review[25] and journal article[26] sponsored by the Ford Foundation summarized the findings of these projects including: FINCA (Uganda), IMAGE (South Africa), SHAZ (Zimbabwe); CRECER (Bolivia); Pro-Mujer (Argentina, Bolivia, Mexico, Nicaragua, Peru); Fonkoze (Haiti); the Women and Wealth Project (Cambodia, India); CHARCA (India); and the Sunflower Support Groups (Vietnam). The review concluded that although these approaches are promising and feasible, there is a lack of rigorous documentation and evaluation of the health outcomes in economically based interventions[26].

Economic Status and Mental Health

As with many other health outcomes, mental health disorders show a relationship with lower socioeconomic status[27]. Hunger, gender disadvantage and economic stressors have all been associated with mental disorders[28-32]. For adolescents, the presence of safe and supportive environments and access to essential requirements such as food, clean water, and safe shelter are all important predictors of positive mental health[33, 34].

Nyamukapa et al. have worked to develop a theoretical framework for the causes and consequences of psychosocial distress among orphans in Zimbabwe. This framework was developed based on existing literature on psychosocial distress in children from both developed and developing countries and tested using data from a large national survey in Zimbabwe. They

found that orphans had greater psychosocial distress than non-orphans and that living in a poor household and being out of school were associated with psychosocial distress. They also found that social connectedness was associated with reduced distress, suggesting that social support could mitigate the negative effects of orphaning [35].

Mental Health and Economic Interventions

Access to and funding for individual mental health services and treatment is particularly inadequate in resource-poor countries. Mental health is often seen as a lower priority than other health issues. Fortunately, emerging evidence indicates that mental health can be promoted by more general public health actions targeted at vulnerable population groups [36]. A World Health Organization review of school based life-skills interventions found decreases in substance abuse and adolescent pregnancy, and increases in academic performance, mental well-being and health behaviors[37].

It is now recognized that mental health must be an integral component of public health interventions. This has been pointed out in the recent series of articles on mental health published in the Lancet [38-42]. Fortunately, the factors which promote mental health also are important features of many economic development and HIV prevention projects.
A public health framework proposed initially by the Victorian Health Promotion Foundation[43] identifies three key social and economic determinants of community and individual mental health: social inclusion, freedom from discrimination and violence, and access to economic resources. A recent review of mental health promotion among children and adolescents in low and middle income countries also argues that the strategies that are most likely to promote mental health are also the strategies found within existing economic development initiatives that address core social and economic inequities [44]. That same review highlights the paucity of published research on child and adolescent mental health in low and middle income countries as well as a gap in the evidence base for interventions in these contexts.

While some studies have indicated a protective effect of economic intervention for mental health outcomes[45], there may be unintended consequences of such interventions. A conditional cash transfer program in South Africa found that mental health could be both positively and negatively affected by the intervention[46]. Little or no information is available in the literature on the impact poor mental health may have in preventing participation in economic interventions.

The HIV epidemic in Zimbabwe

Zimbabwe is among the countries with the highest prevalence of HIV in the world. Although evidence suggests that incidence and prevalence of HIV in Zimbabwe has declined, the most recent prevalence estimates remain high[47, 48]. In the Demographic and Health Survey conducted between 2005 and 2006, prevalence among adults was estimated at 20.1%[49]. Incidence in the capital city of Harare is estimated to have peaked between 1988 and 1990[50]. Declines in incidence and prevalence are attributed to changes in heterosexual risk behavior, the main transmission route for the epidemic in Zimbabwe[47, 48, 51, 52].

In Zimbabwe as in the rest of Sub-Saharan Africa young people, and in particular young women are recognized as an important target for intervention[53, 54]. In Zimbabwe overall, the incidence of HIV infection peaks at adolescence in women; young women experience up to three times the incidence of HIV compared to their male counterparts[55]. In countries such as

Zimbabwe, where incidence of HIV has been decreasing, there has been evidence of reductions in sexual risk behavior, and the greatest changes have been observed among young people[56, 57].

Economic and Social context of the epidemic

Zimbabwe has been undergoing a severe economic crisis over the past decade. Since involvement in the 1998-2002 war in the Democratic Republic of Congo, the economy of Zimbabwe has collapsed rapidly. Land reform policies, decline in the commercial agriculture sector and severe hyperinflation have led to an estimated 40% decrease in the economy of Zimbabwe over the past decade. Estimates of inflation have reached over 2.2 million percent and unofficial estimates have run as high as 70 million percent for some goods [58]. Unemployment estimates were 80% during the time of this research, and basic commodities were often in shortage. At the time of this research 68% of Zimbabweans were estimated to be living below the poverty line [59-61].

Political instability and civil unrest is widespread. In power since independence was achieved in 1980, the ruling party has rigged elections, organized violence against opposition supporters, and manipulated markets to favor allies[62]. In 2005, less than a year prior to the start of recruitment for the SHAZ! project, the government instituted a program called Murambatsvina, officially this program was intended to enforce laws and stop illegal activities. The UN special envoy report however, indicates that this program was responsible for an estimated 700,000 people loosing homes, livelihoods or both, and affecting a further 2.4 million people in varying degrees. According to this report many disruptions were caused in access to food, water, sanitation, health care and education[63].

The impact of the social and economic chaos in Zimbabwe has been magnified by the HIV epidemic. A comparison of the 1994 and 2005-2006 Demographic and Health surveys shows the percentage of children less than 15 years old who have lost one or both parents has increased from 9 percent to 22 percent[49]. This estimate is conservative as it does not include those orphaned children living in institutions or without homes. One study found that half of young women ages 15 to 19 living near Harare had lost one or both parents[64]. Another study in eastern Zimbabwe estimated that over 30% of students enrolled in secondary school had been orphaned[65]. Traditional culture in Zimbabwe is patrilineal and based on strong relationships with extended family networks. These systems and the social supports they provide have been eroded by the socioeconomic forces in Zimbabwe. Most orphans are not living in institutions. Some orphans remain with a surviving parent, many are living with other relatives or elderly grandparents [66-68].

Mental Health in Zimbabwe

In World Values Surveys of subjective well-being, Zimbabwe is ranked as 'the least happy country in the world" [69],and in a series of commentaries in the Lancet, Clare Kapp has described the effects of instability on health and described Zimbabwe as being in a "state of national social depression"[70-72]. Estimates from a 1997 study in Zimbabwe found a 15.7% one month prevalence of depression/anxiety among women[73]. A 2001 study found a 17% prevalence of depression among a random sample of urban women[74]. A study of rural youth in Zimbabwe found that 51.7% were at risk of having affective disorders[75]. Although no estimates are currently available the above estimates indicate that it is reasonable to suppose that the prevalence of mental health disorders among female adolescent orphans is quite high.

Economic Status and HIV

Poverty has been recognized as an important contributing factor to the HIV epidemic[18, 76, 77]. The economic and political instability in Zimbabwe has severely affected public service infrastructures, such as schools and health care, and has been linked to Zimbabwe's high HIV infection rates [55]. Economic disadvantage also has been linked to sexual risk behaviors. Adolescent females, especially orphans, have few economic opportunities or options to mitigate the effects of poverty. Data on adolescent sexuality and reproductive health from across Africa, Asia, and Latin America uniformly indicate that HIV risk behaviors are intimately connected to the social and economic context of young people's lives[78-80]. Economic hardship has been found to be associated with several sexual risk behaviors in young women including; multiple partnerships, older partners, and transactional sex[81, 82]. A recent survey in Zimbabwe found that 13% of all unmarried females aged 15-19 recently received money/gifts in exchange for sex[83], a problem that is estimated to be much more prevalent among adolescent orphans[84].

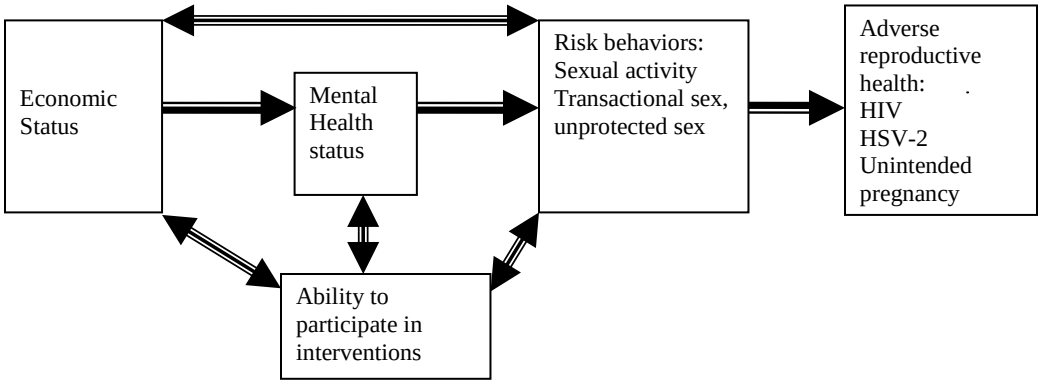
Mental health status and HIV

People with poor mental health, such as those with untreated depression or anxiety, tend to have impaired judgment, impulsive behavior, reduced fear of consequences, and increased vulnerability to outside influences. As a result, such people are more likely to engage in HIV risk behaviors [85, 86] and acquire HIV infection [87]. Research in rural areas of Zimbabwe has found a higher than 50% prevalence of affective disorders among youth ages 15 to 23. This same study found that mental health disorders were associated with sexual risk taking in this population[75]. The above mentioned study of psychosocial distress also found that distress led to early onset of sexual intercourse[35].

Conceptual framework of research

This dissertation aims to explore the interrelationship between a young woman's economic status, mental health and exposure to intervention projects. Understanding these interrelationships and their effects on reproductive health related behaviors is an important step towards optimizing the effectiveness of interventions. The below diagram (figure 1) indicates the factors and relationships of primary interest for this research. Formal directed acyclic graphs (DAGs) incorporating temporality for each analysis question in the dissertation are presented in the analysis chapters. The conceptual framework for this dissertation is constructed based on the theories of gender and power used to develop the SHAZ! intervention, and on research establishing a theoretical framework of childhood psychosocial stress related to orphan status in Zimbabwe[35, 88, 89].

Figure 1. Conceptual diagram of research



Chapter 2. Shaping the Health of Adolescents in Zimbabwe – the SHAZ! project

Data for this dissertation come from the SHAZ! project. This project was begun in 2000, with formative and qualitative work. In 2003 and 2004, pilot work was conducted testing the feasibility of a micro-credit based intervention in this population. Based on this pilot work, it was decided that micro-credit was not a good intervention strategy for this population and a revised intervention was designed based on the pilot results. In 2006 a randomized controlled trial of a combined life skills and vocational training intervention was begun. Below I describe the three phases of the SHAZ! project and the methods and design of the randomized trial from which the data for this dissertation are drawn.

Formative and Pilot phases

Qualitative work for SHAZ! began in 2000 with interviews and focused group discussions(NIMH 5P50 MH42459-15). Participants included groups of young people and adults from urban and peri-urban areas in and around the capitol city of Harare. Results from this phase were presented at the Barcelona AIDS conference in 2002[90, 91]. In summary, we found that social and economic factors (such as gender inequities and lack of economic opportunities) heightened HIV risk for adolescent girls and women. Participants described the prioritization of immediate material needs over long term potential consequences of HIV infection. These findings led to the development of a cross-sectional survey that asked about these factors and conducted laboratory tests for HIV and HSV-2 in a convenience sample of 200 adolescent girls. Findings from this preliminary work were used to inform development of the SHAZ! pilot intervention, which combined life skills education with access to micro-credit, for adolescent female orphans.

Pilot phase: Results from the pilot work among a small sample of 50 orphans were presented at the International Society for Sexually Transmitted Diseases Research (ISSDTR) conference in 2005[92], and have been further documented in two papers, one on HIV vulnerability related to orphan status[93] and another presenting the complexities of conducting micro-credit programs among young women and girls[22]. In our 6 month pilot study, we found that young girls were interested in participating in a livelihoods intervention; 100% of eligible girls agreed to participate. Attendance at trainings averaged 80% at each session. Numerous obstacles to successful generation of income and loan repayment were identified, including skyrocketing inflation and lack of skills to do anything with the loan besides buying and selling of goods. Buying and selling goods as informal traders also carried risks associated with travel and with storing goods and profits safely. Interviews with participants suggested that travelling between rural and urban areas to move goods exposed young women to risks from those providing transportation and also resulted in having goods confiscated by both official and non-official groups. Several participants also reported having no safe place to store goods or money at home. Only 10 individuals made a first payment on the microcredit loan, and only 2 participants were able to repay the loan in full. We determined that given the context and skills of the population with which we were working, microcredit was not the best livelihood option to reduce risk in this group.

The participants who did succeed in pursuing economic opportunities and making payments towards their micro-credit loans had an existing skill or support from someone engaged in the business they were pursuing.

Redesign of intervention: Based on these findings our research group decided that vocational training was a better strategy for livelihoods intervention. I led the research team in Zimbabwe to explore vocational training options and to conduct focused group discussions with young women who had completed those vocational trainings about the opportunities made available through this training. We also had discussions with young women from our pilot study about what trainings they thought would have been helpful prior to their having received their micro-credit loans. In addition, we worked with the youth forum of Chitungwiza and a community advisory board to discuss the advantages and disadvantages of different vocational trainings available.

We found that having a certificate of training by a recognized program or institution in Zimbabwe could provide legitimacy and opportunities in both the formal and informal sector. We further found that areas where young girls could find economic opportunities were often in working with hair, sewing, and nurse aide work. For those with more educational background, business receptionist or similar skills could be viable options. Based on these findings, I worked with local vocational training institutions and the Zimbabwean Red Cross to develop agreements on how SHAZ! could support participants to attend their respective training. We also decided to engage guidance counselors to work with the participants to choose a training program that fit their interests and their background.

The redesigned SHAZ! project is a randomized, controlled trial of an intervention that combines a vocational training package – which includes a conditional stipend and completion bonus -- with life-skills education and social support, compared to life-skills education alone.

SHAZ! study procedures

Recruitment: Study participants were recruited through community events and referrals. A skit and songs describing the project were developed by the Chitungwiza Youth Form. Community events were held in busy transit and market locations. Events included performances by the Youth Forum, with staff members present to answer questions about the project. Potential participants recruited at community events were given appointments to come to the clinic for screening. Referrals were made by community advisory board members and by word of mouth from participants enrolled and others who had attended recruitment events.

Study enrollment and follow up are summarized in figure 2.2. A total of 367 potential participants were screened for the SHAZ! study. Enrollment of 315 out-of-school orphan girls ages 16 to 19 years was conducted from February through August 2006. Main study participants were required to be HIV and HSV-2 negative at baseline. An additional pilot study cohort of 51 participants was enrolled in May and June of 2007 and included HIV and HSV-2 positive girls. Although the initial study design was to recruit 1000 participants, due to political upheaval in Zimbabwe, our study was scaled back and re-conceived as an expanded feasibility study rather than a full test of intervention effectiveness. Thus, our power to detect biological outcomes was limited.

Randomization: Prior to the start of enrollment a randomization log was prepared to enroll girls into intervention and control groups in blocks of 50. Blocks were chosen so that the

life skills groups of 25 participants each would form at similar rates. Sequentially numbered envelopes were prepared with a group number inside. When determined eligible by test results and screening questionnaire, participants returned to the clinic for enrollment and opened an envelope to determine their intervention or control group status. Due to the nature of the intervention it was not possible to blind study staff or participants to the study arm of participants.

Study visits: Participants in the main study were followed for two years and pilot study participants for one year. Data collection and service provision to participants was provided primarily through a health clinic at the Chitungwiza South Medical hospital and through occasional outreach visits using a mobile clinic. The frequency of intervention visits (i.e., visits related to the intervention program such as life-skills training, SHAZ reunions, and vocational training) is described below. Clinic based visits included behavioral data collected through Audio Computer Assisted Self Interview (ACASI) and face-to-face interviews with a nurse counselor as well as testing for HIV, HSV-2 and pregnancy. Clinic visits were conducted at baseline, and every six months thereafter for a total of five visits in the main cohort and three in the pilot study. A laboratory results visit was scheduled at two weeks after each clinic visit to disclose HSV-2 test results. Participants were also welcome to come to the clinic between scheduled visits, if they had health or psychosocial issues, desired additional counseling, or wished to bring a partner for HIV/STI testing.

In addition to quantitative data collection, a random subset of 40 main cohort participants agreed to participate in two, in-depth interviews and to have their household head or guardian contacted for an interview. Data collection for this study ended in October 2008. Protocols for this study were approved by the University of California San Francisco, and the Medical Research Council of Zimbabwe.

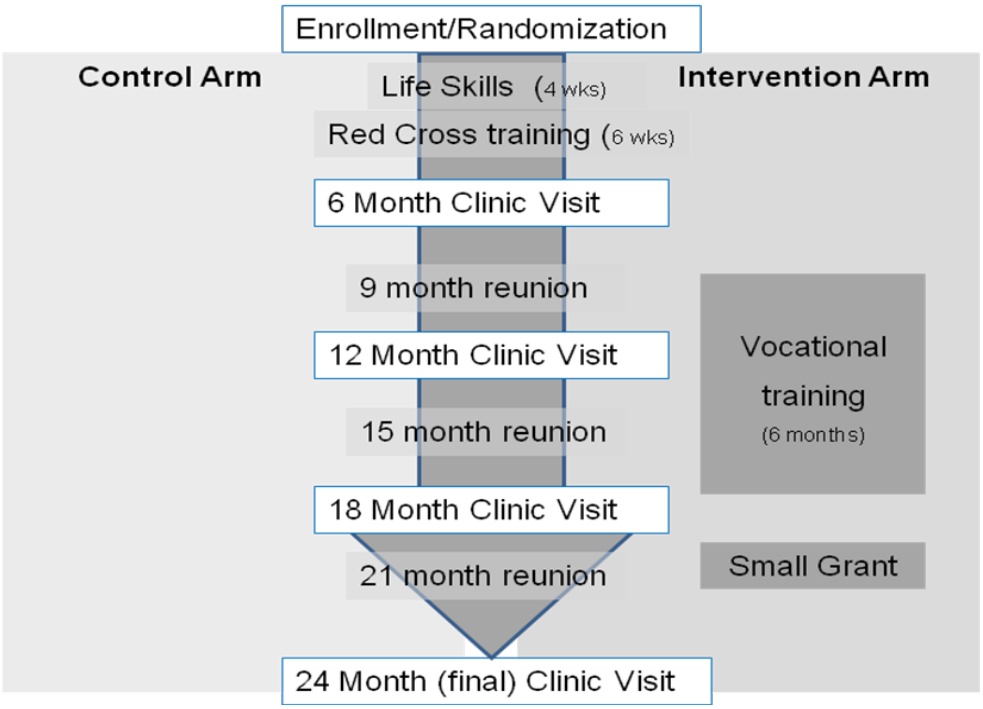
SHAZ! intervention activities

At enrollment, participants were randomized to the intervention or control arm of the study. All participants attended an orientation session and were assigned to a four-week life-skills training. Life-skills training included goal setting, awareness and avoidance of risky situations, communication and negotiation skills, personal hygiene, and reproductive health knowledge. Discussion of gendered expectations and self-efficacy around sexual behavior decision making was incorporated into all modules of the training. This training was the same for both arms, although the intervention and control participants attended separate sessions. Participants who attended at least 80% of the life-skills training were sponsored to attend a six-week training in home-based health care conducted by the Red Cross of Zimbabwe.

Intervention participants who successfully completed the Red Cross training were sponsored to attend a 6-month vocational training of their choice. Training options were offered at locally recognized institutions and included programs such as; nurse aid, sewing, hairdressing, tailoring and receptionist. Choices were discussed with a guidance counselor who helped the participant decide which training would be the most appropriate. Control participants who successfully completed the Red Cross training were sponsored for the same vocational training course options after their last clinic follow-up visit. All participants were scheduled for reunion events to reinforce life-skills trainings at 9, 15 and 21 months after enrollment. Participants who successfully completed a vocational training were eligible to receive a small grant to pursue

economic opportunities, for example, those who completed a course in sewing were able to use the small grant to purchase a sewing machine.

Figure 2.1 Study Activities



Data collection methods

At each clinic visit participants completed an audio computer assisted self interview (ACASI), had a face to face interview with a study nurse, and underwent laboratory testing for HIV, HSV-2 and pregnancy. ACASI interviewing was chosen because of evidence that this data collection method could help to alleviate social desirability biases in young people and could improve the reporting of sensitive behaviors [94]. We continued to have a face-to-face interview with a nurse counselor to assure that health and psychosocial issues could be addressed immediately and care or referrals provided at the time of the study visit.

Although English is the official language of Zimbabwe, most people in the study area also speak Shona, and for many, Shona is their first language and the one in which they are most comfortable communicating. All interview forms and ACASI programs were available in Shona and English. Study participants were able to choose the language of interview at each visit. All study interviewers, nurses, counselors, trainers and outreach workers were fluent in both languages. Study materials were developed in English (with the exception of the Shona Symptom Questionnaire) and translated to Shona, with back translation to English to verify translations.

Study tracking databases were maintained and records kept for attendance at all scheduled clinic visits and for all intervention activities run by the SHAZ! staff (i.e. orientation, life skills, reunion events, guidance counseling visits, unscheduled clinic visits, outreach visits).

The Red Cross of Zimbabwe and the other vocational training institutions with which we worked provided information about the commencement and completion of trainings for our participants, although most did not provide attendance information.

Qualitative interviews were conducted with a random sample of 40 participants at the beginning of and during the study. Household heads for those 40 participants were also interviewed about their household circumstances and about their impressions of the project.

Measures available from SHAZ!

Study participation was measured through attendance at activities and evaluations of knowledge gained. Questions on material taught during life skills were included in ACASI interviews. Evaluations of other training were conducted by the Red Cross and by the vocational training institutes, according to their standard practices.

Mental Health Symptoms were measured with the Shona Symptom Questionnaire (SSQ), an indigenously developed 14 item screening tool for common mental disorders. Chapter 3 discusses the measurement characteristics of the SSQ in detail.

Measurement of economic status has become difficult in Zimbabwe, because inflation has rendered income figures un-interpretable and savings non-existent. Other measures of economic status traditionally applied to resource poor settings and commonly used in Demographic and Health Surveys, such as building materials and access to sanitation infrastructure, are not accurate markers of current status. The economic situation has declined so rapidly that a family which lives in a brick building may have plumbing and electricity that no longer function and no food to eat. As part of the SHAZ! study, we collected information in ACASI interviews on sources of income, use and control of income and consumption of basic commodities, such as food and soap.

For the main study analyses, measures of consumption, particularly food security and the ability to pay for medication will be used as the indicators of economic status.

HIV knowledge questions were chosen to match those used in the Demographic and Health Survey being conducted at the time of our study. Questions included knowledge of transmission modes, treatments, and prevention of mother-to-child transmission.

Social factors included maternal orphan-hood, level of social support, gender norms and experience of violence. Orphans status was defined as maternal orphan (having lost a mother), paternal orphan (having lost a father) or double orphan (having lost both parents). Maternal orphan-hood was considered a sign of social vulnerability, based on studies showing increased HIV and reproductive health risk among maternal orphans [95, 96].

Social support was assessed using a series of questions about support received and support demands from others. The measure for social support was adapted from measure developed by a colleague (Dr. Emily Ozer, social support questionnaire). The Cronbach's alpha for this measure in the SHAZ! baseline population was 0.67.

Sexual risk behaviors were measured at each follow up visit. Participants completed ACASI interviews that included the number and type of sexual partners, and for each partner the contraceptives used, unprotected sex and transactional sex. Participants reported receiving material support, or being taken on trips, taken out for meals or taken to events by partners. For

these analyses, sex is considered transactional if participants reported these interactions with partners and further reported that they would not have had sex with that partner if their partner had not provided support or taken them out.

For each romantic relationship whether sexual or non-sexual, we asked a series of questions about the power dynamics of the relationship. These questions were adapted from the sexual relationship power scales developed by Pulerwitz and further adapted by Jewkes for use in South Africa[84, 97]. Prior to the main study, cognitive interviews were conducted with our pilot participants and some youth forum. Adjustments were made to the scale to respond to concerns and issues raised during this process.

In accordance with the Zimbabwe national practices, HIV testing was conducted with two rapid blood tests at the clinic. Conflicting results resulted in a third rapid test in the clinic. HIV test results were disclosed within half an hour of testing. For positive and conflicting results, we also used blood drawn for the HSV-2 test to conduct western blot tests.

Blood samples were sent to the laboratory for testing with the MRL HSV-2 ELISA IgG test to assess serostatus for HSV-2. HSV-2 results were available two weeks after the clinic visit. Urine was collected at each clinic visit and a rapid HCG pregnancy test was conducted. Pregnancy test results were disclosed immediately after testing.

At each visit participants who were pregnant were asked questions about their intentions with respect to their current pregnancy. The pregnancy intention questions were drawn from the measure developed by Barrett and colleagues. In the original validation studies this measure was found to have good reliability and validity Cronbach's alpha = 0.92; test-retest reliability = 0.97 [98].

Baseline Characteristics of the main study population

Overall characteristics of the population at enrollment are shown in table 2.1. Most participants were paternal rather than double or maternal orphans and had been orphaned for an average of 6.7 years (sd 4.2). Almost all were single and about one-quarter had become sexually active. About one-third of participants reported some form of food insecurity or inability to pay for medicines or clinic visits. Almost half had moved households within the past 5 years. Most participants self reported being in good or excellent health, although almost one-quarter screened positive for mental health distress based on the raw score of the Shona Symptom Questionnaire.

Table 2.1 Characteristics of the Cohort at Enrollment

	N=315
Age mean (sd)	17.6 (0.97)
Orphan Status	
Maternal	38(12.1)
Paternal	168(53.3)
Double	109(34.6)
Years orphaned mean(sd)	6.7(4.2)
Marital status	
Single	288(93.51)
Married/living with a partner	11 (3.57)
Previously married (widow/divorce/separated)	9 (2.92)
Did not complete form 4 education	78 (24.8)
Economic indicators	
Eat two meals a day	250 (80.39)
Did not eat for a day because there was no food	101 (32.58)
Eat meat/fish 4 days a week	112 (36.01)
Can have food with tea	211(67.85)
went to bed hungry	35(11.25)
Can afford medicines	116 (37.30)
Can afford clinic fees	117 (37.62)
Has changed household in the past 5 years	151(48.9)
Ever Homeless	67 (21.9)
Is the household head	5 (1.66)
Someone in house too ill to work	110 (35.37)
Social support	
low	113 (35.87)
medium	107 (33.97)
high	95 (30.16)
Exposure to violence	
Experienced physical violence	14 (4.44)
Experienced sexual violence	25 (7.94)
Forced sex	20(6.35)
Someone in household has experienced violence in the past year	25(8.0)
Feel safe at home	
very safe	112(36.3)
secure/safe	112(36.3)
more ore less insecure	51(16.5)
insecure/unsafe/very unsafe	34(11.0)
Self efficacy score mean(sd)	2.43 (0.43)
Screened positive for mental health symptoms (raw score method)	77 (24.44)
General Health	
Fair/poor	17 (5.40)
good	211 (66.98)
excellent	87 (27.62)
Sexually active	79 (25..4)
Ever or currently pregnant	17 (5.47)
Ever had an STI	5 (1.61)

Intervention completion

Completion of intervention activities is summarized in the study flow chart below (figure 2.2). More than 90% of participants in both arms completed the 4 week life skills training. For both life skills and Red Cross training, more intervention participants completed the training than did control participants; although this difference was not statistically significant, the trend for all study activities and visits suggests greater participation in the intervention arm.

Of the 124 intervention arm participants that began vocational training, 7 (6%) chose business or secretarial programs, 38(31%) chose dressmaking or sewing, 52 (42%) chose hair dressing, and 27 (22%) chose nurse aid training. After the study, control participants who completed the Red Cross training were able to choose a vocational training paid for by the SHAZ! project. Of those eligible 84 (73%) chose and were sponsored for a training program.

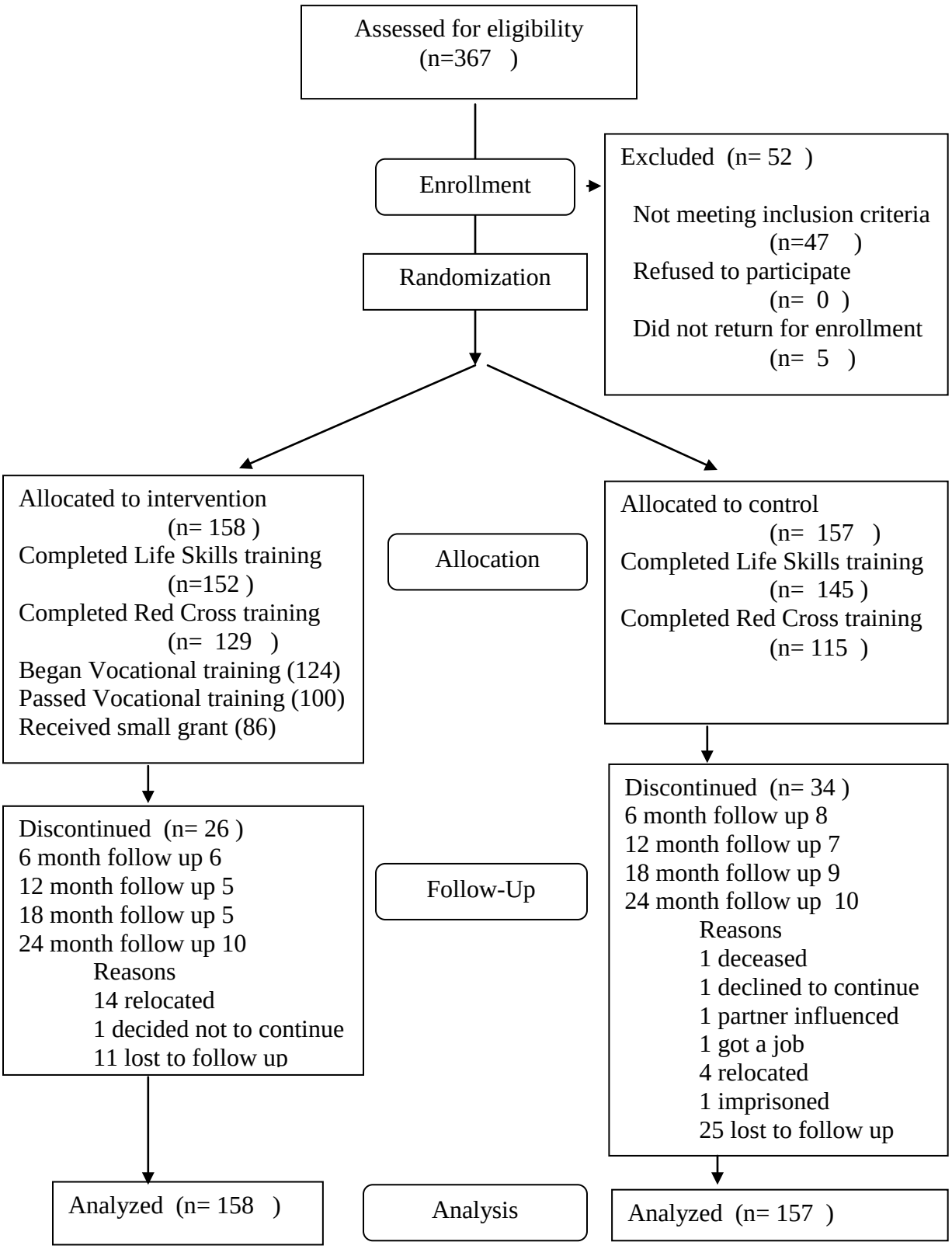
For at least 10 intervention arm participants, we know that they did not complete vocational training because they relocated either to the rural areas or out of the country before the training was completed. An additional 3 intervention participants said they did not complete their vocational training because their husband/partner did not want them to do so.

Life skills reunions were poorly attended as the study progressed. After the 9 month reunion many participants stopped attending (table 2.2). For intervention participants it was difficult to attend while doing their vocational training. Control participants also noted that finding time and transportation to attend reunions became more challenging as time progressed.

Table 2.2 Reunion Attendance by study arm

	Intervention		Control	
9 month reunion	120	75.9%	108	68.8%
15 month reunion	65	41.1%	59	37.6%
21 month reunion	53	33.5%	44	28.0%

Figure 2.2 Study flow chart



Main study results

Overall study retention was good, more than 80% of participants were retained until the 24 month follow up visit. However, loss to follow up and missed visits were more frequent in the control than in the intervention arm, particularly at the 18 month visit (table 2.3 below).

Table 2.3 Missed Visits by Study Arm

	Intervention		**Control**	
	N	**%**	**N**	**%**
6 months	9	6%	14	9%
12 months	16	10%	20	13%
18 months	22	14%	39	25%
24 months	26	16%	34	22%

Incidence of viral infections was lower in this population than we had anticipated prior to the study start (less than 5 per 100 person years for either viral infection). Incident pregnancy was more common (15.2 per 100) with the majority of the pregnancies unplanned (Table 2.4). We hypothesize that because our control arm also experienced benefits from participation relative to the general population we may have seen lower incidence in the study population overall; and this reduced our ability to detect a difference between the control and intervention arms of the study. However we did observe a significant difference in pregnancy, particularly unplanned pregnancy between the control and intervention arms of the study.

Because of differential loss to follow up between the study arms, censoring weights were added to the analysis. Censoring was related to educational status and relationship power. Stabilized inverse probability of censoring weights were applied using the following equation:

$$\frac{P(C)}{1/[1+\exp(-(\alpha_0+\alpha_1 education\ +\alpha_2 relationship\_power))]}$$

Where P(C) = observed (crude) probability of censoring, $\alpha 0 = -0.9085$, $\alpha 1 = -0.9947$, $\alpha 2 = -0.6224$. Median weight was 0.98465 with an inter quartile range of 0.98465 to 1.07095. Weights ranged from 0.6629 to 2.5712.

Table 2.4 Incident biological outcomes (per 100 person years)

	Intervention	Control	Overall
HIV	7 (2.2)	7 (2.4)	14 (2.3)
HSV-2	17 (5.7)	11 (3.8)	28 (4.7)
Pregnancy	39 (13.2)	48 (17.4)	87 (15.2)
Unplanned pregnancy	26 (8.6)	37 (13.2)	63 (10.8)

Hazard ratios were calculated using strict intent-to-treat analysis, and with weighting for differential loss to follow-up using inverse probability of censoring weights. Conclusions from both the weighted and unweighted analyses were similar (table 2.5).

We did not observe significant differences in viral infections between study arms, but we did see a reduction in pregnancies, with unplanned pregnancies bordering on statistical significance. Our lack of significant results for viral infections is not unexpected given the size of our study. Given our small sample size, the lowest detectable risk ratio would have been 0.29.

Table 2.5 Incident outcomes by study arm, adjusted for censoring

	Hazard Ratio	**95% Confidence interval**		**Hazard Ratio IPCW**	**95% Confidence interval**	
HIV	0.94	(0.33,	2.69)	1.02	(0.35,	2.96)
HSV	1.50	(0.70,	3.20)	1.60	(0.74,	3.49)
Pregnancy	0.73	(0.48,	1.11)	0.72	(0.47,	1.11)
Unplanned Pregnancy	**0.62**	**(0.38,**	**1.02)**	**0.61**	**(0.37,**	**1.01)**

Chapter 3. Measuring Mental Health Symptoms among Adolescent Orphan Girls

Background

Mental health is increasingly recognized as an important aspect of health and well being in low and middle income countries. As one recent article points out there can be no overall health without mental health[40]. However mental health is often poorly described outside of high-income countries. Overall, research in low and middle income countries contributes only 3-6% of all published mental health research in the world.

To characterize mental health morbidity and begin to address it within the context of interventions accurate measures of mental health status are needed. Despite this need, very little work has been done on measurement tools for mental health in low and middle income countries. Measurement tools developed in the United States and Europe are often translated and used in these settings but may not be appropriate to non-western settings. The ways in which symptoms of mental distress are conceptualized and expressed may be quite different in non-western cultures. In Zimbabwe, for example, one common expression in Shona is the term Kufungisisa, for which there is no direct equivalent in English; but it translates roughly to "thinking too much or about too many things" and is an expression often used to express mental distress[99].

The Shona symptom questionnaire, published in 1996[100] is one of the only instruments measuring mental health distress in Sub-Saharan Africa which has been developed in the local language and uses local idioms. Shona is the majority ethnic group in Zimbabwe and also the name of the most common local language.

The original Shona Symptom Questionnaire (SSQ) is 14-item measure of non-psychotic, psychological morbidity intended to detect common mental disorders. The SSQ is a simple screening tool which has been used widely to measure psychological morbidity in both clinic-based and community-based studies.

Validation work with the original instrument has focused on adult women in Zimbabwe. In the original validation work in Zimbabwe, the SSQ was found to have high internal consistency ($r = 0.85$). Area under the curve was maximized at a cutoff point between 7 and 8 symptoms present (0.88, SE .02), sensitivity is 67% and specificity 83%[100]. In a study of antenatal women, 79% of women with high SSQ who were referred for evaluation by a study psychiatrist met the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition criteria for clinical depression[101]. The SSQ was adapted for use in the SHAZ! Study with adolescents who spoke a mix of English and Shona.

This chapter describes the characteristics of the instrument used to measure mental health among the adolescents screened for the SHAZ! Study. The framework of Item response theory and modeling is used to assess the measurement characteristics of the instrument. Using this approach the differences between behaviors of the questionnaire items by population subgroups are also explored. Finally the summary measures chosen for inclusion in subsequent analyses are presented and discussed.

Methods

Instrument adaptation

Although English is the official language of Zimbabwe, many people in Zimbabwe are primarily Shona speakers. In the high density suburb of Harare, where our research took place, participants generally speak a mixture of Shona and English. Our research group began with the published instrument and translated it from Shona to English to allow participants to choose the language they would most like to use to answer the questions. English translations were back translated to Shona to ensure the quality of translation. Informational interviews with staff members who had experience working with our study population indicated that the items from the original scale were a reasonable set of symptoms related to common mental disorders for this population.

We then recruited a group of young women who were in the age group and from the same area as our target population through the local youth forum. Bilingual study staff conducted cognitive interviews with this group. We asked these participants to go through the questions one-by-one to describe what the question was asking and tell us if they found any of the items or answers confusing or unclear, or if they were not sure how to answer one of the questions. Further comments were solicited in a group after each participant had a chance to go through the cognitive interview. Participants indicated that they were comfortable with the items on the original questionnaire. As a result, no items were added or removed to the adapted instrument.

The items from the original instrument had the response options limited to yes or no. When this instrument was pilot-tested in our study population, the participants indicated that they did not want to answer only yes or no, but to have the option of expressing how much they had experienced the symptom. We changed the instrument accordingly. The result is a 14 item instrument asking whether each symptom was experienced all the time, some of the time or none of the time in the past week. Individual items in English and Shona are shown in table 3.1.

Data used for validation work

This questionnaire was implemented as part of a randomized trial of the SHAZ! combined life skills education and economic livelihoods intervention. The questionnaire was administered to 402 participants, who were screened for enrollment in the longitudinal study. Language of the interview was split evenly with 201 participants choosing to complete the questionnaire in English and 201 choosing to take the interview in Shona.

Item response approach

Ideally in developing a measure of mental health, we would be able to generate an estimate of the underlying mental health status and understand how each item in the questionnaire/scale relates to this underlying trait. Item response modeling is an approach that allows the researcher to describe the relationship between latent trait estimates and individual items. Each item receives a “difficulty” estimate representing a probability of endorsing the item given a set value of a latent trait. The latent trait is assumed to be measured on a uni-dimensional continuum and is estimated by a measurement model. Item difficulty estimates are assumed to be fixed and to be independent conditional on the latent trait estimate. The simplest

case of this model, in which all items have binary response categories, and are assumed to fit a one parameter logistic model is as follows:

eq 3.1
$$p\langle Xi = 1 | \theta, \delta i \rangle = \frac{e^{(\theta - \delta i)}}{1 + e^{(\theta - \delta i)}}$$

Where Xi represents to response (X) to item i, conditional on a latent trait estimate θ and an "item difficulty" δi for item i. Thus, if a person's latent trait estimate is greater than the item difficulty estimate, then that person has a greater than 50% probability of endorsing the item.

Item response modeling has as an advantage the ability to compare item difficulties and evaluate the consistency of these estimates with theorized difficulty of item endorsements. A schematic showing the difficulty of items in relation to latent trait estimates called a Wright map can be generated and compared to the theorized values. This provides an advantage compared to classical test theory, in which only the overall score is considered and individual items are not examined. This approach also allows evaluation of differences in item functioning between groups of participants and can be used with questions that have multiple formats within one scale.

Construct to be measured

The construct this instrument is intended to measure is mental health distress from common mental disorders such as depression and anxiety. This is conceptualized here as one underlying latent trait measured on a uni-dimensional continuum from no distress to extreme and debilitating distress.

Because the Shona symptom questionnaire used in this research as a measure of ability to participate in interventions, the construct can also be considered as a continuum of impairment of daily functioning caused by psychological issues. We presume that participants with very high raw scores on the SSQ and/or higher latent trait estimates using a modeled approach will be less likely to fully participate in intervention activities. This hypothesis will be tested in the longitudinal analyses in chapters 6 and 7.

Calibration of item response model

Responses from the screening data were used to calibrate the item response model. All categories of response for all items had responses available in the data. Items were coded as 0 (never), 1(sometimes) or 2(always) experiencing a symptoms in the past week. Item 12 was positively framed and thus reverse coded such that the lowest(0) level corresponded to 'always' and the highest to 'never'. Frequencies of the raw scores for each item and means and standard deviations for both the raw scores and the item difficulty estimates for each item were calculated.

The simple binary case shown in eq 3.1 can be expanded to describe items with polytomous responses[102, 103]. This follows what is called a "partial credit" model, in which it is assumed that the amount of the latent trait for someone who endorses level 3 of an item is greater than the amount of the latent trait required to have endorsed both level 1 and level 2 of the item. For example, someone who answers that they "always" experienced a symptom in the past week would be assumed to have a higher level of mental health distress than someone who responded that they "sometimes" or "never" experienced that symptom.

In this paper we assume a Rasch model with polytomous responses of the form:

eq3.2 $$P(Xni = x \mid \theta n, \delta ij) = \frac{\exp \sum_{j=0}^{x} (\theta n - \delta ij)}{\sum_{k=0}^{mi} \exp \sum_{j=0}^{k} (\theta n - \delta ij)} \quad x=0,1\ldots m_i$$

Where Xni represents the response to the ith item given by person n and δij represents the difficulty of endorsement for level j of the ith item.

Item response models were fit using marginal maximum likelihood estimates for the parameters of the models. All item response models were fit using the Conquest software package[104].

Table 3.1. **Adapted Shona Symptom Questionnaire items:**

ITEM1 **********
There were times in which I was thinking deeply or thinking about many things
Paive nenguva dzandaifunga zvakadzama uye kufunga zvinhu zvakawanda

ITEM2 **********
I found myself sometimes failing to concentrate
Ndaiwana ndichikundikana kunyatsofunga chinhu chimwe panguva imwechete

ITEM3 **********
I lost my temper or got annoyed over trivial matters
Ndakashatirwa nepamusana pezvinhu zvidikidiki

ITEM4 **********
I had nightmares or bad dreams *Ndairota hope dzaityisa*

ITEM5 **********
I sometimes saw or heard things which others could not see or hear
Ndaiona zvinhu kana kunzwa zvinhu zvaisaonekwa nevamwe

ITEM6 **********
My stomach was aching *Ndairwadziwa nemudumbu*

ITEM7 **********
I was frightened by trivial things *Ndaityiswa nezvinhu zvidiki*

ITEM8 **********
I sometimes failed to sleep or lost sleep *Ndaitadza kurara kana kushaya hope*

ITEM9 **********
There were moments when I felt life was so tough that I cried or wanted to cry
Pane nguva dzandaifunga kuti hupenyu hwakaoma zvekuti ndaichema kana kuti ndaida kuchema

ITEM10 **********
I felt run down (tired) *Ndainzwa kuneta*

ITEM11 **********
At times I felt like committing suicide *Dzimwe nguva ndainzwa kuda kuzviuraya*

ITEM12 **********
I was generally happy with things that I would be doing each day
Ndaifara nezvandaiita zuva nezuva

ITEM13 **********
My work was lagging behind *Basa rangu raisarira mumashure*

ITEM14 **********
I felt I had problems in deciding what to do *Ndaive nedambudziko rekusarudza zvekuita*

Raw score and latent trait (θ)estimate frequencies

Raw scores varied from 0 to 22 out of a possible 28. The distribution of raw scores, shown below in figure 3.1, was centered on a raw score of 11. The distribution of θ estimates, shown in figure 3.2 ranged from -6.38366 to 2.37091 and was centered on an estimate of -0.80259 logits.

Cutpoint choices

As the SSQ is intended as a screening tool, the score must be dichotomized to identify participants as symptomatic or at high risk for CMD. In the original instrument, possible scores ranged from 0 to 14 and a cutoff between 7 and 8 was determined to be the optimal cutpoint for screening based on area under the curve. Therefore, we chose to evaluate two potential cutpoints corresponding to similar levels for our scale, 14/15 and 15/16. If we choose a corresponding raw score cutpoint of between 14 and 15, 20% of our sample would be considered symptomatic. If we chose a raw score cutpoint of between 15 and 16, then 15% of the sample would be categorized as symptomatic. The corresponding theta values for these raw score cutpoints were also evaluated. If we use a cutoff of estimated theta at or above 0 then 27% of the sample would be considered symptomatic; if we use a cutpoint of 0.5 for theta, then 15% of the sample would be considered symptomatic. Theta of 0.5 falls between the difficulty estimates of the first step (sometimes experiencing a symptom) for the most difficult to endorse symptom and the second step (always experiencing a symptom) for all by the least difficult to endorse symptom. The higher cutpoint was considered the more theoretically appropriate cutpoint based on these step estimates.

Figure 3.1. SSQ raw score distribution

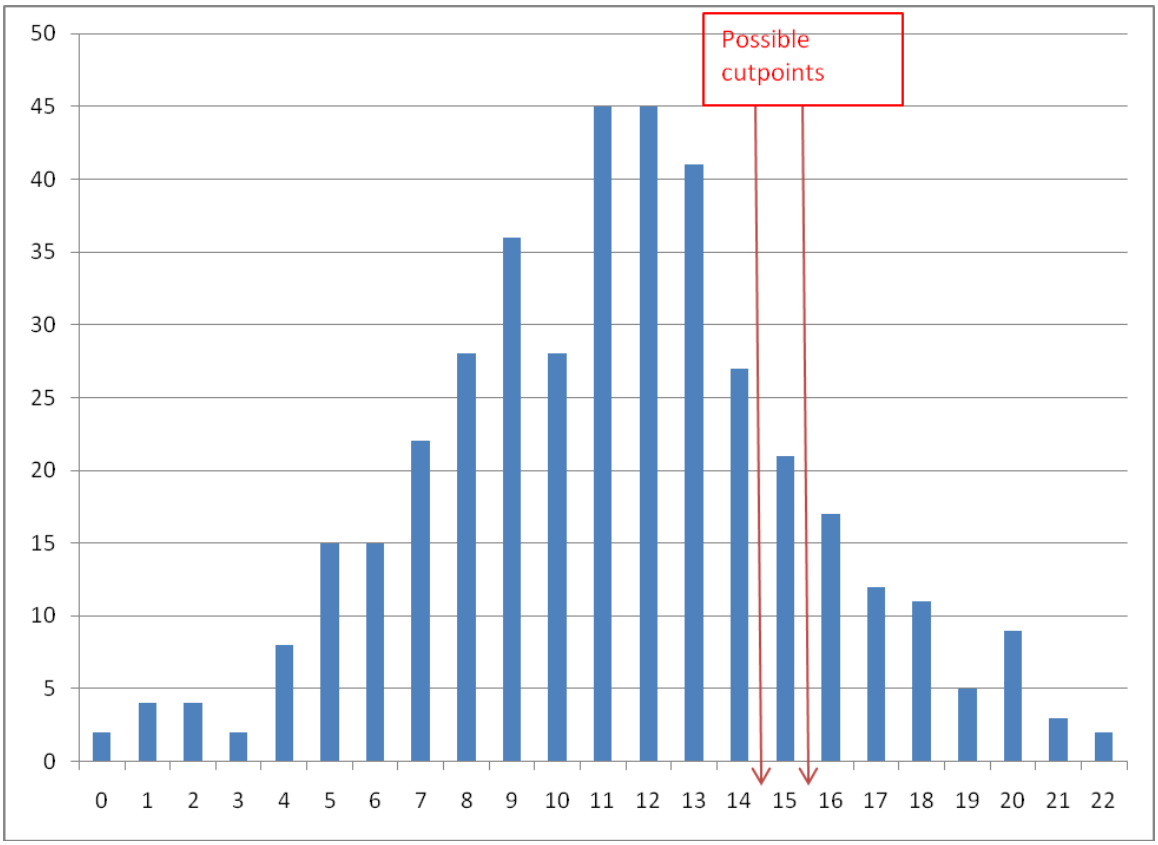
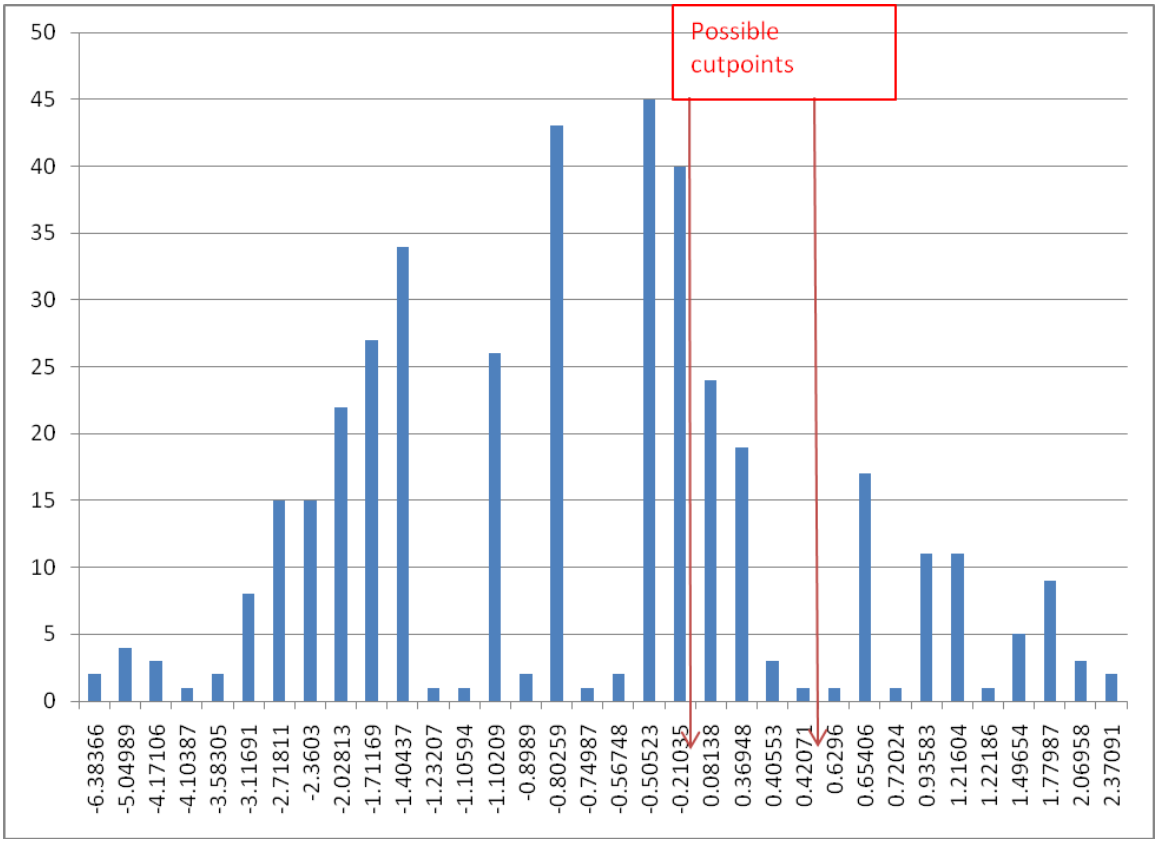


Figure 3.2. latent trait estimate (θ) distribution



Results of the Item response models

Item estimates and fit

Difficulty estimates for item and step (δij) ranged from -4.01 for item 9 (feeling like you wanted to cry sometimes in the past week), to 3.335 for item 5 (seeing or hearing things others could not see or hear all the time in the past week). Fit estimates were calculated based on residual indices as described by Wright and Stone and Wright and Masters[105, 106]. All item fit estimates fell within generally accepted ranges of mean square between 2/3 and 4/3. All further results are from a model including all 14 items. Individual item and step estimates are shown in table 3.2 with the raw frequencies of answers for each item.

Reliability evidence from the model fitting

Chronbach's alpha for this instrument was 0.81. The separation reliability for the instrument was 0.996.

Table 3.2. Item frequencies and difficulty of endorsement (δij) estimates

Item description	Item number and step	% reporting this symptom/level	δij
Thinking too much (kufungisisa)	1.1	58.2	-3.955
	1.2	36.3	-0.087
Trouble concentrating	2.1	68.8	-3.061
	2.2	19.0	0.971
Lose temper	3.1	69.0	-2.083
	3.2	6.0	2.385
Nightmares	4.1	64.2	-1.709
	4.2	4.7	2.619
Seeing or hearing things	5.1	27.4	0.413
	5.2	1.5	3.335
Stomach ache	6.1	69.7	-2.199
	6.2	7.2	2.179
Frightened	7.1	49.0	-0.835
	7.2	3.5	2.793
Trouble sleeping	8.1	65.7	-1.786
	8.2	4.5	2.688
Crying	9.1	71.6	-4.01
	9.2	22.6	0.744
Tired	10.1	69.6	-2.089
	10.2	5.5	2.491
Suicidal ideation	11.1	29.4	0.183
	11.2	4.5	2.163
Generally happy (reversed)	12.1	64.8	-1.289
	12.2	7.7	1.371
Trouble working	13.1	50.6	-2.11
	13.2	12.0	0.72
Trouble deciding	14.1	56.5	-1.901
	14.2	20.9	2.059

Validity evidence

Coherence of item difficulty results with the construct.

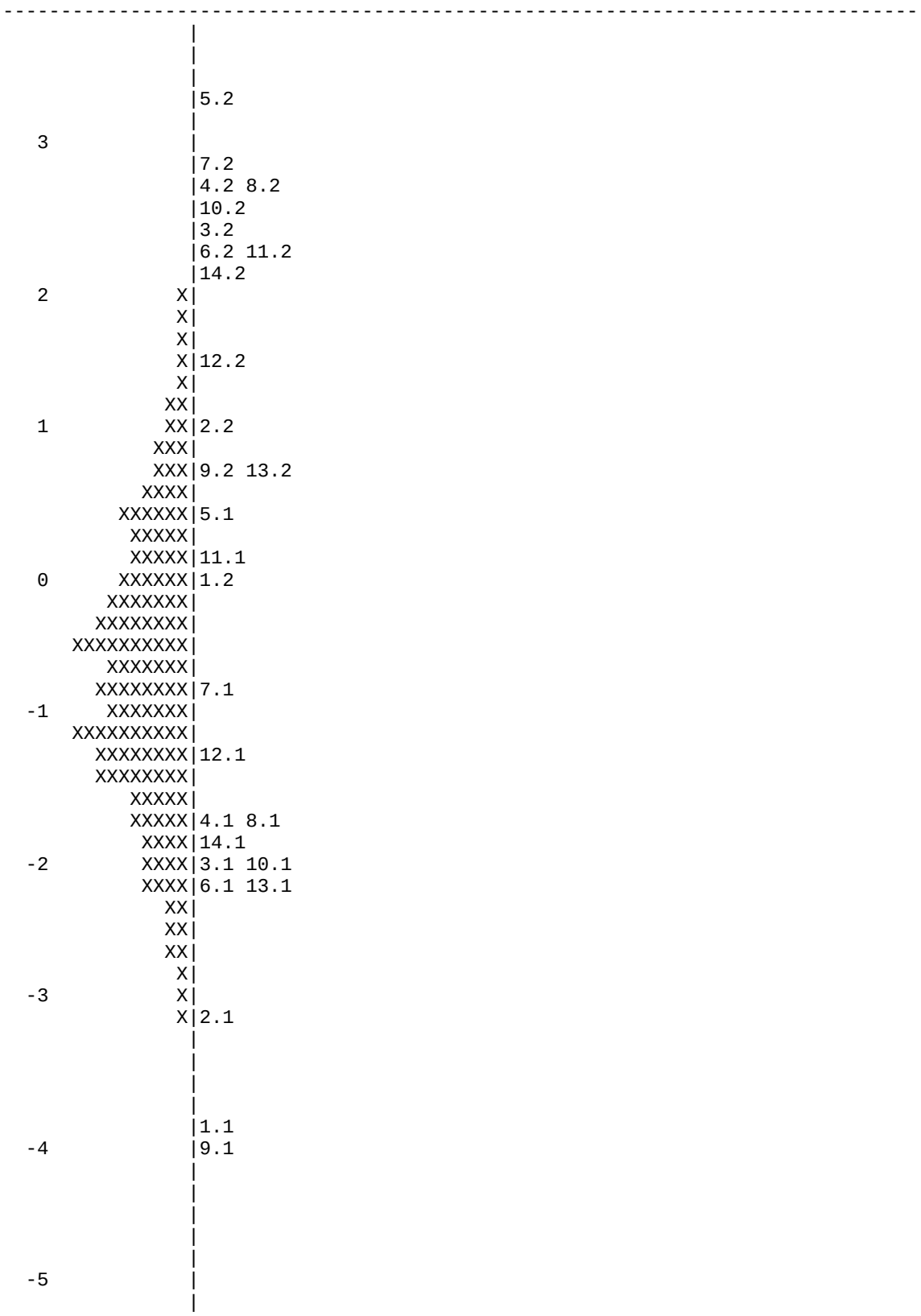
Latent trait estimates for this population and the item and step difficulty estimates are shown in a Wright map (figure 3.3). In this figure the distribution of person estimates (θ) are represented by x's on the left hand side of the graph and the item/step difficulty estimates (δij) are plotted on the right hand side of the graph. Items less likely to be endorsed and persons with higher levels of the latent trait are shown towards the top of the graph and items more likely to be endorsed and persons with lower latent trait estimates are shown towards the bottom of the graph. For these graphics, the probability of endorsing an item is thus represented by the position of the x relative to the item/step difficulty. For example a person with a θ of 0 would have a greater than 50% chance of endorsing item/steps below difficulty levels of 0 and a less

than 50% chance of endorsing items with difficulty estimates above 0. Evaluating the relative positions of the items and steps on this graph can give investigators a sense of whether items are behaving according to hypothesized probabilities of endorsement.

Although this is the first application of item response theory to this instrument and locations on the item map were unknown, some initial hypotheses were made based on discussion with local investigators and study staff. The item expected to be most predictable was item11, suicidal ideation, which was expected to be at the highest end of the Wright map.

The item that ranked highest in difficulty was not suicidal ideation, but visions – seeing or hearing things, however suicidal ideation was also at the high end of the map. In keeping with initial hypotheses, the items related to thinking (thinking too much, trouble concentrating, trouble making decisions) were ranked lower in difficulty than were the items related to fear and poor sleep (afraid, nightmares, trouble sleeping). The distribution of item difficulty estimates relative to our hypotheses is considered to be coherent with the construct the SSQ was designed to measure.

Figure 3.3 Wright map of Shona Symptom Questionnaire

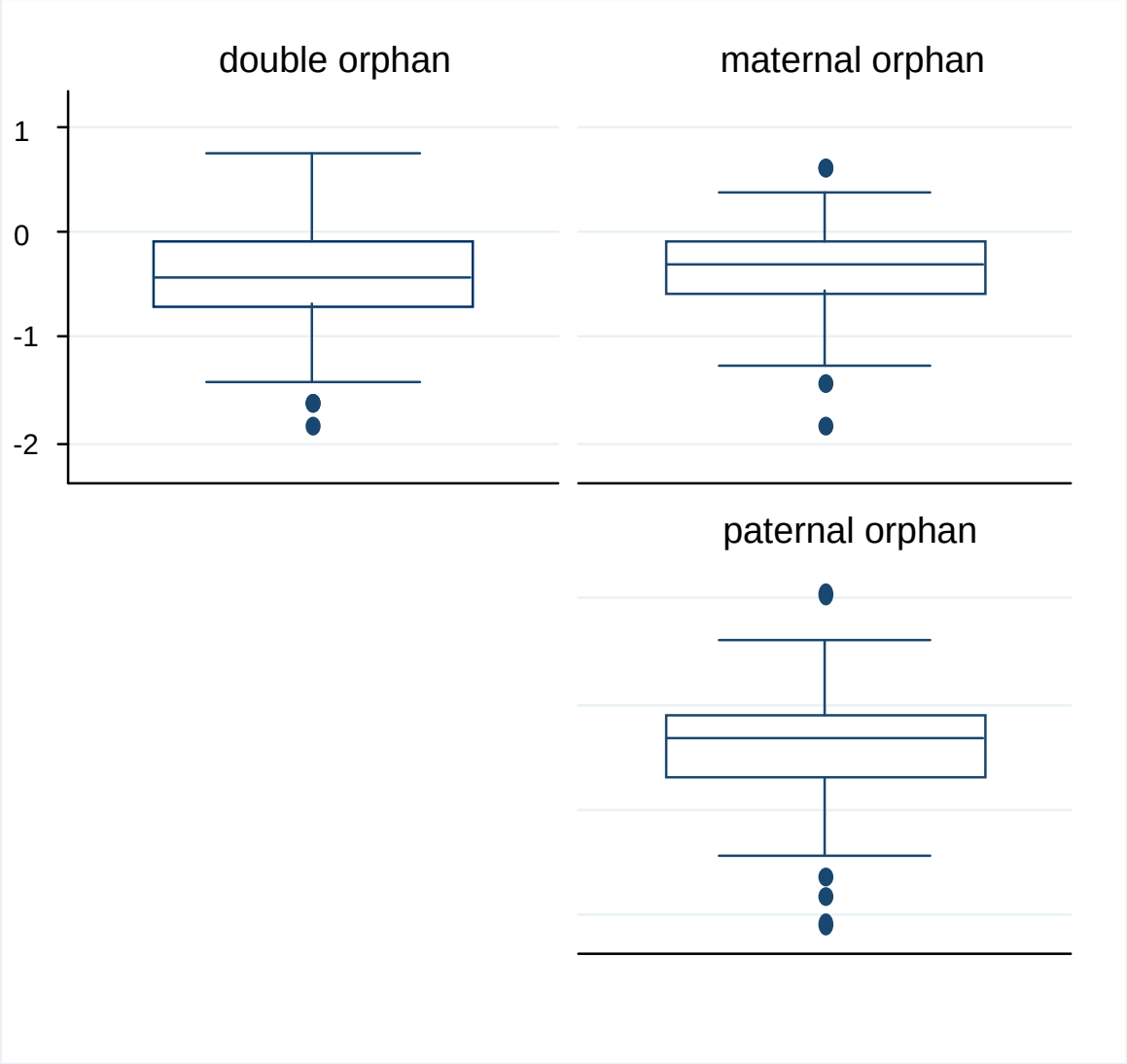


Evidence based on relationships to other variables

A large number of variables were collected in this study, several of which have been shown in previous research to be related to mental health status. Based on the literature, I expected to find correlations between mental health distress measured by the SSQ and experience of violence and abuse, and between mental health distress and being HIV positive. I also hypothesized that there might be a difference in mental health symptoms by orphan status.

Mental health distress estimates from construct map were imported into STATA for analysis. Anova statistics and box plots were generated for the hypothesized associations (figures 3.4 to 3.6).

Figure 3.4 Mean Mental Distress by orphan status



Mean levels of mental distress were not different by orphan status. This may indicate that it is the condition of being an orphan that is related to mental health distress and not the type of orphan status. Because this study did not include any individuals who were not orphaned this hypothesis is not testable in this sample.

Experience of violence.

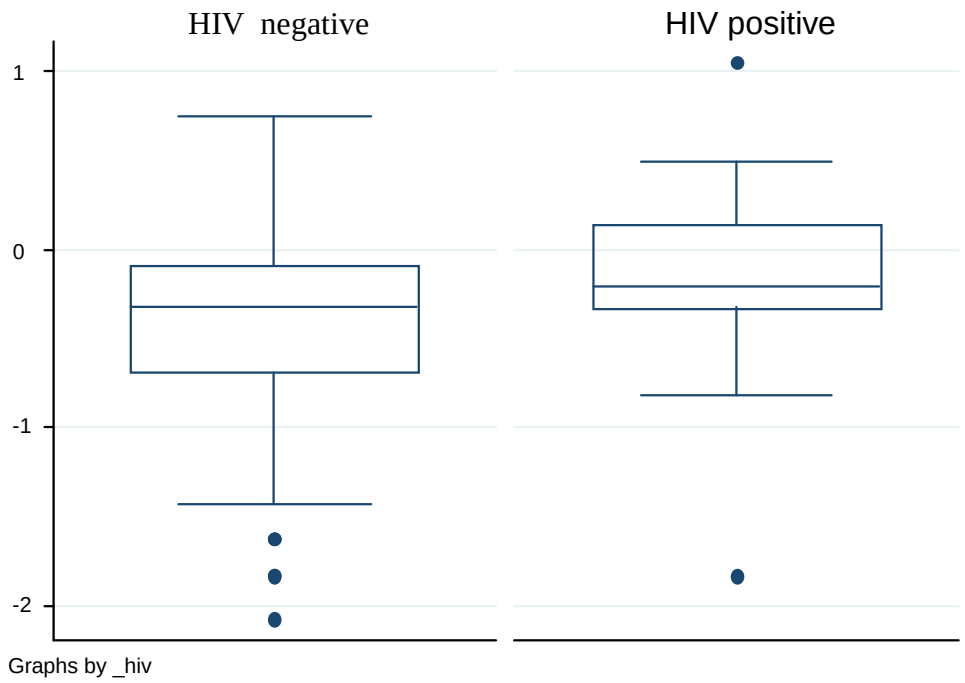
This variable was coded 0 if there was no reported history of physical or sexual abuse and 1 for those who reported any experience of abuse. Those experiencing abuse had higher scores on the SSQ. This difference was statistically significant (p-value 0.001).

Figure 3.5 Mean Mental Distress by experience of violence

HIV status.

This variable was coded 0 for HIV negative participants and 1 for HIV positive participants. Mental health distress by HIV status is shown in figure 3.6. HIV positive participants had a higher score on the SSQ. This difference was also statistically significant (p= 0.02).

Figure 3.6 Mean Mental Distress by HIV status



Differential item functioning (DIF)

Because data were collected on a large number of participants, an attempt was made to look at differential item functioning for subgroups of the population studied. Of most concern was that the instrument might function differently for those who completed the instrument in English compared to those who completed the instrument in Shona (the traditional language of most Zimbabweans).

Despite efforts to verify translations, some concepts may not have equivalent meaning, if expressed in English rather than Shona. However there are also good reasons to think that participants who choose to take the interview in Shona are different in many ways from those who take the interview in English and that these differences may be related to the underlying construct we wish to measure. For example those with lower educational levels may choose to take the interview in Shona, and may also be those who are more likely to have been displaced from rural areas to the city and have more mental distress.

Partial credit models allowing differential item functioning were estimated for both differences by language of interview and by education. Models were constructed allowing for the item difficulties to vary by language or education, a second set of models were constructed allowing both item difficulties and step difficulties to vary by language or education status.

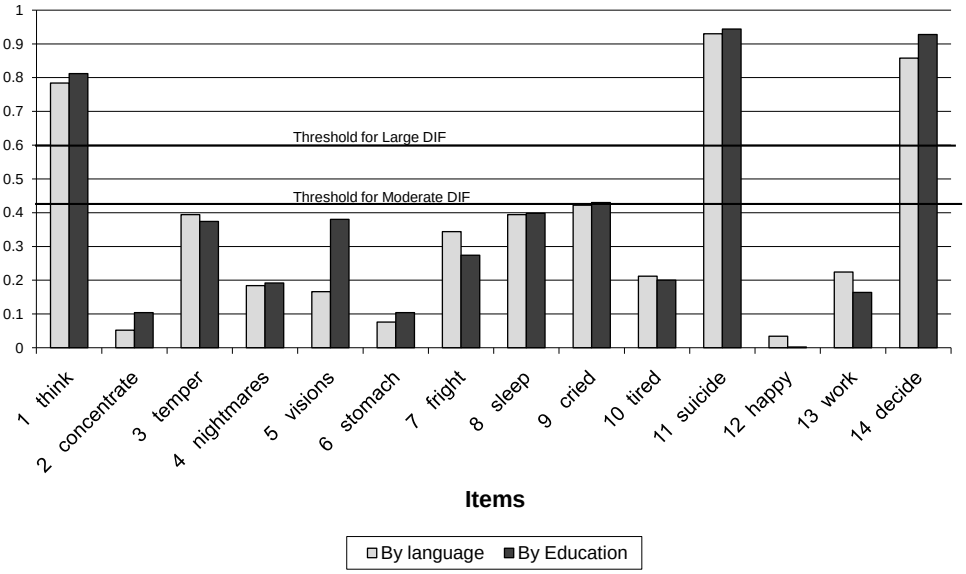
The chi-squared tests comparing overall fit using these two modeling strategies showed that the more complex model, allowing for differences in items and step difficulties, was a better fit to the data.

The hypothesis that those with lower educational levels might be those who chose to take the interview in Shona rather than English was examined. More of those who completed the interview in English had attended secondary school.

	No secondary school	Attended secondary school
English interview	26 (13%)	175 (87%)
Shona interview	78 (39%)	123 (61%)

When the DIF analysis was repeated for attending secondary school, the model allowing for differences in step thresholds again fit better than the model allowing only item difficulties to be modified by education. Interestingly, the three items that showed large DIF in the analysis by language of interview are also the same items that show DIF by educational status. The sizes of DIF for both the language and educational status models is shown in figure 3.7. This suggests that differences in item functioning could be associated with educational differences.

Figure 3.7. Size of DIF



Possible translation/cultural issue

The three questions which showed DIF on both analyses are ones where there could be cultural and or translational issues contributing to the DIF.

For Item 1:
There were times in which I was thinking deeply or thinking about many things
Paive nenguva dzandaifunga zvakadzama uye kufunga zvinhu zvakawanda

The issue may be translational. The concept of kufunga or kufungisisa is a well defined idea in the Shona language and has no direct translation in English. Those who took the

interview in Shona and those with less than secondary education were less likely to endorse this statement than were those with higher education who took the interview in English. This may indicate that it is easier to endorse the English translation, which does not relate to a specific concept in Shona language and culture.

For item 11:
At times I felt like committing suicide *Dzimwe nguva ndainzwa kuda kuzviuraya*

Shona speakers and those with lower education were more likely to endorse this statement than were higher educated English speakers. There may be fewer cultural taboos against endorsing this statement among those more identified with traditional Shona culture. However, this may also reflect the generally lower economic status and, perhaps, increased hardship experienced by those with lower education and less ability to speak the "official" language.

For item 14:
I felt I had problems in deciding what to do *Ndaive nedambudziko rekusarudza zvekuita*

I have fewer hypotheses about why this might differ across the groups. Shona speakers and those with lower education were less likely to endorse this statement at threshold 1 (the difference between none of the time and some of the time) but were not very different at threshold 2 (the difference between some of the time and all of the time).
I am hoping to go back over the translations and cultural issue with some of the Shona staff in Zimbabwe who helped with the testing and adaptation of this instrument.

Impact of DIF on screening

Although there were differences in item functioning for three questions, the latent trait estimates under a model allowing for these differences, and a partial credit model without this flexibility were very small. In particular, using the cutpoint of 0.5, only 6 people out of the sample of 402 would have been categorized differently using the models allowing for DIF.

Discussion

The Shona Symptom Questionnaire showed good reliability in this population of adolescent orphan girls. Item difficulty estimates fit well with the hypothesized severity of symptoms. Higher latent trait estimates were found in those who had reported experience of violence and those who were HIV positive, factors we assume to be associated with poorer mental health.

Using a cutoff for raw scores of greater than 15 out of 28, or a theta value of 0.5 or greater, 15% of our validation population would be considered symptomatic and at higher risk of CMD. This estimate is similar to the two previous estimates in adult Zimbabwean women conducted in 1997 and 2001 (15.7% and 17% respectively)[73, 74] and lower than the 51.7% estimate in rural youth[107]. Further analyses for the dissertation will use these cutoff values to dichotomize mental health status into symptomatic or non-symptomatic categories. Unfortunately no data on clinical diagnosis was available for this population so sensitivity and specificity compared to clinical assessment could not be determined in this sample.

The SSQ is intended to serve dual purposes in the implementation of our study. In the evaluation of the intervention, we will examine repeated measurements of mental health status

during follow up; and our hypothesis is that we will find that participants mental status improves as participants gain access to counseling, health care and economic livelihoods training. Another important purpose of the SSQ is to help identify young people who should be referred for psychological counseling and treatment.

The initial description of the instrument in this paper is promising, but suggests that some issues of translation and comparability between the two questionnaire versions may need to be addressed. For practical purposes, however, the differential item function does not lead to large changes in categorization of symptomatic or non-symptomatic status. Therefore, subsequent analyses in this dissertation will use latent trait estimates from the partial credit model without the added complexity of DIF. Chapter 4 will use both the latent trait estimates from the partial credit model and the raw score values to explore the associations of baseline factors with mental health status.

Chapter 4. Baseline Population Intervention Models for Mental Health Status

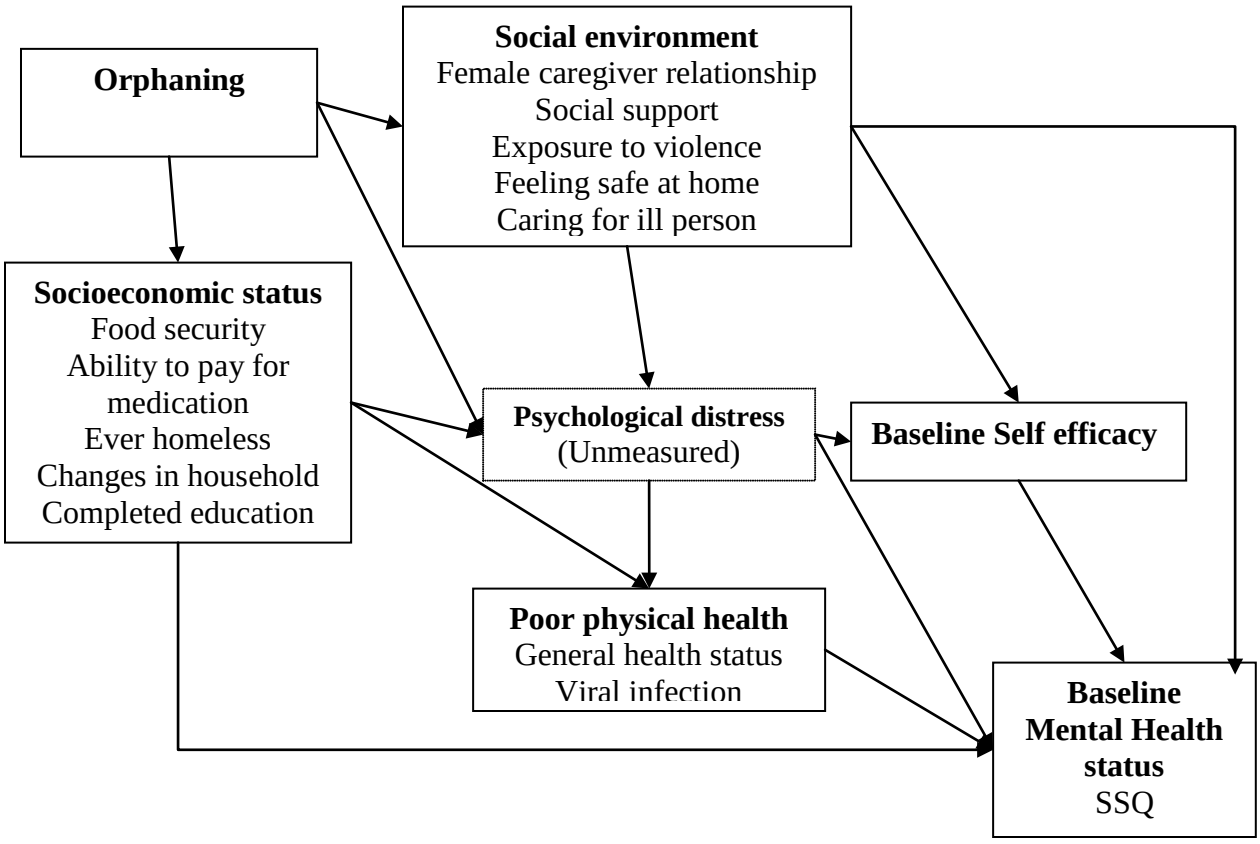
Background

As discussed in chapters 1 and 3, mental health morbidity estimates are high in Zimbabwe, with between 15 and 17%[73, 74]of adult women found to have depression or anxiety and estimates of risk for affective disorders as high as 51.7% in rural youth[75] . Orphaning, particularly orphaning due to HIV in a parent is an established risk factor for psychological distress[108-113].

A framework for understanding the effects of orphanhood on psychological distress has been developed by Nyamukapa *et al*. [35] Based on that framework, the authors suggest that programs to increase psychosocial support for orphans should be underpinned by efforts to reduce poverty, increase school attendance and support out of school youth[114]. The SHAZ! Intervention fits well into this framework of intervention, since it attempts to provide vocational training and support to out of school orphans, while also trying to provide social support to the youth.

Our conceptual framework, shown in figure 4.1, is heavily influenced by the framework proposed by Nyamakupa *et al*. Briefly, orphan status is believed to contribute to a loss of both psychosocial and economic support leading to poorer mental and physical health and eventually resulting in low employment prospects, poverty, risky behavior and disease. We also hypothesize that the consequences of psychological distress may become factors contributing to subsequent psychological distress.

Figure 4.1 Conceptual framework



To evaluate whether our data fit the *a priori* assumptions of this framework, baseline data are used to assess associations with the mental health scale in this population. A primary focus of these analyses is to understand which of the pathways of this framework would result in the largest impact, if an intervention were able to address them. A secondary objective of these analyses is to reduce the set of candidate covariates for longitudinal analyses by choosing those variables which are most likely to be related to mental health over the course of the study.

Population intervention models (PIMs) can provide an insight into the modifiable factors that may yield the most impact in a given population. Analogous to a population attributable risk, the parameters derived from this model give a population-level estimate of the outcome under hypothetical intervention scenarios. Unlike a traditional population attributable risk the PIMs estimate averages the estimate across the other covariates and allows an estimate of impact holding these other covariates constant. This chapter presents the results of population intervention models used to assess the effect of intervention on various covariates on four summary measures of mental health status: latent trait estimates from item response models, raw scores on the mental health instrument and binary categorizations of both estimates into symptomatic and non-symptomatic categories.

Methods

Data for baseline analyses include all participants enrolled in the main cohort of the SHAZ! project who completed screening questionnaires and a baseline interview. Also included are potential participants who screened out of the main study, because they had positive laboratory tests for either HIV/HSV-2. This allows us to look at the potential relationship of mental health symptoms with viral infection factors.

Outcome measures

Mental health distress was assessed with the SSQ, and was analyzed using four measures: Latent trait estimate, raw score estimate, and binary categorizations of both latent trait and raw score. Calculation of latent trait estimates from item response models was conducted according to the methods described in chapter 3. Because the SSQ was intended as a screening instrument, a binary categorization was created for both the latent trait estimates and the raw scores. Raw scores above 15 were considered symptomatic as were latent trait estimates above 0.5 logits.

Covariates of interest

Social support, self efficacy and economic status variables were collected through audio computer assisted self interview (ACASI). General health status and exposure to abuse were collected through face-to-face interviews with a nurse counselor. Viral infection was determined by laboratory test. Covariates in this dataset are described in more detail in chapter 2. Coding of covariates evaluated for association with mental health are shown in table 4.2. Wording of the self efficacy scale questions is shown in table 4.1

4.1 Self Efficacy Scale Statements

There is really no way I can solve some of the problems I have.
Sometimes I feel that I am being pushed around in life.
I have little control over the things that happen to me.
I can do just about anything I really set my mind to do.
I often feel helpless in dealing with the problems of life.
What happens to me in the future mostly depends on me.
There is little I can do to change many of the important things in my life.

Statistical approach

Standard regression models provide an estimate of conditional effects, that is, the effect of an exposure of interest holding other covariates constant. This can be formalized as the expected value of the outcome (Y) when the exposure (A) = 1 minus the expected value of the outcome when (A) = 0 conditional on measured covariates ($\vec{W}$):

eq 4.1 $$E(Y \mid A = 1, \vec{W} = \vec{w}) - E(Y \mid A = 0, \vec{W} = \vec{w})$$

Often the goal of a statistical analysis is to use available observational data to approximate what would be found, if a randomized trial were possible. If the individuals who

experience the exposure (a=1) are considered to be exchangeable with those who do not experience the exposure (a=0) then the parameter in equation 4.1 approximates the situation of randomization and thus the total effect of the exposure. In observational data, exposures are rarely distributed in this way.

The marginal structural model (MSM) approach assumes that the parameter of interest is the population marginal total effect rather than the conditional effect. This can be formalized as the expected value of the outcome averaged across covariates(E_w), if everyone in the population experienced the exposure (Y_1) compared to a counterfactual situation where no one in the population experiences the exposure (Y_0):

eq 4.2 $$E_w(Y_1) - E_w(Y_0)$$

The MSM approach begins by theorizing that the existing data are a subset of a theoretical full dataset, in which an outcome value would be available for each person under both the exposed and unexposed states. Various estimation approaches are then used to approximate the parameter of interest from the observed data under a set of assumptions.

When considering the potential effects of an intervention, however, the parameter of interest is, in fact, the relative benefit of removing certain exposures in the population of interest, or reducing them to a minimum attainable level[115]. This can be formalized as the expected value of the outcome (Y), averaged across the measured covariates ($\vec{W}$), given everyone in the population experiences the target or optimal level of exposure (a) and the actual mean of the population:

eq 4.3 $$E_w(Y_a) - E_w(Y)$$

This approach compares the mean counterfactual outcome (that experienced under the hypothetical intervention condition) to the observed or "real" (crude) mean outcome. For example, the difference in average mental health scale score for the population, or the prevalence of mental health symptoms above the cutoff between a population of adolescent orphan girls who all have enough food to eat every day (counterfactual) and a population where some girls do not have enough to eat each day(actual). Because they describe the mean effects of a hypothetical intervention in a specific population, these models are referred to as population intervention models[116].

Arriving at the population intervention parameter requires 4 steps: 1) fitting the model describing the probability of the outcome given the exposure of interest and the confounders – so called "nuisance parameters"; 2) creation of a dataset including counterfactual exposures, i.e. setting exposures of interest to an investigator defined intervention level. To place realistic boundaries on the intervention potential and to confine estimation to parameters identifiable from the data, this is often chosen to be the lowest level of exposure experienced in the population of interest; 3) predicting the outcome under the counterfactual exposure situation using the model estimated in step 1;and, finally, 4) calculating the difference in outcome under the actual and counterfactual scenarios.

Models created in step one of this procedure require estimation of potentially high-dimensional nuisance parameters (parameters needed for estimates of counterfactual means

beyond the parameter(s) of interest). To take an empirical approach to dimension reduction and estimation of nuisance parameters, models were fit using a combination of computer learning algorithms to allow flexible model fitting while forcing the covariate of interest to be included. A more detailed explanation of the model fitting algorithms is included in appendix A. For models where self efficacy or general health are the exposures of interest, all variables shown in table 4.2 were treated as candidate covariates, as was age. For models where socioeconomic status or social environment variables are the exposures of interest; age and all variables in table 4.2 with the exception of self efficacy and general health are treated as candidate covariates. General health and self efficacy are not included in socioeconomic status or social environment analyses because they are on the causal pathway from the exposures to mental health. Confidence intervals were constructed using the influence curve. Predicted probabilities of treatment were examined to determine whether there were violations of the experimental treatment assumption.

To provide comparison, conditional estimates of effects were calculated for each of the potential intervention variables. Conditional estimates were calculated by running traditional linear and logistic regression analyses including all candidate variables.
Traditional regressions were conducted using SAS software. All other analyses were conducted using the R program version 2.12.1. A list and description of specialized packages used for analysis in R is provided in appendix A.

Results

Of 410 potential participants screened for the SHAZ! Study, 383 provided enough information to be included in these analyses. Prevalence of each risk factor in the analysis population is shown in table 4.2. The most prevalent risk factors for poor mental health were low baseline self efficacy (87.5%) and less than excellent general health (72.6%). Reported social support was also low in this population with 60.3% reporting that there were not enough people to count on when they needed to talk to someone and 30.3% reporting that they did not have a supportive female caregiver in their lives. Estimates of conditional and population intervention effects are shown in table 4.3.

Risk factors that were statistically significant in the traditional models for conditional effect included; physical violence, unsafe home environment, caring for an ill person in the home, low social support, absence of a supportive female caregiver, inability to buy medicine, ever having been homeless, low self efficacy and poor physical health. Although p-values varied somewhat, the same factors were identified as important in the population intervention models. The difference is in primarily in the effect estimates. For example, the largest conditional effect estimate for the continuous raw score was seen for ever having been homeless, with an increase in raw mental health distress score of 1.84 for those who had been homeless. Because only 22.5% of the population had that risk factor, however, removing that risk factor from the population results in only a 0.45 decrease in the average raw mental health distress score of the population. The largest potential population reduction in mental health distress was for changing low self esteem in the population, a reduction in average raw score of 1.43 and 9.2% fewer participants categorized as symptomatic for mental health distress.

Table 4.4 shows the estimated probabilities of treatment generated from the nuisance model for treatment. Estimated probabilities of less than 0.05 and greater than 0.95 occurred for several variables.

4.2 Covariates of Interest

Domain/variable	Question(s) and coding	Prevalence in Population		Hypothesized intervention level
		N	%	
Social environment				
Physical violence	Ever experienced physical abuse	18	4.7%	no experience of physical violence
Sexual violence	Ever expereienced sexual abuse (not including forced sex)	29	7.6%	no experience of sexual violence
forced sex	Ever experienced forced sex	28	7.3%	no experience of forced sex
Unsafe home environment	Describe the home environment as less than "very safe"	241	62.9%	home environment considered very safe
Household expereince of violence	Someone in the household has been the victim of physical violence in the last year	34	8.9%	noone in the house experiencing violence
Caring for ill	Participant is caring for a sick hosehold member	115	30.0%	not caring for someone ill in the household
Low social support	When you need someone to listen to your problems when you are feeling low, are there.... "Too few people" or "no one" I can count on	231	60.3%	"enough" people you can count on
Absence of supportive female caregiver	Report either no female caregiver or an average response of "sometimes" or "never" speaks to her warmly, understands problems and worries, enjoys talking things over with her, or is "often" or "always" emotionally cold	116	30.3%	presence of a female caregiver who is "often" or "always" supportive
Socioeconomic status				
Food security	Reports going to bed hungry, or not eating at least one day in the last week because there was no food	132	34.5%	never going to bed hungry or not eating because there is no food
Unable to buy medicine	If someone in the household is ill the household cannot obtain medcicine within one or two days	235	61.4%	able to buy needed medicine within 2 days
Changes in household location	Have changed household location or composition within the last 5 years	197	51.4%	no changes in household location within the past 5 years
Ever homeless	Report ever being homeless	86	22.5%	never homeless
Less than form 4 education	Less than form 4 (secondary) education	99	25.8%	at least form 4 (secondary) education
Low baseline self efficacy	Average response of "disagree/strongly disagree" with positive statements, "agree/strongly agree" with negative statements	335	87.5%	Average response of "agree/strongly agree" with positive statements, "disagree/strongly disagree" with negative statements
Poor physical health				
Less than excellent health	Report of "poor", "fair" or "good" rather than "excellent" general health	278	72.6%	excellent self reported health
Viral infection HIV/HSV-2	Laboratory positive for HIV or HSV-2 infection	42	11.0%	no viral infection with HIV or HSV-2

4.3 Results from Conditional and Population Intervention Models†

	Conditional Effects parameter (standard regression)				Population intervention parameter			
	Raw score*		Latent trait estimate*		Raw score		Latent trait estimate	
	Continuous	Dichotomized OR	Continuous	Dichotomized OR	Continuous**	Dichotomized***	Continuous**	Dichotomized***
Social environment								
Physical violence	1.12	**3.67**	0.40	*3.21*	-0.05	-1.1%	-0.02	-0.9%
Sexual violence	0.54	0.61	0.19	0.76	0.04	0.0%	0.01	-0.6%
forced sex	0.80	2.99	0.22	3.19	-0.01	-0.7%	0.00	-1.0%
Unsafe home environment	**1.01**	1.50	**0.29**	1.53	**-0.65**	-3.5%	*-0.17*	-3.6%
Household expereince of violence	0.95	1.85	0.29	1.71	-0.08	-1.1%	-0.03	-0.9%
Caring for ill	**1.44**	**5.19**	**0.44**	**5.34**	*-0.44*	**-5.8%**	*-0.13*	**-5.9%**
Low social support	**1.11**	1.64	**0.33**	1.75	**-0.69**	*-4.4%*	**-0.21**	**-4.7%**
Absence of supportive female caregiver	**1.31**	**2.57**	**0.43**	**2.42**	*-0.41*	**-3.9%**	*-0.13*	**-3.7%**
Socioeconomic status								
Food security	0.21	0.88	0.09	0.88	-0.04	0.4%	-0.02	0.3%
Unable to buy medicine	**0.85**	1.30	**0.28**	1.30	*-0.59*	-2.7%	*-0.19*	-2.9%
Changes in household location	-0.03	1.11	0.01	1.03	0.00	-0.9%	-0.01	-0.5%
Ever homeless	**1.84**	**2.40**	**0.56**	**2.61**	*-0.45*	-2.8%	*-0.14*	-3.0%
Less than form 4 education	0.40	1.38	0.07	1.49	-0.08	-0.5%	-0.01	-0.8%
Low baseline self efficacy	**1.51**	*4.84*	**0.42**	*4.72*	**-1.43**	**-9.2%**	**-0.39**	**-9.2%**
Poor physical health								
Less than excellent health	**0.93**	**2.67**	*0.27*	**2.69**	**-0.75**	**-7.4%**	**-0.23**	**-7.4%**
Viral infection HIV/HSV-2	**1.25**	*2.57*	0.31	*2.47*	-0.13	-1.3%	-0.03	-1.3%

†bold values indicate statistical significance p≤0.05, italicized values indicate statistical significance p≤0.10

*all standard regressions controlled for age

** parameters represent the difference in population mean mental health score

***parameters represent the difference in population proportion of participants with mental health distress scores above a cutoff for symptomatic status

4.4 Distributions of Estimated Probability of Treatment

	Min.	1st	Median	Mean	3rd	Max.
Social environment						
Physical violence	0.031	0.031	0.031	0.047	0.031	0.250
Sexual violence	0.023	0.023	0.023	0.076	0.023	0.750
forced sex	0.019	0.019	0.020	0.073	0.045	0.795
Unsafe home environment	0.399	0.533	0.642	0.629	0.716	0.896
Household expereince of violence	0.008	0.030	0.056	0.089	0.100	0.693
Caring for ill	0.202	0.202	0.202	0.300	0.371	0.547
Low social support	0.382	0.499	0.595	0.603	0.700	0.839
Absence of supportive female caregiver	0.145	0.192	0.342	0.303	0.386	0.465
Socioeconomic status						
Food security	0.089	0.226	0.326	0.345	0.467	0.800
Unable to buy medicine	0.147	0.473	0.631	0.614	0.759	0.984
Changes in household location	0.514	0.514	0.514	0.514	0.514	0.514
Ever homeless	0.006	0.092	0.174	0.225	0.303	0.852
Less than form 4 education	0.041	0.126	0.219	0.259	0.348	0.840
Low baseline self efficacy	0.800	0.800	0.903	0.875	0.903	0.903
Poor physical health						
Less than excellent health	0.453	0.686	0.733	0.726	0.774	0.936
Viral infection HIV/HSV-2	0.029	0.047	0.077	0.110	0.124	0.361

Discussion

In both the conditional and population intervention analyses, results were consistent with the conceptual framework proposed in this chapter. Not all relationships were statistically significant; however all relationships that were statistically significant had estimates of effect in the expected direction.

Conclusions from these analyses should are limited by the cross sectional nature of the dataset. These analyses used baseline data to test assumptions about which covariates in the dataset would be associated with mental health status. Although the temporality of exposure and outcome are not clear, the mental health status was assessed for the week prior to the baseline/screening visit and most of the exposures could be considered to have happened prior to that week. The exceptions to this assumption are the self-efficacy and self-reported health variables. It is unclear in these data whether low self-efficacy at baseline is a cause or a consequence of poor mental health status. Self efficacy could be considered a dimension of mental health and thus be part of the same underlying mental process rather than a risk factor. Self reported poor physical health might also be a consequence rather than a cause of the baseline mental health measure. Like self efficacy poor mental health could be perceived as a part of poor general health by participants and would be linked for that reason. Longitudinal analyses cannot completely solve this problem, but will allow a more detailed exploration of these relationships.

These baseline data are hopeful in that the largest potential impacts were observed for changes in the self efficacy measure. The SHAZ! Intervention is structured around the concept of empowering young women and would hopefully have a positive impact on self efficacy and thus on mental health. Social support and awareness of safety are also components of the intervention and were significantly associated with reductions in mental health distress in the population intervention models. Analyses of the longitudinal data will show whether these factors were indeed affected by the intervention and to what extent this resulted in improved mental health.

In these analyses, conclusions did not differ drastically between analyses using raw score and latent trait estimates. More differences were observed in the data between analyses of using continuous and categorical outcomes. Because the SSQ is intended as a screening tool, the ease of scoring and interpretation is an important aspect of the usefulness of this instrument. In order to provide more easily interpretable results, raw score based estimates of mental health will be used in longitudinal analyses.

In this small sample, estimated probabilities of treatment for some variables of interest were below 0.05 or above 0.95 and could be considered practical violations of the experimental treatment assumption. However, these extreme probabilities did not occur in the variables for which statistically significant results were found in the population intervention models.

The secondary objective of these analyses was to identify a reduced set of covariates to include as candidates for longitudinal analyses. Variables identified as significant at below a p-value of 0.10 at baseline will be included as potential confounders in the longitudinal analyses of mental health and participation in subsequent chapters.

Chapter 5. Methods for longitudinal analysis

Time dependant confounding and methodological approach

In the course of the longitudinal study, mental health distress and intervention participation are both exposures and outcomes. I hypothesize these two variables of interest both have an effect on, and are affected by, each other as the participants move forward in time. This type of hypothesis cannot be addressed by conventional analyses[117]. Conventional methods of analysis are biased when time dependant covariates are a predictor of the outcome of interest and of subsequent exposure. They are also biased when past history of exposure predicts subsequent levels of a factor[118].

Using a causal inference based marginal approach allows estimation of causal effects of a history of exposures that varies over time when there are covariates which also vary over time and may function simultaneously as confounders and intermediate variables[119]. This chapter describes the analytic approach used in the longitudinal analyses to avoid the bias due to time dependant confounding.

Hypothetical "Ideal Experiment"

To identify clearly the parameter of interest, it is often helpful to think of a hypothetical "ideal" experiment. In the ideal experiment, the researcher could observe every subject in his/her study under every exposure level s/he wishes to make effect/association estimates, holding all other variables (including time) constant. Although this hypothetical experiment is not possible in the real world, it is a thought experiment defining the data that could answer definitively the question of interest. The hypothetical full dataset would then contain two (or more) copies of data for each participant representing his/her data given each level of the exposure of interest i.e. one copy of data in which they are exposed and one copy of data in which they are unexposed. This full dataset is never possible to obtain, because all participants can only be observed under one exposure status.

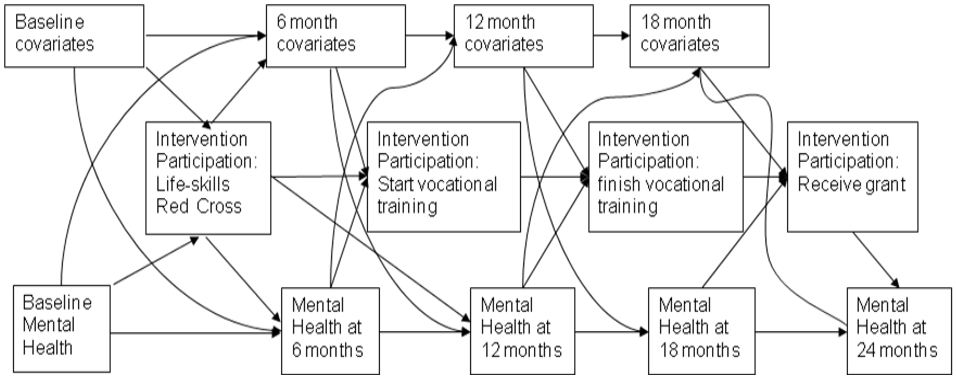
Beginning from this thought exercise allows a researcher to think through how a full dataset for the question of interest would be structured. It can also be used to me the calculation of a causal estimate as a missing data problem treating the unobserved (counterfactual) exposure situations as missing data.

The questions of interest for the longitudinal analyses in this study are the effects of intervention participation and mental health status at each study visit on subsequent mental health and participation, given the observed mental health, and participation up to that time point. Each intervention component is only available to participants who have completed the previous component; thus, the questions of interest are also dependant on having completed the previous component. For example, Red Cross training was only available to those who completed the life-skills training; thus, we are interested only in the effect of mental health at baseline on completing Red Cross among those who had completed life-skills training. To discuss the ideal experiments that could answer these questions, I begin with some notation.

Imagine a hypothetical complete dataset (O) that is composed of a vector of time dependant covariates ($\vec{W}$) measured at times 0 to k ($\vec{W}_0 \ldots \vec{W}_k$), a time-dependant exposure ($\vec{A}$) measured at the same times ($A_0 \ldots A_k$) and an outcome (Y) measured at time k+1. Therefore, in the case where k is 0 (a baseline and an outcome time point) O = ($\vec{W}_0$,A_0,Y). If the outcome of interest is a time-dependant covariate that is part of $\vec{W}$; for example, if baseline mental health is treated as a covariate for the analysis of mental health at 6 months, it can be separated out for notational clarity (L_0) and the structure of O can be written as O=($\vec{W}_0$,L_0,A_0,Y). Extending this notation to a longitudinal case where k is 1, O = ($\vec{W}_0$, L_0,A_0, $\vec{W}_1$, L_1,A_1,Y). Because the outcomes of interest are conditional on completing a previous intervention component, Z is added to represent completion of the previous component.

The data in this study are described in a Directed Acyclic Graph below (Figure 5.1). Using this graph, helps to think through the hypothesized relationships in the data and the temporality of which exposures and covariates occur prior to the outcome measures.

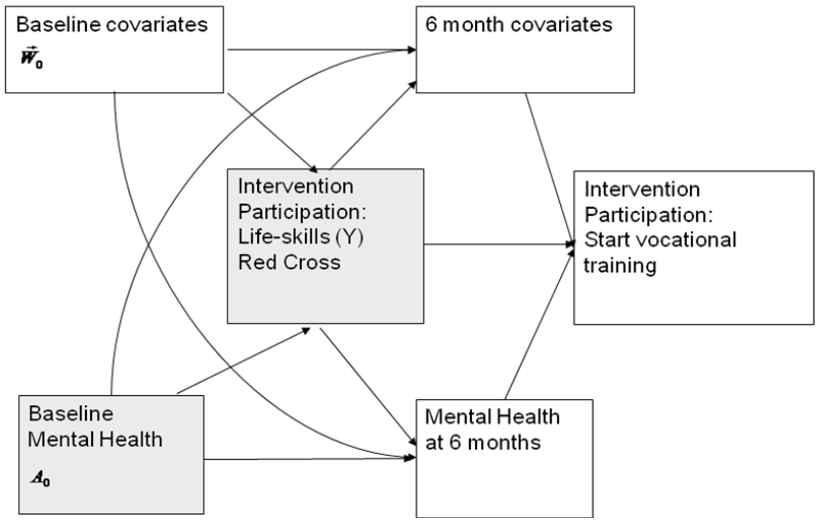
Figure 5.1 Directed Acyclic Graph (DAG)



For the longitudinal data in this study the "ideal" experiment actually becomes a series of experiments changing the values of A for different time points and observing the subsequent Y values.

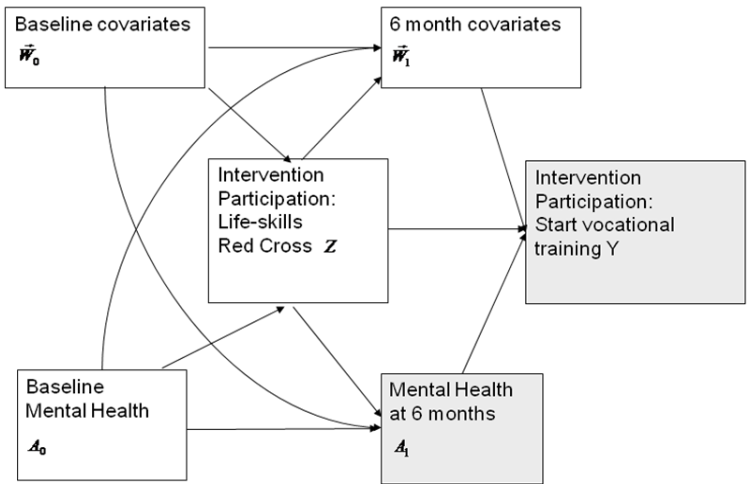
For example, to determine the composition of the data (O) for an experiment answering the question: "What is the effect of baseline mental health status on completion of the life-skills training (which was finished prior to the 6 month visit)?" the part of the DAG that depicts the variables of interest is shown in figure 5.2:

Figure 5.2 Example 1



To determine the composition of the data (O) for an experiment answering a different question: "What is the effect of mental health status at 6 months on starting vocational training among those who completed the Red Cross training, given there was a range of mental health at baseline?" the part of the DAG that depicts the variables of interest is shown in figure 5.3:

Figure 5.3 Example 2:



From a practical standpoint this helps the researcher understand when mental health status might matter most. For example a large impact of baseline mental health on intervention completion is found but little impact of 6 month mental health on completion is found, more staff resources might be devoted to counseling and support at the beginning of the study.

Parameters of interest

Standard regression models provide an estimate of conditional effects, that is, the effect of an exposure of interest holding other covariates constant. This can be notated as the expected value of the outcome (Y) when the exposure (A) = 1 minus the expected value of the outcome when (A) = 0 conditional on measured covariates ($\vec{W}$):

Eq 5.1 $$E(Y \mid A = 1, \vec{W} = \vec{w}) - E(Y \mid A = 0, \vec{W} = \vec{w})$$

Given our hypothetical "ideal" experiments, the parameters of interest are not the conditional effects, but the total effects averaged over all covariates. The parameters of interest for the "ideal" experiments can be notated as the expected value of the outcome averaged across covariates (E_w) if everyone in the population experienced the exposure (Y_1) compared to a counterfactual situation where no one in the population experiences the exposure (Y_0). For this parameter estimate, measures of past exposure ($A_0 \ldots A_{k-1}$) and past outcome ($L_0 \ldots L_k$) become part of the vector of covariates ($\vec{W}$):

Eq 5.2 $$E_w[(E(Y \mid A = 1, \vec{W}) - E(Y \mid A = 0, \vec{W})) \mid Z = 1]$$

Estimation of the parameters of interest

To estimate the parameters of interest as described by equation 5.2, a targeted maximum likelihood estimation approach was used. This begins by defining the observed data as:

Eq 5.3 $$O = (W, A, Y) \sim P_o$$

Several assumptions are then made about the identifiability of the data generating distribution to estimate the parameters from the observed data. Assumption 1, the randomization assumption, assumes that treatment is random with respect to the set of all counterfactual outcomes given the covariates. Assumption 2, the experimental treatment assignment (ETA) assumption is that no participant has a zero probability of a treatment level given the observed covariates, in other words, that there is experimentation within strata of the data defined by measured covariates. Assumption 3, the Stable Unit Treatment Value Assumption (SUTVA) assumes that the outcome of one participant does not depend on the exposures of the other participants. Assumption 1 is similar to the assumption of no unmeasured confounding in standard regression techniques. This assumption is not testable in the data. However, a large variety of covariates were available for analysis and there are no major factors in the theoretical framework for which there were no data available for analysis. Assumption 2 is testable in the data. Estimated probabilities of treatment were predicted from the nuisance model in order to test this assumption. Assumption 3 is also not testable in the data. However, we have no reason to believe that vocational training given to

one participant would affect the results of another participant. There is also no reason to believe that the mental health of one participant would affect the intervention completion for another participant.

With these assumptions, the data generating distribution can be factorized as follows:

Eq 5.4 $$P_o(o) = P_o(w,a,y) = P_o(y \mid a,w)P_o(w)P_o(a \mid w)$$

And two estimators can be defined:

Eq 5.5 $$\overline{Q}_o(A,W) \equiv E(Y \mid A,W)$$

Also referred to as the outcome model and:

Eq 5.6 $$g_o(a \mid W) \equiv P_o(A = a \mid W)$$

also called the treatment model.

The estimation approach chosen for this dissertation, Targeted maximum likelihood estimation (TMLE), targets maximum likelihood estimation to reduce bias in the parameter of interest. TMLE targets the estimation of models for both the Q_o and the g_o portions of the likelihood to be asymptotically unbiased when either the outcome or treatment models are correctly specified. Relative to the equivalent estimating equation approach, TMLE also has the benefit of being robust to sparse data[120].

In practice TMLE can be thought of as having four steps: 1) An outcome model (Q_o) is estimated; 2)This estimate is augmented by adding a so-called special covariate, which is a function of the estimate of the treatment model (g_o) to create a new *targeted* estimate of the outcome model; 3) The outcomes are simulated from this model for both A=1 and A=0, and 4) the distributions of these simulated outcomes are compared via the specified parameter of interest. For the dissertation analyses the parameter of interest is the average treatment effect conditional on completion of the previous intervention component (as described in equation 5.2).

Model fitting algorithms

Models created to estimate the marginal parameters of interest require estimation of potentially high-dimensional nuisance parameters (parameters needed for estimates of counterfactual means beyond the parameter(s) of interest. To take an empirical approach to dimension reduction and estimation of nuisance parameters, models were fit using computer learning algorithms to allow flexible model fitting. The use of machine learning algorithms allows data-adaptive approaches to optimize the fit of the models and reduce bias in the parameters of interest.

Deletion/Substitution/Addition algorithm (DSA)

The DSA performs data-adaptive estimation through estimator selection based on cross-validation and the L2 loss function. Candidate estimators are defined with polynomial generalized linear models generated with the algorithm under user-specified constraints[121].

Traditional regressions were conducted using SAS software. All other analyses were conducted using the R program version 2.12.1. A list and description of specialized packages used for analysis in R is provided in appendix A.

Chapter 6. The effect of intervention participation on mental health

Introduction

As discussed in chapter 1, economic livelihoods interventions may have a positive impact on the mental health status of participants. Many of these interventions, including SHAZ!, are designed within a framework of empowerment, hope and future orientation. This chapter examines the relationship between participation in the SHAZ! intervention and mental health status over time. I begin by describing the distribution of mental health status in the study. I present a traditional intent to treat (ITT) logistic regression model. I then estimate a series of average treatment effects for the longitudinal data to explore the associations of particular intervention components with subsequent mental health status as described in chapter 5. Results are presented for average treatment effects generated using targeted maximum likelihood estimation and data adaptive deletion substitution addition (D/S/A) algorithms.

Distribution of Mental Health Status

For all analyses in this chapter, mental health status is treated as a binary categorization of the raw score on the Shona Symptom Questionnaire (SSQ). As described in chapter 3, participants above the cutoff of 15 out of 28 are considered symptomatic for mental health distress. All models in these analyses use this dichotomous variable for mental health status. At baseline, 24.8% of participants were classified as symptomatic for mental health distress using the SSQ. Table 6.1 shows the percent of participants who were symptomatic at each visit by study arm. Using a chi-squared test, the 24 month follow up visit is the only visit for which there is a statistically significant difference in percent symptomatic.

Table 6.1 Percent of Participants Symptomatic for Mental Health Distress by Visit and Study Arm

	Intervention	Control	All Participants
Visit			
Baseline	27.1	22.4	24.76
6 months	26.9	30.1	28.42
12 months	20.4	25.6	22.94
18 months	19.9	20.3	20.08
24 months	8.5	22.7	15.32

The percentage of symptomatic among all study participants decreases over the study period from 24.8% at baseline to 15.3% at the 24 month follow up visit. As shown in table 6.2, mental health status is correlated over time. For example, of participants symptomatic at baseline, 60.3% were symptomatic at the 6 month visit, and 57.1% were symptomatic at the 12 month visit. All relationships in table 6.2 are statistically significant at $p< 0.05$ using chi-squared tests.

Table 6.2 Percent Symptomatic for Mental Health Distress at Each Follow up Visit, by Prior Mental Health Status

Status at prior visit	6 month	12 month	18 month	24 month
Baseline				
not symptomatic	18.6	12.7	12.6	11.4
symptomatic	60.3	57.1	42.6	27.9
6 month				
not symptomatic		9.7	11.7	10.3
symptomatic		55.3	42.7	25.4
12 month				
not symptomatic			9.3	8.6
symptomatic			56.4	37.7
18 month				
not symptomatic				7.5
symptomatic				50.0

Intent to Treat (ITT) Analysis

Standard logistic regression models were fit for mental health status at each visit using study arm as the only variable. Results from these models are shown in table 6.3. Odds ratios, and the corresponding confidence intervals and p-values are presented. As with the crude proportions, the 24 month visit is the only visit for which a statistically significant difference is observed between the intervention and control groups.

In order to facilitate comparison between the results from these analyses and the targeted maximum likelihood estimation results, the predicted differences in proportion were estimated using the intent to treat model, and are also shown in table 6.3. For the 24 month visit, the predicted difference in proportion is -0.14, meaning that 14% of participants in the intervention arm would have been symptomatic at the 24 month visit had they not received the intervention.

Table 6.3 Intent to Treat Analysis Logistic Regression Results for Mental Health Status* at each Follow up Visit by Intervention Arm

Visit	Ln(odds)	OR	95% CI	p-value	Predicted Difference for Intervention compared to control participants
6 months	-0.16	0.85	(0.51, 1.42)	0.54	-0.03
12 months	-0.29	0.75	(0.43, 1.31)	0.31	-0.05
18 months	-0.03	0.97	(0.52, 1.80)	0.92	0.00
24 months	-1.15	0.32	(0.15, 0.67)	0.00	-0.14

*symptomatic for mental health distress

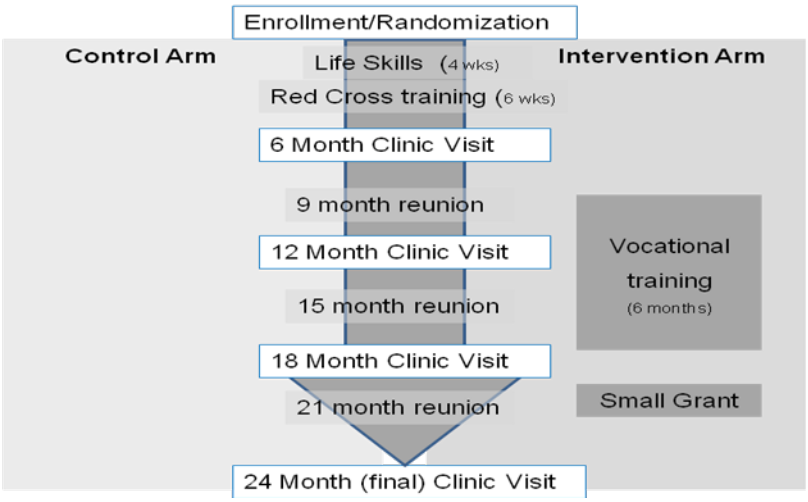
Average Treatment Effects

Average treatment effects were estimated for the effect of each intervention component on subsequent mental health status, given completion of the previous intervention component. As described in chapter 5, the parameter of interest for each exposure and outcome pair can be written as:

$$E_w[(E(Y \mid A=1,\vec{W}) - E(Y \mid A=0,\vec{W})) \mid Z=1]$$

Where Y denotes the outcome, A represents treatment, $\vec{W}$ represents the vector of covariates and Z represents completion of the previous intervention component. Each model was fit using data restricted to the subset for which the previous intervention component was completed (Z=1).

Figure 6.1 Study Activities



For example, for the model estimating the difference between mental health status at 18 months if everyone had completed Red Cross training, compared to mental health status at 18 months if no one had completed Red Cross training, the estimate is conditional on having completed Life-skills training and the model is fit using only those who completed the life-skills component. Because completion for each component conditional on completing the previous component is quite high in some cases, very little data is available to estimate the parameters of interest related to those components.

To give a sense of the data distributions used for modeling, table 6.4 shows the distribution of mental health distress at each visit by intervention component completion, restricting observations to those for whom the previous intervention component was completed. Table 6.4 helps to illustrate questions for which there may not be enough data to estimate the parameter of interest. For example, there were only 4 participants who did not complete Life-skills training who provided data at the 18 month follow up visit, none of whom was symptomatic for mental health distress.

Table 6.4 Mental Health Distress at Each Follow up Visit by Intervention Participation, Given Completion of Prior Intervention Components

	6 Months				12 Months				18 Months				24 Months			
	Not Symptomatic		Symptomatic		Not Symptomatic		Symptomatic		Not Symptomatic		Symptomatic		Not Symptomatic		Symptomatic	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Life skills completion																
no	5	55.6%	4	44.4%	7	70.0%	3	30.0%	4	100.0%	0	0.0%	6	85.7%	1	14.3%
yes	194	72.4%	74	27.6%	198	77.6%	57	22.4%	188	79.0%	50	21.0%	194	84.0%	37	16.0%
Red cross completion																
no	24	57.1%	18	42.9%	24	60.0%	16.0	40.0%	20	58.8%	14	41.2%	24	77.4%	7	22.6%
yes	170	75.2%	56	24.8%	174	80.9%	41.0	19.1%	168	82.4%	36	17.6%	170	85.0%	30	15.0%
Started vocational training																
no									77	84.6%	14	15.4%	74	80.4%	18	19.6%
yes									88	80.7%	21	19.3%	95	90.5%	10	9.5%
Vocational training completion																
no									23	74.2%	8	25.8%	23	82.1%	5	17.9%
yes									64	83.1%	13	16.9%	69	93.2%	5	6.8%
Received grant																
no													2	100.0%	0	0.0%
yes													67	93.1%	5	6.9%

Table 6.5 presents the average treatment effect estimates derived using targeted maximum likelihood estimation and the D/S/A algorithm. Sample sizes for each subset of the data used for estimation are shown in the first column of the table. Life-skills training was not significantly associated with mental health status at any visit. However, so few participants failed to complete life-skills training that the effect of this intervention component could not be expected to be estimated from these data.

The Red Cross training was significantly associated with a reduction in the proportion of participants symptomatic for mental health at the 6, 12 and 18 month follow up visits. Red Cross training was associated with a reduction in symptomatic mental health status of between 20% and 22%. In other words, if no one completed Red Cross training, an additional 20 to 22% of participants who finished the Life-skills training would be symptomatic for mental health distress compared to a situation where everyone completed the Red Cross training.

Starting vocational training was associated with a reduction in proportion symptomatic at the 24 month visit. However, vocational training completion was not significantly related to mental health, and the model for receipt of the small grant was not estimable from the data. Only two participants who completed vocational training and provided data at the 24 month visit did not receive a grant.

Table 6.5 Difference in Proportion Symptomatic for Mental Health Distress by Intervention Participation, Conditional on Completion of Prior Intervention Components: Average Treatment Effects (ATE) using tMLE (D/S/A) estimation

		6 Months	12 Months	18 Months	24 Months
	Sample Size	ATE (95% CI)	ATE (95% CI)	ATE (95% CI)	ATE (95% CI)
Life skills completion	300	-0.11 (-0.27, 0.04)	-0.03 (-0.19, 0.13)	--	0.02 (-0.09, 0.13)
Red cross completion	282	**-0.20 (-0.33, -0.08)**	**-0.22(-0.32, -0.11)**	**-0.21 (-0.33, -010)**	0.01 (-0.05,0.07)
Started vocational training	226			0.02 (-0.06,0.10)	**-0.12(-0.20, -0.05)**
Vocational training completion	110			-0.06 (-0.20, 0.09)	-0.11(-0.26, 0.03)
Received grant	77				--

bold numbers indicate parameters statistically significant at p<0.05

missing estimates represent models that could not be estimated using the available data

Discussion

These analyses demonstrate an important advantage of the causal inference approach to intervention evaluation. In contrast to the ITT models in which the only finding is a statistically significant difference between intervention and control arms at 24 months, the causal inference approach reveals the importance of the Red Cross component of the intervention. Because that component was provided to both study arms, the impact of that component on mental health cannot be assessed in the ITT analysis. This is particularly important because the magnitude of the reduction in mental health distress is large – a difference in 20% for the Red Cross training.

Another result of the causal inference approach is the observation that the follow up period may not have been long enough to capture the impact of the vocational training components of the intervention. The association of starting vocational training is significant at 24 months, and the association with finishing vocational training is in the direction of reduction, but is not significant. Starting vocational training, which occurred between the 6 and 12 month visits, had an effect only at 24 months. Finishing vocational training, which occurred for most participants between the 12 and 18 month visits, may not have an effect until later.

Starting vocational training was also associated with a smaller effect on the proportion of those symptomatic for mental health distress than finishing the Red Cross training (12% vs. more than 20%). Although findings from this small dataset should be interpreted with caution, this suggests that the mental health benefits conferred by participation in the 6 week Red Cross component may be as much or more than those conferred by the much longer vocational training component.

Chapter 7. The Effect of Mental Health on Intervention Participation

Introduction

As discussed in chapter 1, mental health distress may have an impact on intervention participation. Populations in need of economic livelihood interventions may also be suffering from high prevalence of mental health morbidity. This may lessen their ability to take advantage of the interventions available. This chapter examines the relationship between mental health status at each visit and participation in the SHAZ! intervention.

I begin by describing intervention participation by study arm and by baseline mental health status. I then present the percent of participants completing each intervention component, by mental health status at previous visits, conditional on having completed the prior intervention component. For the effect of baseline mental health status on completion of intervention components, where time dependant confounding is not an issue, I present standard logistic regression models. Finally, I use a series of marginal structural point treatment models for the longitudinal data to explore the associations of mental health status with particular intervention components as described in chapter 5. Results are presented for targeted maximum likelihood estimation models fit using deletion, substitution, addition (D/S/A) algorithms.

Distribution of Intervention Participation

Tables 7.1 and 7.2 show the distribution of intervention participation, by study arm, and by baseline mental health status respectively. Although the percentages of intervention completion are slightly higher for intervention participants and for those not symptomatic for mental health distress at baseline, these differences were not statistically significant using chi-squared tests.

Table 7.1 Intervention Participation by Study Arm

	Intervention		Control		All Participants	
Intervention components	N	%	N	%	N	%
Completed life skills	152	96.2%	145	92.4%	297	94.3%
Passed red cross on 1st attempt	103	65.2%	95	60.5%	198	62.9%
Completed red cross	129	81.6%	115	73.2%	244	77.5%
Began vocational training	124	78.5%				
Completed vocational training	100	63.3%				
Received grant	86	54.4%				

Life-skills completion was high (over 90%) for both intervention and control groups. Participants were allowed two chances to pass the Red Cross training completion exam. Of all participants, 62.9% passed the Red Cross exam on the first attempt. An additional 14.6% were able to pass the Red Cross exam on the second attempt for a total of 77.5% of all participants completing the Red Cross component of the intervention. Completion of vocational training was lower, with only 63.3% of all intervention participants completing vocational training and 54.4% of intervention participants receiving a small grant. As discussed in chapter 2, control arm participants who completed the study were eligible to participate in a vocational training program after the study ended, but data on vocational training after the study period were not available for analysis.

Table 7.2 Intervention Participation by Baseline Mental Health Status

	Not Symptomatic at Baseline		Symptomatic at Baseline	
Intervention components	N	%	N	%
Completed life skills	220	94.0%	73	94.8%
Passed red cross on 1st attempt	152	65.0%	42	54.5%
Completed red cross	185	79.1%	55	71.4%
Began vocational training	90	79.6%	31	73.8%
Completed vocational training	64	56.6%	19	45.2%
Received grant	62	54.9%	18	42.9%

Table 7.3 shows the percent of participants completing each intervention component by each measure of prior mental health status, conditional on completing the prior intervention component. For example, 83.7% of the participants who were not symptomatic for mental health distress at baseline, and who completed life-skills, also completed the Red Cross training, compared to 74.6% of the participants who were symptomatic for mental health distress and completed life-skills. Completion of Red Cross and completion of vocational training were lower among those symptomatic for mental health distress, but these differences were not statistically significant by chi-squared or fisher's exact tests. Statistical significance (fisher's exact test $p < 0.05$) was only observed for receipt of a grant by symptomatic status at 6 and 12 months.

Table 7.3 Percent of Participants Completing Intervention Components, Given Completion of Prior Component, by Mental Health Status

Mental Health Status	Lifeskills		Red Cross		Started vocational training*		Completed vocational training*		Received a Grant*	
	N	%	N	%	N	%	N	%	N	%
Symptomatic at baseline										
no	215	93.9%	180	83.7%	86	95.6%	61	70.9%	59	96.7%
yes	67	94.4%	50	74.6%	28	96.6%	17	60.7%	16	94.1%
Symptomatic at 6 months										
no					83	95.4%	58	69.9%	**58**	**100.0%**
yes					30	96.8%	20	66.7%	**17**	**85.0%**
Symptomatic at 12 months										
no							63	70.8%	**63**	**100.0%**
yes							14	66.7%	**11**	**78.6%**
Symptomatic at 18 months										
no									63	98.4%
yes									11	84.6%

* among vocational arm only

Table 7.4 Odds of Completion of Intervention Components by Symptomatic Status for Mental Health Distress at Baseline, Conditional on Completing Previous Intervention Components: Estimates from Logistic Regression

Lifeskills		Red Cross		Start vocational training		Completed vocational training		Received Grant	
Sample Size	OR (95% CI)	Sample Size	OR (95% CI)	Sample Size	OR (95% CI)	Sample Size	OR (95% CI)	Sample Size	OR (95% CI)
300	1.1 (0.35, 3.42)	282	0.57 (0.30, 1.11)	114	1.30 (0.14, 12.14)	114	0.63 (0.26, 1.54)	78	0.54 (0.05, 6.37)

Table 7.5 Difference in Intervention Component Completion by Mental Health Distress Symptoms, Conditional on Completing Previous Intervention Components: Average Treatment Effects (ATE) using tmle(D/S/A) estimation

	Lifeskills		Red Cross		Start vocational training		Completed vocational training	
	Sample Size	ATE (95% CI)	Sample Size	ATE (95% CI)	Sample Size	ATE (95% CI)	Sample Size	ATE (95% CI)
Symptomatic at baseline	300	0.03 (-0.02,0.08)	282	**-0.23 (-0.41,-0.05)**	119	-0.01 (-0.16, 0.14)	114	-0.18 (-0.43, 0.07)
Symptomatic at 6 months					118	0.05 (0.02,0.10)	113	0.04 (-0.19,0.26)
Symptomatic at 12 months							110	-0.01 (-0.28, 0.26)
Symptomatic at 18 months								

bold numbers indicate parameters statistically significant at p<0.05

Logistic Regression Results

Odds ratios for the effect of being symptomatic for mental health distress at baseline on completion of Red Cross training, vocational training completion, and grant receipt were in the expected direction. Table 7.4 summarizes the logistic regression results. Participants symptomatic at baseline were less likely to complete these intervention components. However, no results in logistic regression modeling were statistically significant and associations for completing life-skills training and starting vocational training were in the direction opposite the hypothesized relationship.

Average Treatment Effects

Average treatment effects (ATE) were estimated for the effect of each intervention component on subsequent mental health status, given completion of the previous intervention component. As described in chapter 5, the parameter of interest for each model can be written as:

$$E_w[(E(Y \mid A = 1, \vec{W}) - E(Y \mid A = 0, \vec{W})) \mid Z = 1]$$

Table 7.5 summarizes the model results for parameters fit using targeted maximum likelihood estimation and deletion substitution addition algorithms. Unfortunately no models could be run for the outcome of grant receipt because there was not enough data to support estimation of the parameters of interest. The one significant result from the ATE analyses was the reduction in proportion completing Red Cross training by baseline mental health status. Using this approach an additional 23% of participants who finished life-skills training would complete Red Cross training if no one were symptomatic for mental distress at baseline, compared to a situation where all participants were symptomatic at baseline.

Discussion

Because mental health status improved over the course of the intervention period, and because the conditional nature of the parameters of interest reduced the sample size available for estimation of ATE for later intervention components, no parameters related to the grant receipt could be estimated. However, a statistically significant result was found for the effect of baseline mental health status on completion of the Red Cross training, conditional on completing life-skills training. This could be because participation in the intervention improved mental health status (as demonstrated in chapter 6). Participants able to complete Red Cross training may thus be the subset of participants with enough mental health to complete any subsequent intervention components. It may also be that once the Red Cross training is completed the mental health benefits of participating in the intervention take effect and subsequent components are less affected by prior mental health status. Again, the small sample size suggests caution when interpreting these results as the lack of significance for subsequent intervention components could also be due to a lack of sufficient data.

The causal inference based marginal approach allows estimation of the effects of mental health on intervention components in a way that is not possible with traditional methods. Being able to examine these time dependant relationships is an important application of these methods to practical evaluation problems. Knowing the time-points at which mental health status has the most impact on intervention participation can help in the design of future interventions. If

baseline mental health status is the most important time-point with respect to participation, as suggested by these data, then resources for mental health improvement would be best spent at the beginning of an intervention. Future work to replicate these findings in a larger study would be an important contribution to the intervention literature.

Chapter 8. Discussion

Measuring Mental Health

As noted in the introduction and background there is a dearth of research on mental health in low and middle income countries[122]. What does exist is often conducted using western instruments translated for use in non-western settings. An important strength of this case study was the availability of the Shona Symptom Questionnaire (SSQ), a locally developed measure of common mental disorders. In chapters 3 and 4 this measure was evaluated and found to be consistent with the construct and theoretical framework of mental health distress in this population. Findings in chapters 3 and 4 also demonstrated that using raw scores from the SSQ for analyses of associations with other factors did not result in different conclusions from using the more difficult to calculate latent trait estimates derived using item response models.

Unfortunately there were no clinical evaluations for mental health disorder conducted during this intervention, so the sensitivity and specificity of the measure could not be evaluated against clinical diagnosis. To a certain extent any cut-point used to categorize participants as symptomatic or non-symptomatic for mental health distress is arbitrary. No gold standard exists for this categorization. The cut-point chosen for this dissertation work was chosen based on the cut-point deemed best in previous validation work and on the latent trait and item difficulty estimates from item response modeling. Further work with these data should examine how sensitive the findings would be to changes in the cut-point choice. Another important step for future work would be to validate the SSQ against a psychiatric evaluation in an adolescent population.

Potential for Improving Mental Health through Livelihoods Interventions

Findings from population intervention models (PIMs) in chapter 4 suggested that changes in social support, having a supportive female caregiver, self efficacy and general health might result in the greatest potential changes in mental health status. A study using similar methods to look at depressive symptoms in adults in Mexico found the strongest relationships with perceived stress, low social support, lack of control and low social status[123]. Taken together these two studies suggest that the greatest mental health benefits could come from improving the supportiveness of psychosocial environment and the sense of control or self efficacy the individual feels. Both of these domains could be impacted by economic livelihoods interventions. Livelihoods interventions often have empowerment and group social supports built into their design.

Results from the population intervention models presented in chapter 4 highlighted the potential intervention impact of self efficacy and general health on mental health. Temporality and the direction of the associations between these factors were not clear in the cross sectional data used for those analyses. Findings in chapter 6 showed that the intervention was associated with positive changes in mental health status. Further analyses could examine how much of the change in mental health was mediated through changes in either the social or economic factors in the theoretical framework. Although beyond the scope of this dissertation, applying the analytic methods presented in chapter 5 to the longitudinal analysis relationships between self efficacy, general health and mental health would be an important step in understanding the associations between these factors over time.

The Effect of Intervention Participation on Mental Health

The main objective of the dissertation was to use the SHAZ! study as case study for exploring the role of mental health in economic livelihoods interventions. Analyses presented in chapter 6 found evidence that the livelihoods intervention in the SHAZ! study had a positive influence on mental health status. Very few economic livelihoods interventions collect enough information on mental health to assess this outcome. Hopefully future studies will begin to collect more information on mental health and the results found here can be replicated in other livelihoods studies.

Completing the Red Cross training was associated with a larger average treatment effect for mental health distress than was vocational training. If similar findings are replicated in other interventions there are important implications for intervention planning. It may be that there is a threshold effect for mental health between having no vocational training and having some training that is more important than the difference between having as short training and a longer more involved training. If similar benefits can be achieved with a 6 week short course and a 6 month long course then programs could offer a shorter course to many more participants and have a larger impact overall than if the benefits of intervention are restricted to longer and more costly vocational trainings.

Although intended as an extension of life-skills training, the Red Cross home based healthcare component may have served the same function as the vocational training component. Those who completed the Red Cross course successfully were able to obtain employment in home based healthcare. Anecdotal data suggest that another consequence of the Red Cross training was a shift in the way participants were perceived by members of their households and communities, and in how they perceived themselves. Acquiring skills seen as useful and important to the community may have alleviated some of the social stigma associated with being an orphan with few economic or social prospects. This is an issue I intend to explore in future work using the qualitative data collected as part of the SHAZ! study.

Further research is needed to understand why the Red Cross component was important and whether these findings could be generalized to other populations and settings. It may be that health care sector training has more impact in a population so heavily affected by the HIV epidemic. Training in home based healthcare may confer more status in this setting than in other populations. Again, the qualitative data could be helpful in understanding why the Red Cross component was effective for improving mental health.

There is an interest in the use of allied health workers who may be younger or with a shorter and more practical training than traditional nurses or physician assistants. In resource strained settings shifting some of the healthcare tasks to these types of workers could help ameliorate the problems caused by a deficit in health care workers. The finding that completing the Red Cross training had mental health benefits for the participants suggests that this solution to the shortage of health care workers may have benefits for both the workers and the community they work in, making this an even more attractive strategy.

The Effect of Mental Health on Intervention Participation

In chapter 7 the analysis results suggested that adding resources to improve mental health could have a positive effect on completion of intervention components. Further, the detailed analysis of mental health status at different time-points suggests that providing these resources at

the start of economic livelihoods interventions may be the most effective strategy to improve overall participation.

Conditional on completing the Red Cross training, mental health status was not significantly associated with intervention participation for any time-point. Those whose mental health status permitted them to complete the Red Cross training component may be the subset of participants who are capable of completing all intervention components. Alternately the benefits to mental health status conferred by the Red Cross component may boost the ability to complete further intervention components.

In these data, poor mental health did not account for the non-completion of training for any of the vocational training components beyond the Red Cross component of the intervention. Future analyses within the SHAZ! data could explore the data for other drivers of intervention success. Only 63.3% of intervention arm participants completed the intervention through the vocational training and only 54.4% received a grant. Understanding the barriers to successful completion of the full intervention would be helpful in informing future programs and interventions in this population.

This study was small and the sample for evaluating relationships with vocational training was restricted to the intervention arm only. Support in the data was sparse for these analyses and thus findings should be interpreted with caution. Future studies should explore the impact of mental health on completion of vocational training with larger datasets.

Strengths and Limitations of the Case Study Data

The SHAZ! study provided a useful case study of the role of mental health in economic livelihoods interventions. The population of participants in this study is one which suffers from lack of economic opportunities and high mental health morbidity. Although the study was quite small and not all parameters of interest were estimable from the data available, the richness of the dataset was an advantage. Another important advantage was the availability of a locally developed mental health measure. Very few interventions collect mental health information, and even fewer use a culturally appropriate tool in measuring mental health.

Given the high completion rate of the life-skills component, there was very little support in the data for examining the effect of non-completion of this component. Investigation of the relationships between mental health status and vocational training components of the intervention were limited to the intervention arm of the study. This reduced my ability to estimate vocational training related parameters. An additional difficulty with examining the vocational training related components of the intervention was the short length of follow up. As discussed in chapter 6, the true impacts of vocational training on mental health status may not have been observable until after the follow up period ended.

Evaluating Complex Interventions

There has been a lack of rigorous documentation and evaluation of the health outcomes in economic livelihoods interventions[26]. Many interventions collect only process data or numbers of participants trained. Economic livelihoods interventions tend to be multi-faceted, incorporating social support, or multiple training components is common. To provide the most effective interventions with limited resources, evaluation analyses must be able to demonstrate health outcomes and link positive outcomes to the components most important for those outcomes.

The approach to analysis used for this dissertation was rooted in the causal inference based methods. Graphical techniques and the link to systems of equations as presented by Pearl[124] were used to determine the covariates considered for each analysis. For interventions, the parameter of interest is most often the effect of some intervention or intervention component on the overall population. Traditional analysis approaches often define the parameter of interest by default as a regression coefficient. The traditional approach also provides only a conditional estimate rather than the population effect. In contrast, the average treatment effect provides this population marginal effect estimate.

Using a causal inference based marginal approach to analysis in combination with targeted maximum likelihood estimation(TMLE) and adaptive data fitting techniques had several benefits in answering the research questions in this dissertation. This approach allowed exploration of time dependent variables in a way that would not be possible with traditional regression approaches. The TMLE and machine learning estimation techniques allowed fitting of the parameters most relevant to answering the questions with a reduction in bias targeted to these parameters. Using machine learning also separated the identification of the parameter of interest from the model fitting approach. This approach is particularly useful when there are high dimensional nuisance parameters as in this data analysis.

For both chapters 6 and 7 statistically significant relationships were found for average treatment effects that were not picked up in the traditional regression models. The analysis strategies used in this dissertation allow a more nuanced understanding of the quantitative data collected and greater clarity in describing the parameter of interest. In economic livelihoods interventions complex approaches with multiple components are often used. The causal inference based approach used here allows individual components and exposures to be examined in these interventions. The ability to look at the contribution of components separately is important for informing future program and intervention designs. Applying this approach improves the ability to evaluate economic livelihoods interventions.

Conclusions

Mental health is an important component of overall wellbeing. Incorporating the evaluation of mental health into economic livelihoods interventions contributes to our understanding of intervention effectiveness. In this case study, as hypothesized, poor mental health had a negative impact on intervention participation and conversely, intervention participation had a positive impact on mental health status.

Incorporating mental health support, particularly at baseline may have important benefits for the increasing the impact of economic livelihoods interventions in disadvantaged populations. As always further research is needed to confirm these findings, but the results of the case study presented in this dissertation are an exciting first step in understanding these relationships and improving future work in this field.

Applying novel methods to intervention evaluations allows a more nuanced understanding of multi-component interventions. To the best of my knowledge, this dissertation provides the first application of these approaches to the evaluation of an economic livelihoods intervention. These methods require careful specification of the parameter of interest and use targeted estimation to minimize bias in the estimation of the parameter of interest. For many interventions the parameter of interest is the population level effect of the intervention and not the conditional regression coefficients derived from traditional modeling approaches.

To evaluate health outcomes, intervention evaluations should, at a minimum; collect data on individual exposures and outcomes using reliable and valid instruments, clearly define the parameter of interest, calculate population marginal parameters rather than conditional parameters, and present evidence that the data collected provides sufficient support for the analyses conducted and conclusions drawn. Using rigorous evaluation methods for future evaluations can help determine which interventions, and which components of those interventions are most important for the populations where the interventions are implemented.

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Appendix A. R Software packages used

D/S/A build 3.1.4 Authored by Mark van der Laan's research group at UC Berkeley. Maintained by Romain S. Neugebauer
The DSA performs data adaptive estimation through estimator selection based on cross-validation and the L2 loss function. Candidate estimators are defined with polynomial generalized linear models generated with the algorithm under user specified constraints.

multiPIM build0.4-3 Authors Stephan Ritter, Alan Hubbard and Nicholas Jewell
MultiPIM uses the double-robust extension of inverse probability of censoring weighted estimators to estimate the causal attributable risk or population intervention parameter. The causal attributable risk is a measure of the difference between the mean value of Y for the units in the unexposed group and the overall or crude mean of Y. This package allows the estimation of attributable risk parameters for multiple exposures in one function.

tmleLite build 1.0-2 Authored by Mark van der Laan's research group at UC Berkeley. Maintained by Susan Gruber
"tmleLite" implements a simplified TMLE approach to estimating the additive treatment effect using the DSA algorithm for data-adaptive estimation of the Q and g portions of the likelihood.