

Potentially traumatic event experiences and health care service use in Liberia

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## ABSTRACT

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Several studies in high-income countries (HIC) have shown that the experience of potentially traumatic events (PTE) is associated with increased health care service use. Information on patterns of health care use and expectations by this group of individuals can be useful for providing patient-centric care and improving health system accountability and responsiveness. Despite the necessity of this work, less research has been conducted in low and lower-middle income countries (LIC; LMIC), especially in countries with a recent history of conflict, which is problematic for several reasons. Experience of PTEs, especially assaultive violence and injuries, may be higher in LICs and LMICs compared to HICs, which may lead to poor physical and mental health and increased demand for health care services. The formal health care system in LICs and LMICs, especially in those countries emerging from conflict, however, may be in a process of renewal and improvement. Many necessary health services may remain unavailable for several years during this process, accountability is often lacking, and the health system may not have the capacity to respond to health care needs. Likely stemming from this lack of formal care, many LICs and LMICs have substantial informal care markets, and most individuals view both systems as complementary, despite the complete lack of regulation and training of informal care providers compared to formal care providers. In order for the formal care system to improve accountability and responsiveness, studies that assess the relation between PTE experience and use of both informal and formal care as well as patient preferences for formal care are critical. Such studies would shed light on where individuals with PTE experience are seeking care and what they expect from formal care.

I conducted three investigations in order to better understand the association between experience of PTEs and health care service use in LICs and LMICs. In chapter one, I designed a systematic review of studies published on the topic using data from LICs and LMICs. I found only two studies that met eligibility criteria and suggested several considerations that future studies make, including the use of validated scales to measure PTE experience and the importance of including informal care use in this research. In chapter two, using cross-sectional, population-based data on adults from Nimba County, Liberia, I assessed the relation between lifetime PTE experience and formal and informal care service

use. Lifetime PTE experience increased both formal and informal care use and most persons who experienced PTEs likely complemented their formal use with informal use. One exception to this latter finding was a small group of individuals who used no informal care, among whom a higher number of PTEs was associated with using formal care. In chapter three, using data from a discrete choice experiment carried out on the same sample of adults from Nimba county, I found that those with increased experience of PTEs had a higher preference for a facility that offered a high quality exam, had a lower preference for respectful treatment, and a higher preference for seeing a traditional healer instead of using the facility to obtain care when sick.

Most individuals with increased experience of PTEs used both the informal and formal care system to meet their health care needs. Their reliance on the informal care system may be partially explained by symptoms of psychopathology, poor physical health, easier access to medications, and dissatisfaction with the formal care system. Higher preferences for a high quality medical exam and the traditional healer compared to formal clinics among those with high PTE experience suggest that the expectations of those arguably most in need of health care may not currently be met by the formal care system. Considering that informal care providers are untrained and unregulated, they are unlikely to provide adequate health care that can decrease disease burden in the population. It is likely that use of informal care reflects inadequate formal care; the formal care system must become more responsive to the needs of those with PTEs.

There are several factors related to the PTE experience - health care use relation that merit further attention as well as several improvements that the formal care system should consider. One factor is whether mental health is a central reason why those with PTEs seek informal care. Currently, formal care providers in Liberia are unable to adequately treat mental health problems, which may be one reason why individuals rely on informal care providers. Whether this is a determinant of informal care use should be assessed by future studies as, if this is the case, then any referral program in which informal providers refer patients to formal care may not prove successful. Training formal care providers in treating mental health problems should be implemented, but another aspect that merits further research is whether informal care providers like traditional healers can be trained to screen for mental health

problems or provide limited counseling services for individuals prior to giving referrals to alleviate some of the burden on formal care.

Another aspect of future research should compare the access, perceptions, and expectations of both care systems of those who use only formal care to those who use both. Identifying whether these individuals have better access to formal care, whether they view formal care differently, or whether they have less access to informal care may improve formal care system responsiveness. Lastly the government of Liberia should continue improving access to the nearest facility, training providers to perform better exams, and improving the quality of clinics, including increasing the availability of medications and decreasing wait times, as these changes will likely increase use of formal care services by those with PTEs as well as the larger population.

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## DEDICATION

*There, but for the grace of god, go I*

Adapted, allegedly, from John Bradford, 16<sup>th</sup> century

This dissertation is dedicated to all women who desire education but encounter obstacles in pursuing it because of dangers and restrictions. I have been incredibly blessed to never feel the fear of death as a consequence of going to school. If I had been born or lived under different circumstances, this dissertation may not have happened. It is my hope that the future will only see improvements in safe access to education for all women who choose to attain it.

## DISSERTATION OBJECTIVES

AIM 1: To systematically review the association between potentially traumatic events (PTEs) and health care service use in low and lower-middle income countries.

AIM 2: To assess the relation between lifetime PTEs and formal and informal care service using data from a population-based study of adults in Nimba County, Liberia.

AIM 3: Using data from a population-based study of adults in Nimba County, Liberia, I assessed whether preferences for facility care differed based on PTE experience.

CHAPTER 1: A REVIEW OF THE ASSOCIATION BETWEEN POTENTIALLY TRAUMATIC EVENTS  
AND HEALTH SERVICE USE IN LOW AND LOWER-MIDDLE INCOME COUNTRIES



## Introduction

Potentially traumatic events (PTEs) are common across the lifecourse for most individuals. For some, experience of these events may lead to a greater risk for several physical and mental health problems, including gastrointestinal conditions, immunologic disorders, posttraumatic stress disorder (PTSD), and depressive disorders, among others. These poor health outcomes, along with a direct need for care that some events, like motor vehicle accidents, may confer, lead to increased use of health care services. Considering the service use patterns and expectations of those who are more likely to use services may be important for providing more patient-centric care, as well as improving the accountability and responsiveness of the health care system. This is particularly critical in low and lower-middle income countries (LIC; LMIC), especially those with a history of conflict or instability, where the health system is often lacking in many aspects, but a large proportion of the population has experienced PTEs and has an increased need for services. Post conflict, many of these countries begin rebuilding and improving their healthcare systems; understanding the associations between PTEs and health care use may inform this rebuilding by providing information useful for improving responsiveness of the system.

Since the 1980s, when the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III) recognized PTSD, several studies focused on understanding the epidemiology of PTEs have been conducted. PTEs can refer to any event, such as a mugging, an injury like a motor vehicle accident, or the sudden loss of a close friend or relative, that usually involves a threat to life or physical integrity of the individual or another person and feelings of fear, helplessness, or terror (1). Many of these studies have used a general population sample, rather than a military or veteran population, which gives researchers a clearer picture of the distribution of PTEs in the population. It is now understood that exposure to PTEs over the lifecourse is likely the norm for the majority of individuals, though estimates vary depending on samples. For example, in a population-based study conducted in the U.S., 60.7% of men and 51.2% of women reported at least one lifetime PTE (2). In another population-based study, slightly higher exposure was reported; Goldmann et al. reported that 87.2% of Detroit residents had at least one traumatic event in their lifetime (3). Similarly, Frans et al. found that 80.8% of a Swedish population-based sample reported at least one PTE in their lifetime (4). In a population-based study of South Africans, Williams et al. found that 74.8% of individuals had been exposed to a PTE, the

most prevalent being death of a loved one (38.2%) (5). Lower prevalences of PTE experience have been reported. For example, 24% of a German general population sample reported experience of PTEs (6). Although there is considerable variation, it is clear that, in most populations, experience of PTEs is not rare.

Experience of PTEs has been associated with several physical and mental health outcomes. For example, the link between PTEs and psychopathology, especially PTSD, has been established for several decades. PTSD is a psychopathologic disorder in which experience of a traumatic event is a prerequisite and is characterized by symptoms of re-experiencing, avoidance, and hyperarousal (1). PTE experience has also been linked to other mood anxiety disorders, such as generalized anxiety disorder and major depressive disorder (7-10). In addition to psychopathology, PTEs can also lead to several physical health problems. In a sample of US women veterans, White et al. found an elevated risk of irritable bowel syndrome (IBS) among those who experienced PTEs independent of PTSD and depression (11). A significant direct effect was found between combat exposure and health status in a study of Vietnam War veterans (12). Lastly, Kinyanda et al. reported that experience of a war related sexually violent event was associated with infertility and chronic abdominal pain, likely a direct result of the event, among a sample of health care seeking, internally displaced, Ugandan women (13). Thus, experience of PTEs can lead to several poor health outcomes that include both mental and physical health problems.

While much research has been conducted regarding the role that traumatic events play in shaping psychopathology and physical health, less has been devoted to the relation between PTEs and health care use. Of the studies that have been conducted, several have focused on how specific PTEs are related to use of services. A study by Hulme found that women with a history of childhood sexual abuse were more likely to visit a primary health care clinic compared to women without a history of childhood sexual abuse, despite adjustment for symptom patterns (14). Similarly, a study by Bonomi et al. showed that women with a history of physical and sexual abuse had higher mental, emergency, outpatient, primary care, pharmacy, and specialty service use compared to women without such abuse (15). Several studies have also focused on the relation between any type of PTE experience and subsequent use of health services. Weine et al. reported that lifetime PTE experience was associated

with service use among a sample of Bosnian refugees living in Chicago (16). Similarly, Boscarino et al. reported that having at least one lifetime PTE was associated with an increase in service use one year after the 9/11 attacks in a community sample of New Yorkers (17). Lastly, among callers to the Anxiety Disorders Association of America, the number of lifetime PTEs was associated with increased past six month service use (18).

Elhai et al. carried out a review of the association between PTEs and health care service use in 2005, but this review was not systematic and only one of the included studies was conducted in a low or lower-middle income country (19). Thus, a systematic review of studies assessing the relation between PTE experience and use of services LICs and LMICs has not been conducted. Such information, however, could be potentially useful to policymakers in informing health system responsiveness, especially for those in countries with a recent history of conflict, for several reasons. First, the distribution of PTEs may be different in LICs and LMICs, especially in countries with a recent history of violence or mass disasters. Specifically, populations may experience more injuries and violent events and, thus, their lifetime accumulation of events may be higher and more severe compared to populations in HICs, as may be their need for services (20-22). Second, formal health care available in LICs and LMICs, especially in those with a recent history of conflict, is likely of low-quality. Access to clinics may be problematic, as many areas do not have adequate road infrastructure or transportation options; thus, individuals often have to walk several hours to reach a clinic (23-27). These clinics are also likely to be resource poor, often lacking necessary personnel, medications and supplies, and services (23, 28-30). Third, in order to cope with lack of formal care services, health care in such settings is available from multiple sources. Besides care available from clinics and hospitals, individuals may seek care from traditional and spiritual healers, as well as pharmacists and drug peddlers, especially if the formal care system cannot provide adequate care (31-35). Informal care usually serves as a complement to formal care services, but may be less able to address the disease burden of the population than adequate formal care because informal care providers are untrained and unregulated (32, 33, 35, 36). In order to inform formal health care system responsiveness in LICs and LMICs, so that care adequate enough to address the health care needs of those who experience PTEs becomes available, policymakers and providers need to first

understand the association between PTE experience and formal and informal care. Thus, a systematic review of such studies conducted in LICs and LMICs is warranted.

In order to provide a critical summary of the literature and suggest future directions for research, I designed a systematic review of the association between PTE experience and use of health services in LICs and LMICs.

## **Methods**

### *Data sources*

I used the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines to ensure that review was adequately conducted and reported (37). I used MEDLINE to identify potential medical subject heading (MeSH) terms. These MeSH terms were used to search for studies in the PubMed database. I used similar search terms to identify articles in PsycINFO and ISI Web of Science. As these were unable to handle MeSH terms, I used the MeSH terms as regular search terms in addition to other search terms. All MeSH and search terms used for this review are shown in Table 1. Each health services term was used together with a PTE term. For example, the MeSH term “Medicine traditional” was used with each MeSH term “Life change event”, “Wounds and injuries”, and “Stress disorder, post-traumatic”. For regular search terms, a similar approach was used with each of the health services terms and “trauma” as well as “life change event”, “Wounds”, “Injuries”, and “Stress disorder”. Once I selected eligible studies, I screened those studies’ citations to identify any further studies.

### *Eligibility criteria*

Several criteria were used to determine inclusion eligibility. I only included studies that were conducted between 1980 and the present in LICs or LMICs, as defined by the World Bank in the year when the study data was sampled. When country income classification was unclear, World Development Reports, published yearly by the World Bank, were consulted. The year 1980 was used as a cut point because there was no informed consensus of what constituted a PTE before the DSM III was published. Additionally, only studies that included a formal scale to measure PTE experience, and used that measure in analyses with the health services outcome were considered. I considered any health service use as an acceptable outcome measure. Studies that were conducted using a pediatric sample were

excluded. Studies that were only descriptive in nature, and did not use a comparison group were also excluded. Lastly, I did not include language restrictions.

#### *Data extraction*

I extracted several pieces of information from each study including the author(s), the year of publication, the year the sample was obtained, sample characteristics including sample size and sample type, the scale used to measure PTEs, the health service outcome(s), whether informal care was considered, and the main findings.

#### **Results**

Results from these searches are shown in Figure 1. I identified 8,833 unique titles from all three databases and removed 8,719 studies based on screening of titles. For the remaining 114, I screened abstracts and further removed 84 records. Based on those results, 30 full text papers were screened for eligibility and 28 papers that did not meet eligibility criteria were eliminated. Most papers did not meet eligibility criteria because they did not use a formal scale to measure PTE experience or were conducted in an upper-middle or high-income country. The two studies that met selection criteria are shown in Table 2. Of the 30 full text articles I assessed, two would have met full eligibility criteria if the authors had used a formal scale to measure PTEs. An additional third study would have met eligibility criteria if the authors used a formal scale and a comparison group. These studies are also summarized in Table 2.

As I was unable to identify enough studies for a complete systematic review, I present, instead, a discussion of the two articles that met eligibility criteria and the three that did not, as well as several suggestions that future work on the association between PTEs and health care use should incorporate.

#### **Discussion**

##### *Summary of study findings and discussions of potential bias*

The first study, by Eytan et al., sought to understand the role that PTEs and PTSD had in the use of health care after the conflict that occurred in Kosovo during 1998 and 1999 (38). Eytan et al. used the Harvard Trauma Questionnaire (HTQ) to measure lifetime PTE experience and past month medical care and hospitalizations to measure health service use. These past month values were then interpreted as past year use. Eytan et al. reported a significant association from bivariable models between lifetime PTE experience and any health care in the past year, any doctor visits in the past month, and any

hospitalization in the past month. Potential bias may have affected the results through confounding and differential misclassification. Eytan et al. did not present associations between PTE experience and use of services adjusted for any potential confounding, such as age and income status, which may be associated with both PTE experience and health service use. Thus, it is possible that these findings may be explained by other variables and the true association between PTE experience and use of services is likely closer to the null than the unadjusted. Differential misclassification may have also occurred; those with more PTEs are more likely to have symptoms of poor mental health compared to those with fewer events, and may have symptoms related to cognitive function (39-42). If these individuals reported more health service visits than actually occurred, the differences in health service use between PTE experience groups would be larger, leading to a stronger association, compared to the true association. Conversely, if these individuals reported fewer health service visits than actually occurred, the differences in health service use between PTE experience groups would be smaller, leading to a weaker association, compared to the truth. While differential misclassification is problematic because we cannot predict the direction the bias will take, it is not an unusual limitation in observational studies that rely on self-report data and do not have an independent source to verify the validity of self-report data. Further, the authors listed this potential bias as limitation of this study, recognizing that it may have affected their results. However, though the potential for this bias exists, the effect of it on estimates of interest may be negligible (43).

The second study, by Kruk et al., assessed the relation between several factors, including lifetime PTE experience, and past year formal and informal care service use in a population-based study of adults from Nimba County, Liberia (33). Nimba County experienced heavy fighting during the First Liberian Civil War, which began in 1989 and ended in 1996, and subsequently, lifetime PTE experience in this sample was elevated, with a majority reporting more than 12 events (44). Similar to Eytan et al., Kruk et al. used the HTQ to measure lifetime PTE experience, which was operationalized using a continuous measure of the sum of events. Past year service use was assessed by measuring the number of visits to formal services (clinics and hospitals) and informal services (traditional healers, spiritual healers, black baggers, who are drug peddlers, pharmacists, and traditional midwives). Kruk et al. reported similar significant incidence rate ratios between experience of PTEs and use of formal and informal services, from

multivariable models that were adjusted for socio demographics, village level, and service level characteristics. As the main results presented by Kruk et al. were adjusted for several potential confounders, unlike the results presented in Eytan et al., there is less concern that they may be biased due to confounding, though residual and unmeasured confounding is always a concern in observational studies. The results presented by Kruk et al. are also subject to the same differential misclassification that may have occurred in Eytan et al., for the same reasons.

Three studies did not meet full inclusion criteria, but are discussed here as examples of other approaches to studying the association between PTEs and health care use. A study by Morina et al. compared the past 3-month number of primary, specialist, and hospital visits of women who had lost a spouse during the conflict in Kosovo to women who had lost a relative but not a spouse, and women who did not suffer any loss (45). This study was not included in this systematic review because it did not use a formal scale to assess PTE experience. No significant difference in health care use was found between the three groups, though women who lost a spouse during the war reported a higher amount of health care use in nearly every category. Among women who lost a spouse, a positive, significant association was noted between experience of war related events, measured by the HTQ, and primary health care visits, suggesting that while loss of a spouse due to war was not associated with health care use, the experience of other war related events was, at least among women reporting loss of a spouse. The second study, by Farhood et al., compared hospital visits, doctor visits, and lab tests in the past year among those who experienced a church bombing in Lebanon to those who did not (46). While the authors used the Life Events Scale to gather information on PTE experience, the full scale was not used to measure the relation between PTE experience and health service use. The authors found that those who had experienced the church bombing reported a higher number of doctor visits compared to those who had not suffered the impact of this event. Lastly, Casey et al. focused on health service use after sexual violence in a sample of women from the Democratic Republic of the Congo (47). This study did not meet inclusion criteria because it focused only on one event and also did not compare health service use among those who reported sexual violence and those who did not. However, I mention this study because I use it as an illustration in discussing the necessity of a comparison group for this kind of work in the sections that follow.

### *Considerations for future work*

There are three main objectives regarding the association between PTEs and health care use that future work conducted in LICs and LMICs should focus on. The first is to further the understanding regarding the general association between PTEs and health care use. The second is to understand the relation between PTEs, informal care, and formal care use in LICs and LMICs that have both formal and informal health care available. Lastly, future work should focus on whether PTEs are related to preferences for formal health care. Each of these objectives has a specific contribution to our understanding of the overall relation between PTEs and health care use.

### *Informing our understanding of the PTE-health care use association*

If one explicit goal of future research in this area is to further our general understanding of the association between PTEs and health care use, then we should consider the use of scales to measure PTE experience. Scales provide two central advantages over other approaches such as use of single events. First, several events can increase use of services; thus, limiting our analysis to just one event may not be the best approach to understanding the overall association between PTE experience and health care use. This approach also allows us to measure a variety of PTE experiences, which we can distill into event types such as assaultive violence, other injuries or shocking events, learning about PTEs experienced by others, and sudden, unexpected deaths of close friends or relatives, furthering our knowledge regarding the association between PTEs and health care use (48). For example, if we want to understand whether the use patterns of those who experience assaultive violence differ compared to those who experience another injury or a sudden, unexpected death of a close friend or relative, information that may be useful for public health planning after a conflict or major disaster, then measuring several events is warranted. Similarly, by measuring several events, we can study event accumulation; the accumulation of several events is known to confer a greater risk of several physical and mental illness, and thus, is likely to increase use of health services (17, 49). Health service outcomes of those with more events could be compared to those with fewer; if multiple categories of experience are considered, a dose-response statistic could be calculated. Lastly, the use of scales also allows the investigation of how single events are related to health care use, if that is of interest. In this case,



because information is collected on other events, models can also be adjusted for other events in order to isolate the effect of one particular event or event type.

A second reason to use scales is specific to LICs and LMICs that have undergone recent conflict or have a history of instability due to disasters. In a post-conflict sample, exposure to PTEs is heightened, and individuals not only experience several events, but several different event types. For example, studies have shown that the average number of events experienced in areas of recent conflict is 12 or higher, and these events often include several event types like torture, physical and sexual assault, as well as kidnapping and death of close friends and relatives, all events that may be associated with poor physical and mental health, and increased use of services (44, 45, 50). In understanding whether experience of events leads to increased use of services, especially in countries that are in the process of rebuilding formal care services, an understanding of the full experience of PTEs, how those PTEs are related to use, and whether aspects of care need to be changed in order to better respond to health care needs of individuals with multiple events is useful for public health planning. Focusing on one event may not accurately portray the use of services, especially when multiple events increase service use and individuals are placed in contexts where the experience of multiple events is likely.

Measuring PTEs using scales has several advantages when the goal is to understand the general association between experience and service use, but there are two main considerations that merit attention. First, cultural adaptation of scales is often necessary to obtain valid and reliable measures of PTE experience. Scales such as the HTQ can and should be adapted in cases where an important event specific to the sample is excluded from the original version of the scale or in cases where events are considered culturally inappropriate in the sample under study. For example, Hadley et al. removed three events from the HTQ, abduction for the purpose marriage, rape, and other sexual assault, when interviewing men in their study because asking men if they experienced these events was considered culturally inappropriate (10). Thus, researchers should consider the relevance of each item to the particular group under study. In addition, we should make an effort to ensure that the scale accurately captures the experience of PTEs similarly in each population; that is, that the new version of the scale is equivalent to the original document. We should ensure that all scales we use to measure PTEs are equivalent in several domains. Scales should be content equivalent, meaning that experience of PTEs is

relevant in the sample as well as semantically equivalent, so that the meaning of each PTE question is identical in every sample. Technical equivalence, which ensures that the data collection techniques used to gather data in the new sample measure the same information as in the original sample, is also vital. Criterion equivalence, though not an important concern for PTE experiences, which are measured as yes/no questions and do not include a diagnostic cut off, ensures that the PTE scale agrees with another, independent measure. Lastly, PTE scales should be conceptually equivalent, in that they are able to measure PTE experience in all samples (51). Guidelines exist to facilitate cultural adaptation of scales. The WHO suggests use of bilingual experts, who can assess the scale, translate it, and review a back translated version that has been additionally reviewed by monolingual individuals (52). Prior information about the target population is critical in establishing semantic, content, and technical equivalence. Key informants and other experts such as anthropologists may be useful in this capacity.

Second, while the use of scales presents opportunities to assess whether types of events are related to health care use, there is likely to be much overlap in event experience within individuals, especially in post conflict settings. Overlap in experience of event types makes it difficult to draw inferences regarding how one type of event is related use of services compared to another type because a true comparison group is lacking. Individuals who experience assaultive violence, for example, also experience other injuries, as well as other event types, which presents a difficulty in isolating associations. The use of mutually exclusive groups may be one method of establishing comparison groups, but this often leads to prohibitively small sample sizes and may not be possible if overlap is high. Other methods, such as adjusting for other event types in regression models, are possible, but problems of collinearity may, again, limit inference. Researchers who find this to be a problem may consider other methods, such as numerical categories of exposure based on event accumulation. While this does not allow for event testing, mutually exclusive comparison groups can be achieved without a decrease in sample size.

Studies that focus on single events, such as those done by Morina et al., Casey et al., and Farhood et al. can still inform our understanding of how PTEs relate to health care, especially if they are fulfilling a gap in the literature or trying to ascertain problems of health care access (45-47). They are less informative in helping us understand the general association between PEs and health services use,

especially where accumulation and event types are concerned, but they can provide us with invaluable information, if done well. First, studies focused on a single event should not limit their associations to bivariable statistics or descriptives, such as done in Morina et al. or Casey et al., because it is difficult to draw valid inference on associations that may be biased by confounding (45, 47). Often, small sample sizes make it difficult to adjust for other variables. This should not preclude analysis, but power calculations should be done to understand what type of analysis would be possible, and if multivariable analysis is possible, it should be pursued.

Second, having comparison groups is essential in understanding whether certain events are associated with health service use. Even when access to services is of interest, comparing estimates to an unexposed or less exposed group can provide valuable insight. For example, in their study of victims of sexual violence, Casey et al. measured the use of services after sexual violence, but only among those who reported sexual violence (47). This makes it difficult to draw inference regarding access. Is use of services also low among women who experience other types of violence or other injuries? Further, is use of services for illness or labor and delivery also low? If so, this presents evidence of a larger health care access problem that requires a different policy approach than would be undertaken if use of services were only low among women who experienced sexual violence. Thus, even studies that are focused on the PTE - access relation should consider incorporating a control or unexposed group in order to compare use of services, especially when access to services is known to be a problem, such as in post-conflict LICs.

#### *Considering informal care providers*

A second objective of future studies conducted in LICs and LMICs that have both formal and extensive informal health care service markets should be to measure the association between PTE experience and use of both types of services. It is likely that in most such places, the general population usually considers informal health services, which can include care by traditional and spiritual healers, drug peddlers, pharmacists, and traditional midwives, as a complement to formal services. This is likely true in countries recovering from recent conflict, especially if that conflict has substantially damaged formal health care infrastructure and resources. In these countries, informal care systems are particularly extensive because they likely met health care needs during conflict, and continue to meet needs post-

conflict, during rebuilding of the formal care system. Use of informal care services is prevalent in several areas. Approximately 80% of individuals in Sub Saharan Africa rely on informal care services (32). Increased use has also been noted in the Philippines, where there is one informal care provider for every 300 residents and in Haiti, where nearly 50% of women reported the use of traditional healers often or sometimes (53, 54). Informal care providers are used for a variety of services including bone setting, pediatric care, antenatal care, labor and delivery, treatment for sexually transmitted diseases, and obtaining medications (54-58). Additionally, traditional healers may also serve as a proxy for formal mental health services, especially in areas where access is limited or nonexistent (31, 35, 36). Thus, informal care constitutes a component of care for individuals in many LICs and LMICs, and future studies conducted on the association between PTEs and health care use should incorporate this type of care as a study outcome, if applicable.

Despite widespread use in many countries, informal care has several potential limitations. Informal care providers are generally not formally trained in medical knowledge or practice; therefore, their expertise and ability to provide medical care, especially for invasive procedures, may be questionable. Further compounding this problem is the lack of regulation of informal care providers by any national or local government agency in most LICs and LMICs; thus, there is no way to prevent issues such as the use of counterfeit drugs or remedies that may have little or no medical value (59). Therefore, medication available from drug peddlers or pharmacists may not treat health care problems well. Lastly, the cost of care from informal providers may be more than that of care from formal providers, especially when the latter is offered free or at substantially reduced cost by the government (33, 55, 60, 61). Therefore, informal care in most LICs and LMICs probably cannot adequately decrease the disease burden in the population. Future studies on the association between PTE experience and informal care may help inform formal care systems, specifically on how they may improve health services, so that more individuals choose to use formal health care. Thus, it is important that future studies consider several aspects of the association between PTEs and informal care.

There are two factors regarding the intersection of PTEs and informal care that future studies could focus on in order to address gaps in the literature and help inform formal health policy. First, future studies should assess the reasons for informal care use among individuals with PTEs. Previous work

suggests that experience of PTEs is associated with both formal and informal care, suggesting that formal care may not be sufficient in meeting health care needs (33). However, the factors that drive this dual use remain unclear. Such information could potentially inform planning, especially referral programs, which many LICs are trying to implement in order to increase use of formal care (33, 53). For example, if individuals with PTEs primarily seek care from informal providers to treat symptoms of mental illness, then any referral program that sends individuals to formal clinics would only be successful if formal care clinics provide mental health care and are easily accessible. Otherwise, individuals with PTEs will continue to use the services of informal care providers, care which is unlikely to completely meet their needs, but is at least available. Further, if individuals with PTEs, especially those with severe physical ailments and psychopathology, rely partially on informal care because the logistics of obtaining care at a formal care clinic are too daunting, then referral programs to formal clinics will also be unsuccessful, unless access and quality are improved. Thus, future studies that focus on understanding the reasons for using informal care among those with PTEs may prove informative for policymakers.

A second factor of informal care that future studies should consider is whether PTE experience is related to the type of informal care provider seen. Informal care providers encompass several types, including traditional and spiritual healers, known to treat various physical ailments as well as mental disorders, drug peddlers, who sell medications, pharmacists, and traditional midwives. Each of these providers plays a particular role in dispensing care. It may be that the majority of individuals experiencing PTEs, especially events highly associated with PTSD or depression, such as torture or combat, choose the services of a traditional or spiritual healer over a drug peddler or pharmacist so that they may obtain care for mental illness symptoms (31). Conversely, most people with PTEs may opt for the services of a drug peddler or pharmacist to obtain medication to treat symptoms of poor physical and mental health. Understanding what provider type individuals with PTEs are more likely to use may not only reveal determinants of informal care seeking but also help policymakers better identify the venues that will reach the most individuals if referral programs are implemented, assuming that the formal care system has been improved to meet those needs.

*Preferences for health care*

The third objective of future studies should be to investigate the link between PTE experience and preferences for care. Although the outcome of health preferences was not in the scope of this review, it is a part of the health care experience of individuals, and undoubtedly shapes their use of services.

Considering the strong association between PTE experience and health care use, an understanding of whether PTE experience is associated with preferences with care could provide policymakers with invaluable information on improving formal health system responsiveness. If the overall goal is to improve adequacy of formal care, obtaining information regarding preferences for formal care services could inform this goal.

A few studies have explored the association between PTEs and health preferences, but these have mostly been conducted in HICs and have focused on single events. A study by Rob-Byrne et al. of patients seen in a Seattle hospital for assault found that perceived threat to life during the event and experience of a sexual assault were associated with a higher preference for counseling care over medical care (62). Other studies done in HICs have focused mainly on the association between mental health and preferences. A study by Arora et al. found that persons with depression had a higher preference for shared decision making with a health care provider compared to those without depression (63). Differences have also been found on the types of services preferred. For example, a study by Walters et al. reported that those with mild or moderate mental distress had higher preferences for care from informal sources as well as from a general practitioner rather than mental health oriented therapies compared to those with severe depression (64).

A few studies have shown significant associations between PTEs and preferences in LICs, but these have also focused on single events. One study conducted on the association between PTEs and preferences for care among South African women found that those who experienced sexual assault preferred a more sensitive provider and HIV prophylaxis availability at clinics more compared to women who did not experience sexual assault (65). Studies focused on the association between mental health and preferences have also been conducted in LICs. One study using a cohort of Ethiopian women reported that depressive symptoms and PTSD were associated with lower preferences for indicators of quality care, including having a provider with a positive attitude and consistent drug/equipment availability (66). Considering the lack of studies in this area and the potential for this work to inform health policy,

future work should compare the preferences of those who have experienced PTEs to those who have not. Understanding whether preferences for care differ based on PTE experience can be helpful in implementing a responsive health care system, which is what many post-conflict LICs are striving to achieve.

#### *The application of longitudinal studies*

While I found no longitudinal studies in this review of the literature, there are several benefits to conducting longitudinal studies on the association between PTEs and health care use. Conducting longitudinal studies in LICs and LMICs would shed further light on the pathways through which PTEs lead to health care service use, summarized in Appendix A, but it would also provide information on trajectories of PTE experience, psychopathology, and health service use over time. Considering the different contexts found in LICs and LMICs compared to HICs, and the need for a responsive health care system, especially in post conflict areas, this latter information could be useful in long-term public health and policy planning. Relying on information from studies solely conducted in HICs may not be as informative toward this end.

#### *A brief note on mechanisms and appropriate use of care*

This present body of work is primarily focused on informing future work that seeks to understand the association between PTE experience, the source of health care use, and the preferences that may shape the source choice; a detailed discussion of the mechanisms linking PTE experience to health care use, and whether these links reflect appropriate use of care, is beyond the scope of this work. A description of potential mechanisms through which PTEs may increase service use is presented in Appendix A. Briefly, there are four major hypothesized pathways, including a direct link, when an event takes place that requires immediate care, and three indirect links through PTSD and other psychopathology, through chronic stress, and through poor behavioral coping skills (12). Ultimately, understanding these mechanisms is important for informing our general knowledge of the PTE-health care use link, but it is a research goal that is separate from the one discussed here.

#### *Limitations of this review*

This review had several limitations. First, it is possible that I did not identify every study published on the association between PTEs and health care service use in LICs and LMICs. However, I used three

major databases and a variety of search terms so the probability of not including eligible articles was small. Second, many of the abstracts that I identified and screened for eligibility did not include “trauma”, “life change event”, or “stress disorder” as key words or MeSH terms, which may have affected study yield. However, wherever possible, I searched for those terms in all fields, including the text, and it is likely that this index limitation minimally affected these findings. Lastly, I may have missed articles that were never published in peer-reviewed journals. I did not identify enough studies to quantify the extent to which publication bias may have affected these results. However, considering the relative gap in studies conducted on this topic using samples from LICs and LMICs compared to studies using HICs, it is likely that low study yield is due to a lack of studies, rather than publication bias.

### *Conclusion*

These limitations notwithstanding, this is the first effort that I am aware of that has attempted a systematic review of the association between PTEs and use of health services in LICs and LMICs. My findings indicate a lack of studies of this association using samples from LICs and LMICs. If the goal is to further our understanding of the general association between PTEs and health service use in LICs and LMICs, future work should focus on generating studies that use formal scales to measure PTE experience, take into account informal care where applicable, and assess what factors are associated with choosing informal over formal care. Lastly, future studies should also focus on measuring the association between PTE experience and preferences for formal care, to further inform health care system responsiveness.

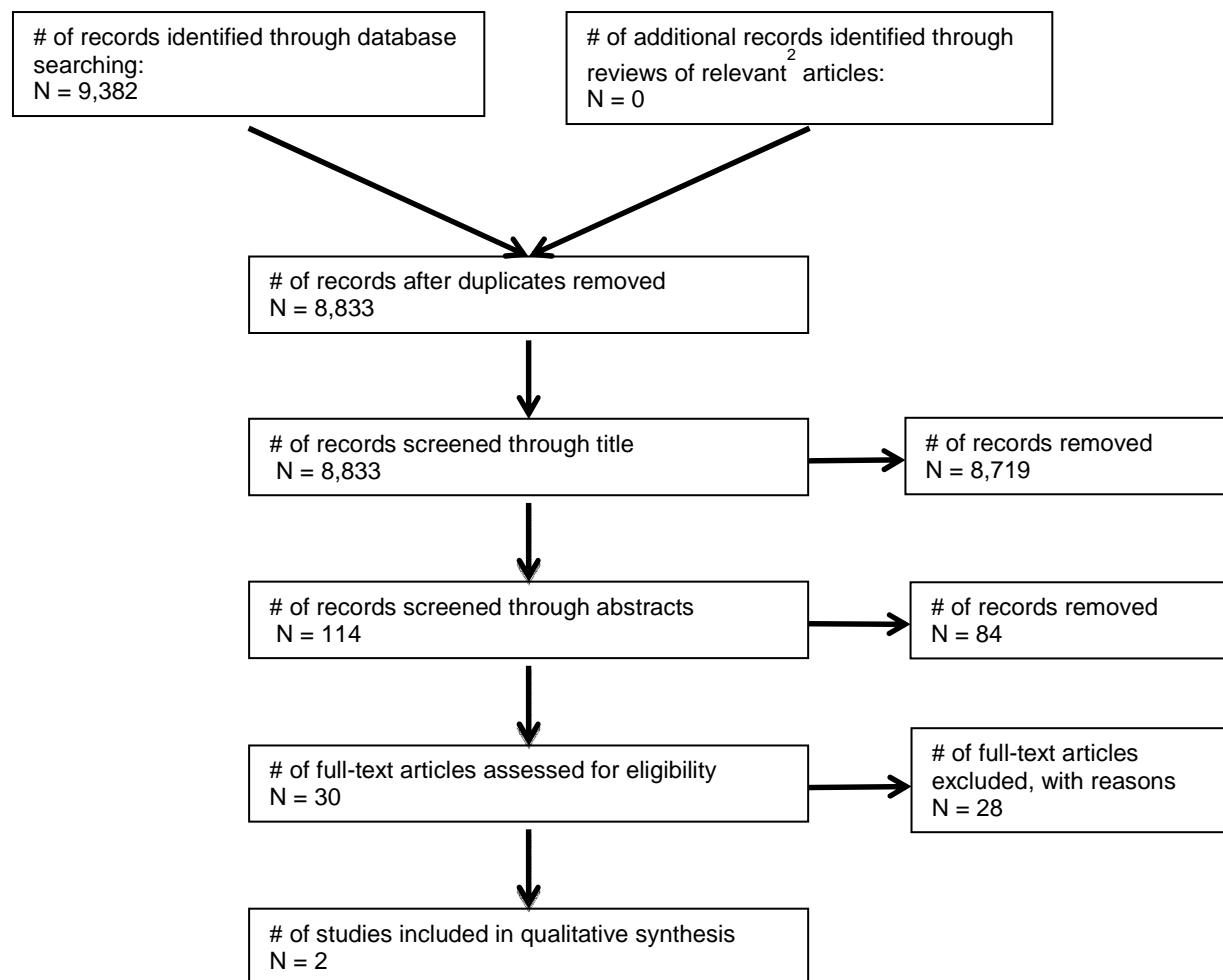
In the following chapters, Chapters 2 and 3, I present an investigation on the association between PTEs, formal and informal health service use, and preferences for formal care using population-based data on adults from Nimba County, Liberia. My work will reflect many, but not all, of the suggestions for future work listed above in order to address the gaps in the literature.



Table 1: Medical subject headings (MeSH) and search terms used in a review of studies on the association between potentially traumatic events and health care use using samples from low and lower-middle income countries

Terms
<u>MeSH search terms</u>
Community health services/utilization
Health services accessibility
Rural health services/utilization
Medicine traditional
Life change event
Wounds and injuries
Stress disorder, post traumatic
<u>Search terms</u>
Health care utilization
Health care services
Health services
Traditional healer
Traditional health
Informal health care
Traditional medicine
Community health services
Rural health services
Trauma
Life change event
Wounds
Injuries
Stress disorder

Figure 1: Selection procedure for articles for a systematic review of the association between potentially traumatic events and health care use in low and lower-middle income countries<sup>1</sup>



<sup>1</sup> Adapted from Liberati et al. "The PRISMA Statement for Reporting Systematic Reviews and Meta-Analyses of Studies that Evaluate Health Care Interventions: Explanation and Elaboration." *Ann Int Med.* 2009; 151: W65-W94

<sup>2</sup> Once I chose eligible articles, I also reviewed the articles cited in those papers for potential inclusion

Table 2: Results of systematic search for peer reviewed studies on the association between potentially traumatic events (PTE) and health care service use in low and lower-middle income countries

Author	Year population sampled	Sample size	Sample type	PTE measure	Health service outcome	Informal care assessed	Main findings	Country and classification
Eytan et al. (2006)	2001	340	General	Harvard Trauma Questionnaire (HTQ); operationalized as three categories: no traumatic event, 0 to 5 events, and more than 5 events	Any use of medical assistance in the past four weeks; any hospitalization in the past four weeks; utilization was then coded as past year	Yes; care from healers and midwives Yes; care from traditional healers, spiritual healers, black baggers, pharmacists, midwives	72% of those with greater than 5 events used any health care in the past year compared to 62% of those reporting 1 to 5 events and 38% of those reporting no event; adjusted results were not given	Kosovo, LMIC*
Kruk et al. (2011)	2008	1434	Population-based, random sample	HTQ; operationalized as the sum of all events	Past year any use of health care services from clinics, hospitals, or informal sources		Positive association between lifetime PTE experience and formal care service use as well as informal care service use	Liberia, LIC*
Studies not meeting full eligibility criteria								
Morina et al. (2012)	2009	206	Community based	Population sampled on loss of spouse during conflict; war related traumatic events from the HTQ as additional covariate, operationalized as sum of war related events	Number of primary health care, specialist care, and hospitalization in the past 3 months, measured using the Client Service Receipt Inventory	No	No difference in health care use between women who lost a spouse during the war compared to women who did not; among women who lost a spouse during the war, a positive association was found between war related events and primary health care use 58.6 % of women who experienced sexual violence sought some kind of health care service after the event. The study did not measure service use in women who did not experience sexual violence	Kosovo, LMIC*
Casey et al. (2011)	2008	607	Population-based, random sample	Exposure to sexual violence during and after conflict	Any health services sought after exposure to sexual violence	Unknown		Democratic Republic of the Congo, LIC*

Farhood et al. (2003)	1995	93	Community based	Experience of church bombing; life events scale; most important traumatic event experienced in 1995 and its impact	10 items related to hospital visits, doctor visits, and lab test in the past year	Unknown	Those who experienced the church bombing had a higher number of doctor visits compared to those with no impact of this event	Lebanon, LMIC*
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\* LIC = low-income country; LMIC = Lower middle income country. As defined by the World Bank

CHAPTER 2: THE ASSOCIATION BETWEEN LIFETIME POTENTIALLY TRAUMATIC EVENTS AND FORMAL AND INFORMAL CARE USE IN A POPULATION-BASED SAMPLE OF ADULTS FROM LIBERIA

## Introduction

Experience of potentially traumatic events (PTE) is common across the lifecourse for most populations. The majority of individuals will experience at least one PTE in their lifetime (2-6, 12, 67, 68). This is especially true in post-conflict settings, where experience of more than one event is likely (33, 38, 69). Experience of these events often leads to mental and physical health consequences, either as a direct result of any injury sustained during the event, or through the development of illnesses such as posttraumatic stress disorder (PTSD), depression, heart problems, gastrointestinal disorders, and inflammatory conditions (11, 12, 68, 70-75). As can be expected, these conditions lead to increased use of health care services. Several studies have been conducted, mostly in high income countries (HIC), to further the understanding of the relation between PTE experience and use of health services (14, 15, 33, 76, 77). Health care for those with a history of PTE experience, especially war related events, may require special consideration, and information on use of services by those with PTE experience can help improve health system accountability and responsiveness (21). Fewer studies, however, have been conducted in low-income countries (LIC), especially in those with a recent history of conflict, compared to HICs. Populations in these settings often experience more PTEs and interact with health care systems that are of lower quality compared to HICs, and require rebuilding and improvement. In order to inform this process, and health system responsiveness overall, there is a need for studies conducted on the association between PTE experience and health care service use in these LICs.

Most studies conducted using HIC samples have found that experience of PTEs increases use of health services, although most have focused on specific PTEs rather than assessing PTE experience overall (14, 78). For example, one study found that women who reported childhood sexual abuse had more visits to primary health care clinics compared to women who did not report this PTE, controlling for disease symptoms (14). Similarly, another study conducted on the Jerusalem Jewish population before and after an intifada in 2001 noted an increase in general care visits following the intifada (78). Compared to HICs, fewer studies have been conducted in LICs to understand the association between experience of PTEs and health care use, especially in areas that have undergone conflict. One study comparing widowed and non-widowed mothers after the Kosovo conflict found that health care use patterns between the two groups did not differ (45). Conversely, another study conducted after the Kosovo conflict found

that those who experienced more than five PTEs had increased medical and hospital visits in the past year (38). Similarly, another study conducted by Kruk et al. reported that lifetime PTE experience was associated with increased past year formal care use as well as past year informal care use, that is care given by traditional healers, black baggers, who are drug peddlers, pharmacists, or traditional midwives (33).

That there is a paucity of studies that have assessed the relation between experience of PTEs and use of health care services in low-income countries, especially in areas with a history of recent conflict, is problematic for several reasons. Populations in low-income countries with a history of recent conflict often have an increased experience of several PTEs such as combat as a civilian, torture, and war related injuries, compared to high income settings, which may increase the need for health care services (33, 50). However, the formal care system, likely lacking pre-conflict, is probably unable to cope with this increased need during conflict, as access to services is limited or nonexistent as well as post-conflict, when formal care is being rebuilt and improved (23, 79). Post-conflict, formal clinics may not always be stocked with necessary medicines or equipment, health care personnel may not be properly trained in all aspects of care, leading to poor examinations, and long wait times are common (23, 80). This may compel individuals to seek care from informal care providers, which are used in many low-income countries as a complement to formal care, especially in areas where the formal care system is lacking (32, 33, 35, 58). Use of informal care, however, may be problematic for several reasons. Treatments by informal providers may not be safe or effective, and the medicines used may be counterfeit (59). More importantly, informal care providers lack any medical training or regulation compared to formal providers, who have some level of training and regulation. Lastly, care from informal providers can be more expensive compared to that found in formal clinics (33, 60, 61). Despite these problems, informal care may be more accessible than formal care, and this may partially explain use of informal care services. The formal system, however, may be able better able to address the disease burden of individuals with PTEs compared to informal care because it is regulated and formal care providers are trained. For those responsible for rebuilding the formal health care system, information on the use patterns of those who have experienced multiple PTEs, more likely to need services compared to the rest of the population, may prove useful in informing formal health system responsiveness and

accountability. Thus, the association between PTE experience and use of formal and informal care in LICs with a recent history of conflict merits attention.

Liberia is a coastal country located in West Africa that has had a recent history of civil war; thus, increased exposure to traumatic events by the general population, especially assaultive violence and injury/other shocking events, are a likely possibility. Civil unrest began in 1980, when Samuel Doe staged a military coup overthrowing the government of William Tolbert, Jr. (81, 82). This coup led to a series of conflicts between those opposed to the Doe government, which culminated in the First Liberian Civil War in 1989, when the National Patriotic Front of Liberia, led by Charles Taylor, committed a series of attacks aimed at removing the Doe government from power (81). The Abuja peace deal was reached in 1995, and Taylor became president in 1997, but new conflict ensued between his government and several groups within the country (81). In 1999, Liberians United for Reconciliation and Democracy began the Second Liberian Civil War and fighting continued until a peace deal was reached in 2003, removing Taylor from office (82).

In addition to increases of morbidity and mortality during the several decades of conflict, Liberia's economy was devastated, much needed resources like water and electricity became unavailable for most, and availability of essential health services decreased substantially (79, 82). Due to the lack of formal health care services during and following the prolonged conflict, many Liberians relied on informal care, and still rely on such care, from country doctors, who are traditional healers, spiritual healers who generally treat problems that have mental origins, as well as black baggers and pharmacists, who have medications available for treatment (23, 33). Currently, the government in Liberia is focused on creating more accountable and responsive formal care, but many formal clinics do not yet offer all essential services, so there remains a substantial market for informal care, even though, as noted previously, problems with this care exist (23, 79). Therefore, Liberia provides an excellent setting to study the association between PTE experience and health care use. In this paper, I build on previous work to better understand the association between lifetime experience of PTEs and use of formal and informal care services using a population-based sample of adults from Nimba County, Liberia (33).



## **Methods**

### *Study description*

The data for this analysis was collected in Nimba County, Liberia, in November and December of 2008. The study has been previously described elsewhere (23, 33, 44, 83). Briefly, the population-based sample of men and women in the study was drawn using a three-stage sampling design. In the first stage, 50 rural census enumeration areas were selected, with a probability of selection proportional to the size of the rural areas. In the second stage, lists of households were obtained, from which 30 were randomly selected. In the final stage, Kish tables were used to select one respondent from each household. A respondent was only eligible if he or she was age 18 or older and a permanent resident of the household.

A structured questionnaire and consent document were developed in English and translated and back translated into Liberian English by Liberian study personnel. A pilot of the survey was carried out and 75 pre-tests were done for the purpose of refining the survey and confirming translation accuracy. Interviewers underwent a two-week training session before conducting interviews. To ensure data quality, five percent of interviews were observed and three percent were chosen for re-interview at random. Written informed consent was obtained from all participants. The Institutional Review Boards of the University of Michigan and Columbia University reviewed and approved the study protocol. The structured questionnaire obtained information about (a) demographics, (b) household wealth, (c) lifetime PTE experience, and (d) informal and formal health care use in the past year.

### *Potential confounders*

Information was obtained on age, sex, marital status, ethnicity, literacy, and wealth. For analytic purposes, age was dichotomized based on the median. Marital status was grouped into two categories, married and cohabitating, widowed, divorced, separated, or never married. Ethnicity was categorized into Mano, Gio, or other (Mandingo, Kpelle, Krahn, Bassa, or other). Those who could read easily were considered literate while those who could read with difficulty or not at all were considered illiterate. Wealth was ascertained based on an asset index, which has been used extensively in low-income countries and found to be a valid measure of household wealth (84). Respondents were asked about several material assets that the household possessed and principal components analysis was used to create an asset index, a measure of the variation in asset ownership in the sample. This asset index was categorized into

tertiles using proc rank in SAS (85). Information was also obtained on distance to the nearest health facility in hours as well as whether a fee was charged for care at the nearest health facility. This information was collected directly by the study personnel and was not based on participant self-report (23).

#### *Potentially traumatic event exposure*

The Harvard Trauma Questionnaire (HTQ) was used to measure lifetime PTE exposure. The HTQ consists of a list of 39 stated stressful life events and has been used widely in low-income country settings (51, 86). I considered three approaches to categorizing lifetime PTE experience: event type, an approach using principal components analysis, and an ordinal exposure. The details regarding the conceptualizations and analyses behind choosing the ordinal exposure as the most appropriate measure of lifetime PTE experience for this analysis can be found in Appendix B. Briefly, the ordinal exposure approach provided the least subjective method and eliminated exposure overlap so that mutually exclusive comparison groups could be created.

To obtain the ordinal measure of lifetime PTE experience, I first summed the number of HTQ items endorsed, then obtained quartiles of this sum using Proc Rank (85). Dummy variables of the quartiles were used in the final analysis, with the lowest exposure serving as the referent.

#### *Health care use*

Two main measures of health care use were included as the outcomes for this analysis. First, the number of informal care visits (care given by a traditional healer, spiritual healer, black bagger, pharmacist, or traditional midwife) in the past year was obtained. Second, the number of formal care visits (care obtained at a hospital or clinic) in the past year was obtained. I operationalized these measures in two ways: as continuous measures and as tertiles. The highest tertile of informal care was used to create a dichotomous measure of high informal care use and the highest tertile of formal care was used to create a dichotomous measure of high formal care use. Third, in order to further investigate the link between PTE experience and high use of informal and formal care, I assessed high use of both types of care by grouping together respondents who were in the highest tertile for both informal and formal care use.

Proc Rank was used to create tertiles for health care outcomes. In the case of past year formal care visits, many individuals had the same number of visits at the particular values used to create cut offs, leading to unbalanced groups (85). Thus, the tertiles for formal care do not represent true tertiles for this reason, despite using the same approach that was used to categorize informal visits.

### *Statistical analysis*

The main analysis for this study consisted of several steps. First, I ran univariable estimates of all variables of interest, including demographics, lifetime PTE experience, and past year health care use. Second, I compared the distributions of lifetime PTE experience and informal and formal health care use. I used Pearson's Chi-square to assess significance for proportions and Somer's D to assess differences for means. Third, I compared the distributions of informal and formal care tertiles; Pearson's Chi-square was used to assess significance. Fourth, I ran bivariable models between lifetime PTE experience, potential confounders and informal and formal care (see Appendix C, Tables 1 - 3). To examine the relation between lifetime PTE experience and potential confounders, I ran multinomial logistic regression models. Experience of 0 to 12 lifetime PTEs was treated as the referent for these models. To assess the relation between potential confounders and continuous measures of informal and formal care, I used negative binomial regression models. Logistic regression models were used to assess the relation between potential confounders and high informal and formal care. Variables that were associated with both lifetime PTE experience and each respective measure of health care use were considered as confounders (see Appendix C, Table 1). Bivariable negative binomial regression models estimated the association between PTE experience and continuous measures of informal and formal use while bivariable logistic regression models estimated the association between PTE experience and high use of informal and formal care. Fifth, I ran multivariable negative binomial regression models between lifetime PTE experience and informal care, adjusted for age, marital status, and ethnicity, and formal care, adjusted for gender and ethnicity. I also estimated the association between lifetime PTE and dichotomous measures of informal care use, adjusted for ethnicity, and formal care use, adjusted for age and gender, and both informal and formal care use, adjusted for ethnicity, using multivariable logistic regression models. Sixth, in order to better understand the relation between lifetime PTE experience and informal and formal care use, I repeated models assessing the relation between lifetime PTE experience and

informal care within strata of formal care visits (no visits, first tertile, second tertile, and third tertile of visits) and repeated models assessing the relation between lifetime PTE experience and formal care within strata of informal care use (no visits, first tertile, second tertile, and third tertile of visits). Lastly, I explored whether the relation between lifetime PTE experience and informal and formal use measures were stronger in older individuals, those most likely to have experienced the First Liberian Civil War (when this study population would have been most affected), compared to younger individuals.

I conducted two supplementary analyses to address limitations of the main analysis. First, it was likely that certain lifetime PTE experiences, such as beatings resulting in an injury, required formal or informal medical care, and thus, an association in such cases would be implicit. The categorization employed in the main approach, based on ordinal measures of PTE experience, did not clearly separate necessary use from other use. Therefore, I redid the analyses by removing individuals who experienced HTQ items most likely to be associated with seeking care (beatings to the body, knifing or axing, and serious physical injury from fighting due to war). Second, one of the events included in the HTQ asks respondents whether they have even been ill but unable to access medical care. This item may have conflicted with my analysis, where outcomes consisted of care use that implied access and choice. Thus, I reassessed confounding and redid the main analyses with this event removed.

All analyses were carried out using STATA SE 12 and adjusted for clustering based on enumeration areas used in the initial sampling design using STATA's `svyset` procedure (87). Only participants with non-missing data for all variables of interest were included in this study through the use of a sub population statement for all statistics, which retained the original clustered design.

## **Results**

Of the 1,464 individuals eligible respondents, 1,434 (98%) completed the survey. Of those, 1,263 (87.9%) met inclusion criteria for the main analyses. Table 1 shows respondent demographic and health facility characteristics. The median respondent age was 38; the majority of respondents were male (54.2%) and unmarried (63.4%). The most common ethnicity reported was Gio (55.1%), followed by Mano (38.6%), and other (6.3%). Twenty-five point seven percent (25.7%) of respondents reported having the ability to read with ease. The mean number of hours of distance to the nearest clinic was 2.4 hours (SD 0.32) while 11.1 % of the nearest facilities charged for care.

Lifetime PTE experience was prevalent throughout the population (see Appendix B, Table 1). The most common experiences reported were being forced to leave under dangerous conditions (97.7%), lacking food or water (94.2%), being in a combat situation (94.1%), followed by being forced to hide (93%), confiscation or destruction of personal property (92%), witnessing beatings or torture (90%), extortion or robbery (73.3%), enforced isolation from others (65%), forced labor (60.7%), receiving a beating to the body (44.1%), and torture (41.5%).

Table 2 shows the distribution of ordinal lifetime PTE experience categories. Respondents were divided into four quartiles: 0 to 12 (24.15%), 13 to 16 (24.07%), 17 to 20 (24.07%), and 21 to 35 (27.78%) events. Additionally, 57.1% of the respondents experienced an event where formal or informal care would have been necessary and sought.

Table 3 shows past year informal and formal health care use. The mean number of informal care visits was 24.5 (SE 4.1). Those respondents in the first tertile made 0 to 5 visits (34.8%), those in the second 6 to 20 visits (33.1%), and those in the third made more than 20 visits (32.1%). The mean number of formal care visits was 5.0 (SE 0.43). Those respondents in the first tertile made 0 to 1 visits (27.0%), those in the second 2 to 4 visits (37.0%), and those in the third made more than 4 visits (35.3%).

Table 4 shows the distribution of lifetime PTE experience across past year informal and formal care use. The mean number of visits made by respondents who experienced more than 20 lifetime PTEs was 50.4% higher compared to those who experienced 0 to 12 lifetime PTEs. The mean number of informal care visits was similar between respondents who experienced 13 to 16 or 17 to 20 lifetime PTEs, at 25.5 (SE 5.) and 26.6 (SE 4.8), respectively. A higher proportion of respondents who experienced 13 to 16, 17 to 20 and more than 20 events made more than 20 informal care visits compared to respondents who experienced 0 to 12 lifetime PTEs. Both means and proportions of informal care use showed a significant difference based on lifetime PTE experience overall. Results for formal care use differed slightly. While those who experienced more than 20 lifetime PTEs had a higher mean of formal care visits (5.1, SE 0.44) compared to those who experienced 0 to 12 lifetime PTEs (4.1, SE 0.47), those who experienced 13 to 16 or 17 to 20 lifetime PTEs had higher mean formal care visits compared to both those who experienced 0 to 12 or more than 20 lifetime PTEs, a pattern not observed for informal care visits. These differences in formal care visit means between lifetime PTE experiences were significant

overall ( $p < 0.05$ ). The proportion of respondents who were high formal care users did not differ based on lifetime PTE experience, although a higher proportion of those who experienced more than 12 events were high users. Lastly, a higher proportion of those who experienced more than 12 lifetime PTEs were high users of both informal and formal care. While the difference was significant overall ( $p < 0.05$ ), the proportion of high users of both types of care was similar for those who experienced 13 to 16 events (17.4%), 17 to 20 events (21.5%), and more than 20 events (18.4%)

Table 5 shows the distribution of past year informal and formal care use tertiles. A majority of those who were in the lowest tertile of formal care use were also in the lowest tertile of informal care use (46.6 %) but 32.6 % were in the middle tertile of informal care and 20.9 % were in the highest tertile. A similar, though slightly more even pattern, was observed for those in the middle tertile of formal care use. Those in the highest tertile of formal care use had a pattern of informal care use that was opposite to those in the lowest tertile of formal care; a majority was also in the highest tertile of informal care use (48.0%) while 22.2 % were in the lowest tertile of informal care use. A similar pattern was observed when comparing formal care use by tertiles of informal care. The association between informal and formal care tertiles was significant ( $p < 0.0001$ ).

Bivariable associations among lifetime PTE experience, past year informal and formal health care use, and potential confounders are shown in Appendix C, Table 1. Age, marital status, and ethnicity were associated with lifetime PTE experience and the number of informal care visits, ethnicity was associated with both lifetime PTE experience and making more than 20 informal care visits. Gender and ethnicity were associated with lifetime PTE experience and with the number of formal care visits, age and gender were associated with lifetime PTE experience and making more than four formal care visits. Lastly, ethnicity was associated with lifetime PTE experience and making more than 20 informal care visits and more than four formal care visits. Wealth, distance to the nearest facility, and whether a fee was charged at the nearest facility were not associated with both PTE experience and health care use outcomes and were not considered confounders. Potential confounders remained the same for the lifetime PTE measure with HTQ item "ill health without access to medical care" removed (Appendix C, Table 2).

Bivariable regression models estimating the associations between lifetime PTE experience and past year health care use are shown in Appendix C, Table 3. Multivariable associations between lifetime

PTE experience and past year informal and formal care use are shown in Table 6. In a negative binomial regression model adjusted for age, marital status, and ethnicity, experience of 13 to 16 (IRR = 1.46, 95 % CI: 1.14, 1.87), 17 to 20 (IRR = 1.54, 95 % CI: 1.18, 2.0), and more than 20 (IRR = 1.86, 95 % CI: 1.4, 2.47) lifetime PTEs remained significantly associated with the number of informal care visits. In a logistic regression model adjusted for ethnicity, those who experienced 13 to 16 lifetime PTEs were 1.64 (95 % CI: 1.13, 2.4) times more likely to have made 20 or more informal care visits compared to those who experienced 0 to 12 lifetime PTEs, those who experienced 17 to 20 lifetime PTEs were 2.13 (95% CI: 1.39, 3.27) times more likely to have made 20 or more informal care visits compared to those who experienced 0 to 12 lifetime PTEs, and those who experienced more than 20 events were 2.18 (95% CI: 1.44, 3.3) times more likely to have made 20 or more informal care visits compared to those who experienced 0 to 12 lifetime PTEs. In a negative binomial regression model adjusted for gender and ethnicity, experience of 17 to 20 lifetime PTEs (IRR = 1.39, 95% CI: 1.15, 1.68) and more than 20 lifetime PTEs (IRR = 1.38, 95% CI: 1.07, 1.77) remained significantly associated with number of formal care visits. Similar results were obtained for a logistic regression model estimating the association between lifetime PTEs and making more than four formal care visits. Lastly, in a logistic regression model adjusted for ethnicity, experience of 17 to 20 (OR = 2.24, 95% CI: 1.39, 3.6), or more than 20 (OR = 1.94, 95% CI: 1.09, 3.45) lifetime PTEs was significantly associated with making more than 20 informal care and more than four formal care visits in the past year.

Tables 7 through 8 show multivariable models stratified by past year formal care use. Table 7 depicts the association between lifetime PTE experience and the number of past year informal care visits, within four strata of past year formal care use [no visits, lowest tertile (0 to 1), middle tertile (2 to 4), and highest tertile (more than 4)] in a negative binomial model adjusted for age, marital status, and ethnicity. Among those who made no formal care visits, lifetime PTE exposure was not associated with informal care use. However, among those who made 0 to 1 formal care visits, those who experienced more than 20 lifetime PTEs had a rate of informal care use that was 1.81 (95% CI 1.07, 3.05) times higher compared to those who experienced 0 to 12 events. Among those who made 2 to 4 formal care visits or more than 4 formal visits, the associations between lifetime PTEs and informal care were significant for each PTE category, as compared to the referent of 0 to 12 events. However, the associations between lifetime

PTEs and informal care appeared stronger among those with 2 to 4 formal care visits as compared to associations among those with more than 4 formal care visits. Table 8 shows the association between lifetime PTE experience and making more than 20 past year informal care visits in a logistic regression model adjusted for ethnicity, within the same four strata of past year formal care use detailed above. Among those who made no formal care visits, the associations between lifetime PTEs and making more than 20 informal care visits remained non-significant. For associations between lifetime PTEs and informal care use within tertiles of formal care, results differed slightly from those obtained from the negative binomial regression model shown in Table 7. Among those who made 0 to 1 formal care visits, the association between who experienced more than 20 lifetime PTEs and informal care was no longer significant. Among those who made more than 4 formal care visits, only experience of 17 to 20 lifetime PTEs was associated with making more than 20 informal care visits. Among those who made 2 to 4 formal care visits, associations between lifetime PTE experience and making more than 20 informal care visits were significant for all PTE categories; those who experienced 13 to 16, 17 to 20, or more than 20 lifetime PTEs were 2.51 (95% CI: 1.19, 5.27), 2.47 (95% CI: 1.2, 5.08), and 3.15 (95% CI: 1.54, 6.44) more likely, respectively, to make more than 20 informal care visits compared to those who experienced 0 to 12 lifetime PTEs.

Tables 9 through 10 show multivariable models stratified by past year informal care use. Table 9 depicts the association between lifetime PTE experience and the number of past year formal care visits, within four strata of past year informal care use [no visits, lowest tertile (0 to 5), middle tertile (6 to 20), and highest tertile (more than 20)] in a negative binomial model adjusted for gender and ethnicity. Among those who made no informal care visits, only the association experience of more than 20 lifetime PTEs (IRR = 2.57, 95% CI: 1.49, 4.43) and the number of formal care visits was significant. None of the lifetime PTE categories were significantly associated with formal care among those who made 0 to 5 informal care visits, among those who made 6 to 20 informal care visits, or among those who made more than 20 informal care visits. Table 10 shows the association between lifetime PTE experience and making more than 4 past year formal care visits in a logistic regression model adjusted for age and gender, within the same four strata of past year informal care use detailed above. Among those who made no informal care visits, the association between experience of more than 20 lifetime PTEs and making more than 4 formal



care visits remained significant (OR = 4.31, 95% CI: 1.02, 18.27). Results differed slightly from those obtained from the negative binomial regression model shown in Table 9. Among those who made 6 to 20 informal care visits, those who experienced more than 20 lifetime PTEs were 2.43 (95% CI: 1.25, 4.7) times more likely to have made more than 4 formal care visits in the past year. However, no other associations were significant in the two other strata, the lowest tertile of informal care visits (0 to 5) and the highest (more than 20).

Results from models testing whether age was an effect measure modifier of the lifetime PTE – care use associations are shown in Table 11. Age was an effect measure modifier of the association between lifetime experience of 17 to 20 PTEs and the number of formal care visits. As shown in Figure 1, the predicted number of formal care visits was higher for individuals who experienced 17 to 20 lifetime PTEs and were older than 38 compared to individuals who experienced 0 to 12 events and were 38 or younger.

Table 12 shows the main models presented in Table 6 with individuals reporting an event implicitly associated with past year care seeking (a beating to the body, knifing or axing, or a serious physical injury from fighting due to war) removed. Results were largely unchanged for the negative binomial model, adjusted for age, marital status, and ethnicity, relating lifetime PTE experience to the number of past year informal care visits. For the logistic model relating lifetime PTE experience to making more than 20 informal care visits, only experience of 17 to 20 (OR = 2.03, 95% CI: 1.31, 3.16) lifetime events remained significantly associated with past year informal care. For the negative binomial model, adjusted for gender and ethnicity, relating lifetime PTE experience and number of formal care visits and the logistic model, adjusted for age and gender, relating lifetime PTE experience and making more than 4 past year formal care visits, the association between experience of more than 20 lifetime PTEs and formal care was no longer significant while the association between experience of 13 to 16 lifetime PTEs and formal care became significant. Results from a logistic regression model, adjusted for ethnicity, relating lifetime PTEs to making more than 20 informal care and more than 4 past year formal care visits followed the same pattern as above. Those who experienced more than 20 lifetime PTEs did not have a significant odds of being in the highest tertile of use for both types of care compared to those who experienced 0 to 12 lifetime PTEs, while those who experienced 13 to 16 lifetime PTEs were 2.51 (95%

CI: 1.38, 4.58) times more likely to be in the highest tertile of use for both types of care compared to those who experienced 0 to 12 lifetime PTEs. These results differed from those shown in Table 6, which included individuals who experienced a beating to the body, knifing or axing, or a serious physical injury from fighting due to war.

Lastly, Table 13 shows the association between lifetime PTEs and past year informal and formal use with the event of illness without access to medical care removed. Similar results to those presented in Table 6 were obtained.

## **Discussion**

In this study, experience of PTEs shaped health care use in post-conflict Liberia. I found that persons who experienced a higher number of PTEs were more likely to use formal care compared to those who experienced fewer events whereas informal care was associated with all three PTE categories compared to the referent. I also found a relation between lifetime PTEs and informal care use among those who used formal care and an association between PTE experience and formal care among those who used no informal care. Among those who were older than 38, experience of more events was associated with a higher number of predicted formal visits, but not informal visits. Lastly, excluding respondents who experienced an event implicitly related to care seeking accounted for some but not all of the associations between lifetime PTEs and care seeking.

Nearly all of the participants in this study reported at least one lifetime PTE; this is consistent with a body of literature that has shown that PTE experience is common across the lifecourse in all settings. In this study, most individuals experienced more than one event, with 75% reporting more than 12 events. Although this prevalence estimate is high, many studies conducted in low-income countries, specifically those with a recent history of conflict, report similarly high estimates. For example, in a study by Robertson et al. of Somali and Oromo women refugees living in Minnesota, the mean number of events reported was 22 (SD 10.7) (50). In a study of Tibetan refugees in India, 71 % reported experiencing at least one traumatic event in their lifetime (88). Even in upper middle and high income, PTE experience is common. In a study of residents in Detroit, Goldmann et al. reported that 87.2% of Detroit residents had at least one traumatic event in their lifetime (3). Similarly, In a population-based study of South Africans, Williams et al. found that 74.8% of individuals had been exposed to a PTE (5). Thus, though slightly

higher, our results regarding lifetime PTE experience in a population-based sample are similar to other published estimates.

In this study, lifetime experience of PTEs was associated with both informal and formal health care use. My results differ from those reported by Morina and Emmelkamp, who reported no difference in use patterns comparing widowed and non-widowed mothers in post conflict Kosovo (45). One potential explanation for this difference was that this present study measured a wide range of events while Morina and Emmelkamp only focused on one type of event (loss of a loved one). My findings were similar to those reported by Eytan et al., who found that health care visits in the past year were significantly higher among individuals who experienced more than five PTEs, or one to five PTEs, compared to those who experienced no events (38). Although Liberia and Kosovo are quite different countries, these similar findings may be due to use of a more general measure of PTE experience, rather than a single event. It may be that the association between PTE experience and health care use may only persist when several categories of events are considered or when events include an exchange of force, such as child physical abuse, or an injury, such as torture. I am not aware of any study that has assessed the relation between PTE experience and use of informal care services that I can directly compare my results to. However, given that 80% of Sub Saharan Africa uses some form of informal care, it is not unexpected that I would find an association between PTE experience and informal care use similar to the one between PTE experience and formal care use (32).

I showed that the relationship between PTE experience and one type of care may be dependent on use of other type of care. Within strata of formal care, among those who used no formal care, the association between PTE experience and informal care was not significant. However, among those with the lowest number of formal care visits, the middle number of visits, or the highest number of visits, the association between PTE experience was significant, with more associations between categories of PTE experience and use of informal care found in higher tertiles of formal care use. Conversely, in general, such a pattern was not seen in the association between PTE experience and formal care use within strata of informal care. Here, I noted an association between PTE experience and formal care, but only among those who used no informal care in the past year. Among those who made informal care visits in the past

year, a significant association between PTE experience and formal care was not found. Three general inferences can be drawn from these findings.

First, these results suggest that higher users of formal care who have experienced several lifetime PTEs are also users of informal care, although they may not always be high users of informal care. While there is no literature I am aware of that I can compare these findings to, there are several explanations for these results. Respondents who are users of formal care may complement their care with informal care. Limited research suggests that care available at clinics or hospitals may require significant travel time for access and may be of low quality, without supplies and with long wait times for examinations that may be short and inadequate, or may not occur at all (23, 33, 80). One qualitative study on formal care services by Gilson et al. noted common themes such as doctors writing prescriptions for patients without an accompanying examination (80). Such factors may prompt individuals to see an informal care provider, where access is easier, the wait is often shorter, and more time is taken to speak and examine the patient (31). Providers like black baggers and pharmacists may provide easier access to medication, another factor that may explain informal provider use. Though this present study did not measure what percent of visits in the past year were made to each type of informal providers, results from a previous study suggest that the majority of most recent visits in the past year were made to black baggers and pharmacists (33). Symptoms of poor mental or physical health may drive persons to seek the easiest care available, especially when the alternative, such as walking to a clinic that may not be able to provide adequate care or medications seems too daunting. Thus, the PTE experience-informal care use association may be partially explained by easier access to care or to more patient-centric care.

Some respondents likely used traditional healers in addition to black baggers and pharmacists in the past year. These types of providers treat physical ailments, but they are well known for treating mental health problems (31, 36). Formal care for mental illness is difficult to obtain in Liberia, as the rate of psychiatrists is quite low, at two per 10 million (89). Doctors and nurses may not be properly trained in providing mental health care and may not have the time to give counseling services if they are, because these often require lengthier provider-patient interactions (80). A qualitative study from Ghana suggests that informal care providers take the time to understand the root of the mental illness, often speaking extensively with the patient, providing positive remarks to uplift the patient's feelings, and involving the

family in the patients care, factors that may serve as proxies for counseling services (31). As there is a clear relation between lifetime PTE experience and psychopathology, it is likely that some of the association between PTE experience and informal care within strata of formal care is related to need for mental health providers.

Second, the finding that increased experience of PTEs leads to increased use of health care services is not always the case. For those who used informal care, especially the high users, I did not note a strong relation between PTE experience and formal care use. This suggests that while PTE experience may increase use of both services overall, those who use informal care may not be as likely to use formal care for treatment of conditions related to PTEs. This may be problematic, given that informal care providers are untrained, unregulated, and likely unable to provide efficacious care (60, 61, 90). Studies of traditional healers have noted problems with bone setting, epilepsy treatments, and treatments of sexually transmitted infections (58, 90, 91). The use of counterfeit drugs sold by black baggers and pharmacists may also be prevalent (55, 59). Thus, it bears considering why individuals rely on this care. As I noted above, it is likely that low quality formal care and the need for mental health care services prompt individuals to rely on the informal care system to meet their needs. It may be that some characteristics of informal care, such as shorter wait times, drug availability, and the availability of quasi-counseling services are improvements over the formal care system (31, 80). Thus, understanding whether informal care use is driven by psychopathology or by low quality care available at formal care clinics could inform policymakers and providers on the necessary steps that need to be taken to improve the formal care system, which is regulated and more efficacious, and more likely to reduce disease burden among those with PTEs.

Third, I found an association between experience of the highest number of PTEs and formal care use among those who sought no informal care services in the past year. Although I can only draw limited inference from this finding, as this group only consisted of 91 respondents, this result suggests that there exists a group of individuals who may only rely on the formal care system for their health care needs. It is possible that these individuals may be able to obtain the care that they need and may not need to rely on informal care services to complement their care. Perhaps they are better able to advocate for themselves, or have a social support network that can do it for them, or are better able to engage with the formal

health care system (92). They may also have higher satisfaction with care or with the government of Liberia in general (33). Results comparing these study participants to the rest of the population are available in Appendix C, Table 4. Due to the small sample size, inference is limited; however, individuals who did not make any informal care visits in the past year were more likely to be younger, of Mano ethnicity, and in the middle wealth tertile compared to those who made at least one informal care visit in the past year. They also lived in areas with a lower average of traditional healers available, suggesting that decreased access to traditional healers may partially explain the association between high PTE experience and formal care use. A further understanding of the reasons and factors that are associated with use of formal care services may help aid policymakers and providers to improve the formal care system. A qualitative study would be an appropriate method, as it would allow researchers to study the health care use decisions of this group of people in detail. Researchers could ascertain in depth how these individuals perceive the formal care system, what they think of the care they receive, and, most importantly, why they do not use care given by informal care providers.

I found that age was a weak effect measure modifier of the association between lifetime PTE experience and formal care use. Those who experienced more lifetime PTEs had a higher number of predicted visits if they were older compared to those who experienced fewer PTEs and were younger. That I did not detect effect measure modification by age of the PTE – high formal care use relation suggests that this effect measure modification is weak. It may be that there is a threshold of effect of PTE experience on formal health care use among older individuals, such that those who experienced the most events do not have higher formal care use compared to younger individuals who experienced fewer while those who experienced slightly more events do. Additionally, those who are older and experienced the most PTEs may be less able to access formal care, given the physical and mental conditions associated with PTEs, compared to older individuals with fewer events.

Lastly, removing individuals who experienced knifing or axing, beatings to the body, or a serious physical injury due to fighting in war did not completely remove the association between PTEs and health care use. This suggests that the association between lifetime experience of PTEs and use of services is more complex than an implicit association. However, I was not completely able to remove all individuals who experienced any injury from this analysis because a large majority of individuals experienced at least

one injury. Thus, I can only draw limited inference from this finding. More work needs to be done to understand how lifetime accumulation of PTEs is related to use of services. It is clear that some use reflects an implicit association but some service use may be driven by psychological symptoms or by general poor health that can occur long after an event has taken place. Understanding the determinants of service use among those who experience PTEs may allow providers to better address those needs.

I must consider several limitations in the interpretation of these findings. First, I was unable to establish temporality between these variables; thus, it is possible that service use preceded some of the PTE experience reported by study participants. Second, the measure of lifetime PTE experience was not validated in this population, though the HTQ has shown good validity and reliability in samples from low-income countries, specifically designed to measure traumatic events in low-income countries with a recent history of conflict (51, 86). Third, the measure of health care service use implemented asked respondents to recall informal and formal service use over the past year and was not validated. Although this measure is similar to that used by other studies, it is likely that some individuals may have incorrectly recalled service use due to a long recall period, leading to a bias towards the null for the associations presented. The potential for differential misclassification due to recall bias is discussed more thoroughly below. Fourth, my analysis was based on self-reports and it is likely that some nondifferential and differential misclassification occurred. These limitations are very similar to all observational, cross-sectional studies that use self-reports to gather data. Specific to nondifferential misclassifications, all persons may have incorrectly reported their traumatic event exposure and health care use during the past year because they did not properly recall these, which may bias associations between PTE experience and service use towards the null. Of greater concern is potential differential misclassification by other variables, including PTSD and depression, which were not assessed. Both PTSD and depression may have affected cognitive function, specifically memory (93, 94). Some literature suggests that the effect of PTSD status on reporting of PTE exposure, while significant, appears to be small, and, overall, reports of PTE exposure likely have high test-retest reliability (43). Thus, it may be possible that any recall bias of service use by those with PTSD and those exposed to traumatic events may be small. However, it is not possible to completely ignore findings from the literature, which suggest that cognitive effects of psychopathology on memory are possible (93, 94). Fourth, one of the events included in the HTQ asks

respondents whether they have even been ill but not able to access medical care, which may have conflicted with the main outcome used in this study. In order to address this limitation, I removed this event from my main analyses and found no change in inference. Lastly, the distribution of lifetime PTE experience, other variables such as education and income, as well as health care availability, quality, and accessibility are likely to differ in other settings, especially in urban areas; therefore, the associations reported here might not be generalizable to settings beyond rural Liberia.

These limitations notwithstanding, I found that lifetime PTE experience was associated with both formal and informal health care service use, but differences were found based on use patterns. Most importantly, these findings suggest that individuals who experience several PTEs compared to those who experience fewer may view informal and formal care as complementary, perhaps because the formal care system may not be completely responsive to their health care needs. However, I noted an association between the highest amount of lifetime PTE experience and formal care use among a small group of respondents who did not use informal care. This suggests that some individuals do not use informal care services. Understanding the drivers of health care use among this group of Liberians may shed light on why they chose the formal over the informal system. It is likely that use of informal care will likely remain among Liberians, especially if the quality of formal care does not improve and availability of mental health care remains inadequate. Specifically, if formal care providers continue to lack the capacity and training that is necessary to treat mental health problems, individuals may continue to seek informal care. It may be possible to introduce a referral program where people who seek care from informal providers can get a referral to a formal care provider (33). Additionally, it may be feasible to train informal care providers to screen for mental health problems and provide limited counseling care before referrals are given, thus introducing some level of regulation and efficacy into this system. Training and regulating some traditional healers who are willing may help alleviate demand for mental health care and studies should be conducted to ascertain the feasibility and success of such a program. However, without a functional mental health system, referral programs are unlikely to succeed, and use of informal care providers will still persist. Thus, improvement of mental health care availability in the formal sector, and health care in general, is necessary to increase use of formal care to decrease disease burden in Liberia.



Table 1: Demographic and health characteristics in a population-based sample of adults from Nimba County, Liberia, 2008 (n=1263)

Variable	n (%) <sup>*</sup>
38 and older <sup>†</sup>	639 (50.6)
Female	579 (45.8)
Married	455 (36.0)
Ethnicity	
Mano	488 (38.6)
Gio	696 (55.1)
Other	79 (6.3)
Reads easily	324 (25.7)
Wealth tertile <sup>‡</sup>	
Lowest tertile	421 (33.3)
Middle tertile	421 (33.3)
Highest tertile	421 (33.3)
Health facility characteristics	
Walking time to nearest clinic (hr.), mean (SD)	2.4 (0.32)
Fee charged for care	140 (11.1)

\* Data is n(%) unless otherwise specified

<sup>†</sup> Based on greater than the median value

<sup>‡</sup> Constructed using principal components analysis on a set of 18 household wealth indicators

Table 2: Lifetime potentially traumatic event exposure (PTE)\* in a population-based sample of adults from Nimba County, Liberia, 2008 (n = 1263)

Exposure to PTE categories	n (%)
First quartile (0 to 12 events); n=305	305 (24.15)
Second quartile (13 to 16 events); n=304	304 (24.07)
Third quartile (17 to 20 events); n=312	312 (24.78)
Fourth quartile (21 to 35 events); n= 342	342 (27.08)
Experienced an event where care was likely sought <sup>†</sup>	720 (57.1)

\* As measured by the Harvard Trauma Questionnaire

<sup>†</sup> Experienced either a beating to the body, knifing or axing, or a serious physical injury from fighting due to war

Table 3: Past year health care use in a population-based sample of adults from Nimba County, Liberia, 2008 (n=1263)

Variable	n (%) <sup>*</sup>
Informal care <sup>†</sup>	
Number of visits, mean (SE)	24.5 (4.1)
Tertiles of care	
0 to 5 visits	440 (34.8)
6 to 20 visits	418 (33.1)
More than 20 visits	405 (32.1)
Formal care <sup>‡</sup>	
Number of visits, mean (SE)	5.0 (0.43)
Tertiles of care	
0 to 1 visits	350 (27.7)
2 to 4 visits	467 (37.0)
More than 4 visits	446 (35.3)

\* Data is n(%) unless otherwise specified

<sup>†</sup> Care in the past year obtained from a traditional healer, spiritual healer, black bagger, pharmacist, or traditional midwife

<sup>‡</sup> Care in the past year obtained from a clinic or hospital; tertiles do not divide evenly into 3 groups due to many individuals having the same number of visits at the particular values used to create cut offs, leading to slightly unbalanced groups

Table 4: Distribution of lifetime potentially traumatic event (PTE) experience by past year informal and formal health care use in a population-based sample of adults from Nimba County, Liberia, 2008 (n=1263)

	Informal care*		Formal care <sup>†</sup>		Informal and formal care
	Number of informal care visits n=1263	Highest tertile of informal visits (greater than 20 visits) n=405	Number of formal care visits n=1263	Highest tertile of formal visits (greater than 4 visits) n=446	Highest tertile of formal and informal visits (greater than 20 informal and 4 formal care visits) n=214
Lifetime PTE experience	mean (SD)	n (%)	mean (SD)	n (%)	n (%)
Total sample (n=1263)	24.5 (4.1)	405 (32.1)	5.0 (0.43)	446 (35.3)	214 (17 %)
First quartile (0 to 12 events); n=305;	15.0 (2.4) <sup>‡</sup>	64 (21.0) <sup>‡</sup>	4.1 (0.47) <sup>‡</sup>	88 (28.9)	31 (10.2) <sup>‡</sup>
Second quartile (13 to 16 events); n=304	25.5 (5.0)	96 (31.6)	5.3 (0.65)	106 (34.9)	53 (17.4)
Third quartile (17 to 20 events); n=312	26.6 (4.8)	117 (37.5)	5.6 (0.63)	120 (38.5)	67 (21.5)
Fourth quartile (21 to 35 events); n= 342	30.3 (5.4)	128 (37.4)	5.1 (0.44)	132 (38.6)	63 (18.4)

\* Number of visits to a traditional healer, spiritual healer, black bagger, pharmacist, or traditional midwife in the past year

<sup>†</sup> Number of visits to a clinic or hospital in the past year; tertiles do not divide evenly into 3 groups due to many individuals having the same number of visits at the particular values used to create cut offs, leading to slightly unbalanced groups

<sup>‡</sup> Differences significant at p < 0.05. Somer's D was used to assess significance for means and Pearson's Chi-square was used to assess significance for proportions

Table 5: Distribution of past year informal and formal care visits in a population-based sample of adults from Nimba County, Liberia, 2008 (n=1263)\*

Tertiles of formal care in the past year <sup>‡</sup>	Tertiles of informal care in the past year <sup>†</sup>		
	First tertile (n = 440)	Second tertile (n=418)	Third tertile (n=405)
First tertile (n=350)	163 (46.6; 37.0) <sup>§¶</sup>	114 (32.6; 27.3)	73 (20.9; 18.0)
Second tertile (n=367)	178 (38.1; 40.5)	171 (36.6; 40.9)	118 (25.3; 29.1)
Third tertile (n=446)	99 (22.2; 22.5)	133 (29.8; 31.8)	214 (48.0; 52.8)

\* Data is n(%)

<sup>†</sup> Number of visits to a traditional healer, spiritual healer, black bagger, or pharmacist in the past year

<sup>‡</sup> Number of visits to a clinic or hospital in the past year; tertiles do not divide evenly into 3 groups due to many individuals having the same number of visits at the particular values used to create cut offs, leading to slightly unbalanced groups

<sup>§</sup> The first percent represents the distribution of informal care tertiles within each tertile of formal care; the second percent represents the distribution of formal care tertiles within each tertile of informal care

<sup>¶</sup> Pearson's Chi-square was significant at p <0.0001

Table 6: Multivariable associations between potentially traumatic event (PTE) experience and health care use in a population-based sample of adults from Nimba County, Liberia, 2008 (n = 1263)

	Informal health care*		Formal health care†		Informal and formal care
	Number of informal care visits	Highest tertile of informal visits (greater than 20 visits)	Number of formal care visits	Highest tertile of formal visits (greater than 4 visits)	Highest tertile of formal and informal visits (greater than 20 informal and 4 formal care visits)
PTE experience	IRR (95% CI) <sup>‡, ¶</sup>	OR (95% CI) <sup>§, ¶</sup>	IRR (95% CI) <sup>‡, ¶</sup>	OR (95% CI) <sup>§, ¶</sup>	OR (95% CI) <sup>§, ¶</sup>
First quartile (0 to 12 events)	Ref	Ref	Ref	Ref	Ref
Second quartile (13 to 16 events)	1.46 (1.14, 1.87)	1.64 (1.13, 2.4)	1.23 (0.97, 1.57)	1.37 (0.88, 2.12)	1.74 (0.99, 3.03)
Third quartile (17 to 20 events)	1.54 (1.18, 2.0)	2.13 (1.39, 3.27)	1.39 (1.15, 1.68)	1.81 (1.27, 2.59)	2.24 (1.39, 3.6)
Fourth quartile (21 to 35 events)	1.86 (1.4, 2.47)	2.18 (1.44, 3.3)	1.38 (1.07, 1.77)	2 (1.29, 3.11)	1.94 (1.09, 3.45)

\* Number of visits to a traditional healer, spiritual healer, black bagger, pharmacist, or traditional midwife in the past year

† Number of visits to a clinic or hospital in the past year

‡ Results based on a multivariable negative binomial regression model

§ Results based on a multivariable logistic regression model

¶ From left to right, model additionally adjusted for: age, marital status, ethnicity; ethnicity; gender, ethnicity; age, gender; ethnicity

Table 7: Multivariable models between lifetime potentially traumatic event (PTE) experience and past year informal health care use\*, within strata of past year formal health care use<sup>†</sup>, in a population-based sample of adults from Nimba County, Liberia 2008 (n = 1263)

	Tertiles of formal care <sup>†</sup>			
	Number of formal health care visits =0 n = 224	First tertile (0 to 1 visits) n = 350	Second tertile (2 to 4 visits) n = 467	Third tertile (more than 4 visits) n = 446
Lifetime PTE experience	IRR (95% CI) <sup>‡, §</sup> of the association between PTE experience and informal care*			
First quartile (0 to 12 events)	Ref	Ref	Ref	Ref
Second quartile (13 to 16 events)	0.85 (0.48, 1.49)	1.01 (0.67, 1.53)	1.88 (1.24, 2.83)	1.44 (1.04, 2.0)
Third quartile (17 to 20 events)	0.89 (0.53, 1.5)	1.17 (0.75, 1.81)	1.93 (1.24, 2.99)	1.48 (1.01, 2.17)
Fourth quartile (21 to 35 events)	1.47 (0.83, 2.62)	1.81 (1.07, 3.05)	1.98 (1.37, 2.88)	1.68 (1.1, 2.58)

\* Number of visits to a traditional healer, spiritual healer, black bagger, pharmacist, or traditional midwife in the past year

<sup>†</sup> Visits to a clinic or hospital in the past year; tertiles do not divide evenly into 3 groups due to many individuals having the same number of visits at the particular values used to create cut offs, leading to slightly unbalanced groups; participants who reported no formal care visits are also included in the first tertile of formal care visits (0 to 1 visits), thus, the strata of 0 formal care visits is not mutually exclusive from the strata of the first tertile of formal care

<sup>‡</sup> Results from a multivariable, negative binomial regression model

<sup>§</sup> All models adjusted for age, marital status, and ethnicity

Table 8: Multivariable models between lifetime potentially traumatic event (PTE) experience and highest tertile of informal health care use\*, within strata of formal health care use<sup>†</sup>, in a population-based sample of adults from Nimba County, Liberia 2008 (n = 1263)

		Tertiles of formal care <sup>†</sup>		
Number of formal health care visits =0		First tertile (0 to 1 visits)	Second tertile (2 to 4 visits)	Third tertile (more than 4 visits)
Lifetime PTE experience	n = 224	n = 350	n = 467	n = 446
OR (95% CI) <sup>‡, §</sup> of the association between PTE experience and highest tertile of informal care*				
First quartile (0 to 12 events)	Ref	Ref	Ref	Ref
Second quartile (13 to 16 events)	0.39 (0.15, 1.04)	0.69 (0.3, 1.61)	2.51 (1.19, 5.27)	1.75 (0.95, 3.19)
Third quartile (17 to 20 events)	1.05 (0.4, 2.74)	1.46 (0.67, 3.17)	2.47 (1.2, 5.08)	2.21 (1.15, 4.25)
Fourth quartile (21 to 35 events)	1.41 (0.52, 3.84)	1.74 (0.75, 4.02)	3.15 (1.54, 6.44)	1.64 (0.94, 2.85)

\* More than 20 visits to a traditional healer, spiritual healer, black bagger, pharmacist, or traditional midwife in the past year

<sup>†</sup> Visits to a clinic or hospital in the past year; tertiles do not divide evenly into 3 groups due to many individuals having the same number of visits at the particular values used to create cut offs, leading to slightly unbalanced groups; participants who reported no formal care visits are also included in the first tertile of formal care visits (0 to 1 visits), thus, the strata of 0 formal care visits is not mutually exclusive from the strata of the first tertile of formal care

<sup>‡</sup> Results from a multivariable logistic regression model

<sup>§</sup> All models adjusted for ethnicity



Table 9: Multivariable models between lifetime potentially traumatic event (PTE) experience and formal health care\* utilization, within strata of informal health care utilization<sup>†</sup>, in a population-based sample of adults from Nimba County, Liberia, 2008

		Informal health care utilization		
		Tertiles of informal care		
	Number of informal health care visits =0	First tertile (0 to 5 visits)	Second tertile (6 to 20 visits)	Third tertile (more than 20 visits)
Lifetime PTE experience	n = 91	n = 440	n = 418	n = 405
IRR (95% CI) <sup>§, ¶</sup> of the association between PTE experience and formal care				
First quartile (0 to 12 events)				
Second quartile (13 to 16 events)	0.92 (0.55, 1.54)	1.06 (0.81, 1.39)	1.2 (0.78, 1.86)	1.23 (0.93, 1.64)
Third quartile (17 to 20 events)	0.83 (0.43, 1.6)	1 (0.72, 1.37)	1.33 (0.93, 1.91)	1.28 (0.91, 1.79)
Fourth quartile (21 to 35 events)	2.57 (1.49, 4.43)	0.98 (0.68, 1.41)	1.36 (0.96, 1.92)	1.02 (0.73, 1.42)

\* Number of visits to a clinic or hospital in the past year

<sup>†</sup> Visits to a traditional healer, spiritual healer, black bagger, or pharmacist in the past year

<sup>‡</sup> PTE quartile distribution: 41 (45.05%), 25 (27.5%), 15 (16.5%), 10 (11.0%) for first, second, third, and fourth quartile, respectively

<sup>§</sup> Results from a multivariable, negative binomial regression model

<sup>¶</sup> All models adjusted for age and gender

Table 10: Multivariable models between lifetime potentially traumatic event (PTE) experience and highest tertile of formal health care utilization\*, within strata of informal health care utilization†, in a population-based sample of adults from Nimba County, Liberia, 2008

Informal health care utilization				
Tertiles of informal care				
	Number of informal health care visits =0	First tertile (0 to 5 visits)	Second tertile (6 to 20 visits)	Third tertile (more than 20 visits)
Lifetime PTE experience	n = 91	n = 440	n = 418	n = 405
OR (95% CI) <sup>§, ¶</sup> of the association between PTE experience and highest tertile of formal care				
First quartile (0 to 12 events)				
Second quartile (13 to 16 events)	0.79 (0.28, 2.29)	1.16 (0.71, 1.91)	1.22 (0.52, 2.89)	1.26 (0.66, 2.41)
Third quartile (17 to 20 events)	0.94 (0.21, 4.29)	1.28 (0.64, 2.56)	1.7 (0.86, 3.36)	1.5 (0.93, 2.44)
Fourth quartile (21 to 35 events)	4.31 (1.02, 18.27)	1.68 (0.81, 3.51)	2.43 (1.25, 4.7)	1.14 (0.6, 2.17)

\* More than four visits to a clinic or hospital in the past year

† Visits to a traditional healer, spiritual healer, black bagger, or pharmacist in the past year

‡ PTE quartile distribution: 41 (45.05%), 25 (27.5%), 15 (16.5%), 10 (11.0%) for first, second, third, and fourth quartile, respectively

§ Results from a multivariable logistic regression model

¶ All models adjusted for age and gender

Table 11: Multivariable associations between potentially traumatic event experience (PTE) and past year health care use, including an interaction between age and PTE experience, in a population-based sample of adults from Nimba County, Liberia, 2008 (n = 1263)

	Informal health care*		Formal health care†		Informal and formal care
	Number of informal care visits	Highest tertile of informal visits (greater than 20 visits)	Number of formal care visits	Highest tertile of formal visits (greater than 4 visits)	Highest tertile of formal and informal visits (greater than 20 informal and 4 formal care visits)
PTE experience	IRR (95% CI) <sup>‡, ¶</sup>	OR (95% CI) <sup>§, ¶</sup>	IRR (95% CI) <sup>‡, ¶</sup>	OR (95% CI) <sup>§, ¶</sup>	OR (95% CI) <sup>§, ¶</sup>
Age	1.5 (1, 2.27)	1.89 (0.95, 3.76)	0.65 (0.45, 0.94)	0.41 (0.23, 0.74)	0.84 (0.4, 1.77)
First quartile (0 to 12 events)	Ref	Ref	Ref	Ref	Ref
Second quartile (13 to 16 events)	1.6 (1.15, 2.24)	2.22 (1.19, 4.12)	1.08 (0.79, 1.48)	1.24 (0.72, 2.14)	1.72 (0.88, 3.37)
Third quartile (17 to 20 events)	1.59 (1.15, 2.21)	2.96 (1.72, 5.08)	1.08 (0.84, 1.38)	1.2 (0.76, 1.92)	1.93 (1.09, 3.42)
Fourth quartile (21 to 35 events)	1.94 (1.34, 2.8)	2.58 (1.59, 4.19)	1.27 (0.94, 1.72)	1.55 (0.89, 2.69)	1.65 (0.8, 3.42)
Interaction between PTE exposure and age					
First quartile (0 to 12 events) X age	Ref	Ref	Ref	Ref	Ref
Second quartile (13 to 16 events) X age	0.82 (0.55, 1.21)	0.55 (0.25, 1.19)	1.42 (0.92, 2.21)	1.22 (0.53, 2.83)	1.04 (0.41, 2.66)
Third quartile (17 to 20 events) X age	0.93 (0.56, 1.52)	0.52 (0.23, 1.2)	1.78 (1.08, 2.93)	2.26 (0.97, 5.24)	1.35 (0.53, 3.44)
Fourth quartile (21 to 35 events) X age	0.91 (0.58, 1.44)	0.72 (0.36, 1.41)	1.26 (0.83, 1.91)	1.94 (0.87, 4.33)	1.41 (0.56, 3.57)

\* Number of visits to a traditional healer, spiritual healer, black bagger, pharmacist, or traditional midwife in the past year

† Number of visits to a clinic or hospital in the past year

‡ Results based on a multivariable negative binomial regression model

§ Results based on a multivariable logistic regression model

¶ From left to right, model additionally adjusted for: marital status, ethnicity; ethnicity; gender, ethnicity; gender; ethnicity

Table 12: Multivariable associations between potentially traumatic event (PTE) experience and health care use, excluding respondents endorsing items implicitly associated with care seeking\*, in a population-based sample of adults from Nimba County, Liberia, 2008 (n = 1263)

	Informal health care <sup>†</sup>		Formal health care <sup>‡</sup>		Informal and formal care
	Number of informal care visits	Highest tertile of informal visits (greater than 20 visits)	Number of formal care visits	Highest tertile of formal visits (greater than 4 visits)	Highest tertile of formal and informal visits (greater than 20 informal and 4 formal care visits)
PTE experience	IRR (95% CI) <sup>§, **</sup>	OR (95% CI) <sup>¶, **</sup>	IRR (95% CI) <sup>§, **</sup>	OR (95% CI) <sup>¶, **</sup>	OR (95% CI) <sup>¶, **</sup>
First quartile (0 to 12 events)	Ref	Ref	Ref	Ref	Ref
Second quartile (13 to 16 events)	1.78 (1.38, 2.31)	1.47 (0.9, 2.4)	1.38 (1.05, 1.81)	1.73 (1.03, 2.91)	2.51 (1.38, 4.58)
Third quartile (17 to 20 events)	1.76 (1.27, 2.46)	2.03 (1.31, 3.16)	1.49 (1.11, 2.01)	2.68 (1.61, 4.47)	2.98 (1.49, 5.96)
Fourth quartile (21 to 35 events)	2.01 (1.13, 3.55)	0.9 (0.37, 2.22)	1.03 (0.66, 1.6)	1.7 (0.68, 4.25)	1.64 (0.71, 3.74)

\* Experienced either a beating to the body, knifing or axing, or a serious physical injury from fighting due to war

<sup>†</sup> Number of visits to a traditional healer, spiritual healer, black bagger, pharmacist, or traditional midwife in the past year

<sup>‡</sup> Number of visits to a clinic or hospital in the past year

<sup>§</sup> Results based on a multivariable negative binomial regression model

<sup>¶</sup> Results based on a multivariable logistic regression model

\*\* From left to right, model additionally adjusted for: age, marital status, ethnicity; ethnicity; gender, ethnicity; age, gender; ethnicity

Table 13: Multivariable associations between potentially traumatic event (PTE) experience, with Harvard Trauma Questionnaire item "ill health without access to medical care removed", and health care use in a population-based sample of adults from Nimba County, Liberia, 2008 (n = 1263)

	Informal health care*		Formal health care <sup>†</sup>		Informal and formal care
	Number of informal care visits	Highest tertile of informal visits (greater than 20 visits)	Number of formal care visits	Highest tertile of formal visits (greater than 4 visits)	Highest tertile of formal and informal visits (greater than 20 informal and 4 formal care visits)
PTE experience	IRR (95% CI) <sup>‡, ¶</sup>	OR (95% CI) <sup>§, ¶</sup>	IRR (95% CI) <sup>‡, ¶</sup>	OR (95% CI) <sup>§, ¶</sup>	OR (95% CI) <sup>§, ¶</sup>
First quartile (0 to 11 events)	Ref	Ref	Ref	Ref	Ref
Second quartile (12 to 15 events)	1.78 (1.38, 2.31)	1.58 (1.09, 2.3)	1.38 (1.05, 1.81)	1.31 (0.83, 2.07)	1.68 (0.96, 2.93)
Third quartile (16 to 19 events)	1.76 (1.27, 2.46)	2.05 (1.32, 3.19)	1.49 (1.11, 2.01)	1.72 (1.18, 2.51)	2.15 (1.31, 3.53)
Fourth quartile (20 to 34 events)	2.01 (1.13, 3.55)	2.14 (1.43, 3.2)	1.03 (0.66, 1.6)	1.94 (1.23, 3.05)	1.93 (1.11, 3.35)

\* Number of visits to a traditional healer, spiritual healer, black bagger, pharmacist, or traditional midwife in the past year

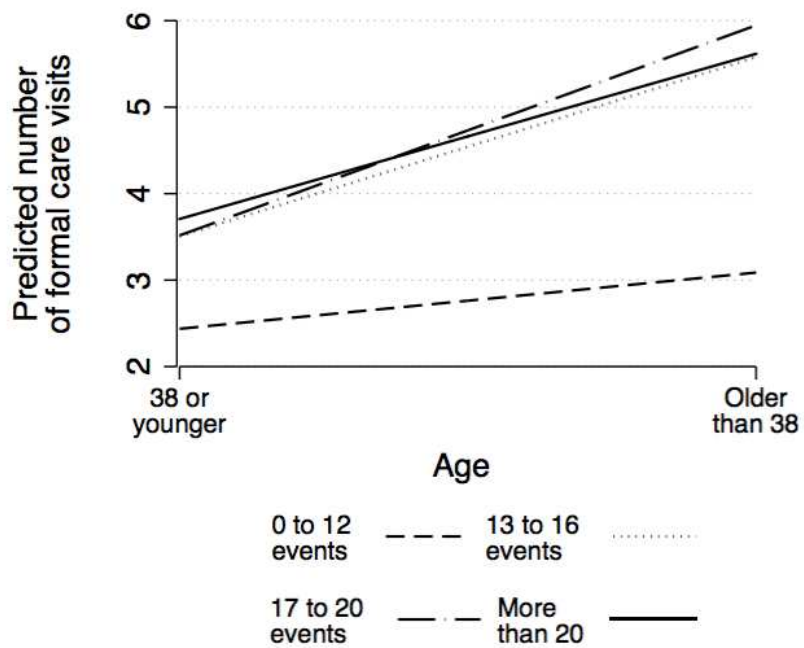
<sup>†</sup> Number of visits to a clinic or hospital in the past year

<sup>‡</sup> Results based on a multivariable negative binomial regression model

<sup>§</sup> Results based on a multivariable logistic regression model

<sup>¶</sup> From left to right, model additionally adjusted for: age, marital status, ethnicity; ethnicity; gender, ethnicity; age, gender; ethnicity

Figure 1: The association between lifetime potentially traumatic events and past year formal care visits among those age 38 and younger compared to those older than 38\*



\*Lines are estimated between the dichotomous age groups and do not represent continuous age data

CHAPTER 3: THE ASSOCIATION BETWEEN LIFETIME POTENTIALLY TRAUMATIC EVENTS AND PREFERENCES FOR FACILITY USE IN A POPULATION-BASED SAMPLE OF ADULTS FROM LIBERIA

**Introduction:**

Several factors can influence use of health services, such as availability of modern technology and medication, facility reputation, costs, and wait times as well as staff related factors like training and expertise, interpersonal skills, and respect. Additionally, characteristics of health care consumers also influence use. Past experiences with the system, both positive and negative, current health status, and preferences for quality, provider patient relationships, and shared decision making can all determine health care service use. Considering the importance of providing more patient centered care and improving health system responsiveness, eliciting and understanding factors related to preferences for care can aid in illustrating the needs of the patient population and inform the changes health systems need to implement in order to meet them.

There are several methods available that can be used to elicit preferences, including standard gamble and discrete choice experiments (DCE) (95, 96). In the latter method, products, such as health services are described using characteristics known as attributes (97). Wait times for seeing a provider and provider training level are an example of attributes. These attributes usually include several discrete levels; wait times could include several levels like 30 minutes, 1 hour, 2 hours, and so forth. During the experiment, study participants are shown a few scenarios that include several attributes used to define a proposed health care clinic, and are asked to choose which scenario they would be most to use. These choices are used to estimate the association between preferences for attributes and choice, with higher associations indicating that a particular attribute is more valued than another, as well as willingness to pay for services (96). In this way, DCEs are particularly valuable in discerning patient expectations and preferences, which can help practitioners and policymakers plan more responsive systems.

Several studies have assessed whether preferences for health care vary based on individual characteristics such as demographics, physical health, mental health, and severity of disease. One study conducted on a general community sample in Australia reported that individuals who had private insurance were less likely to be affected by cost of medication in a discrete choice experiment studying factors related to medication adherence (98). In a discrete choice experiment conducted on skin cancer patients in the UK, individuals who had no prior experience of surgery showed higher preference for using a cream over surgery for the treatment of their skin cancer compared to individuals who had previous



history of surgery (99). In a study of Danish cardiac patients, those who were younger were more likely to prefer personalized meetings with nurses for cardiac rehabilitation, and had lower preferences for other rehabilitation activities such as exercise and diet guidance, compared to older individuals (100).

On the association between mental health and preferences, a study of chronically ill patients from the US showed that participants who had clinical depression preferred a more active role in health decision making compared to those without clinical depression (63). Another study conducted among Medicaid patients from an urban county in the US found that those diagnosed with schizophrenia were more likely to choose higher quality clinics and travel a longer distance to obtain care compared to those not diagnosed with schizophrenia (101). In a study of adults attending general practice offices in London, having mild or moderate mental distress was associated with preferring help from informal care and general physicians, rather than formal mental health care (64). Lastly, Paczkowski et al. found that, in a population of Ethiopian women, depressive symptoms and PTSD were associated with lower preferences for indicators of quality care, including having a provider with a positive attitude and consistent drug/equipment availability (66).

There is a paucity of studies, however, that have assessed the relation between experience of potentially traumatic events (PTE) and health care attributes in low-income countries (LIC), especially in areas that have undergone recent conflict, such as countries in Sub Saharan Africa. This lack of studies is troubling for several reasons. First, the structure of health care as well as quality of and access to care is likely to be different in SSA, making it difficult to apply findings from high-income countries (HIC). Second, populations in countries with a recent history of conflict have increased experience of lifetime PTEs (21, 44, 50). Those who experience PTEs, especially multiple events, may develop long term physical and mental illnesses that require an increased level of care or reliance on the system. Therefore, these individuals may prefer or appreciate aspects of a health care clinic, such as a more thorough medical examination more compared to others. Lastly, experience of PTEs, especially accumulation of events, is associated with increased use of health care (78, 102, 103). In post conflict SSA countries, like Liberia, where the health care system is being rebuilt, it is of particular importance to understand whether preferences for care differ based on PTE experience, as those who experience PTEs are more likely to be high users of care (78, 103, 104). Findings from such an analysis would help practitioners and

policymakers understand the health care needs of a vulnerable segment of the population, and improve health system responsiveness.

Kruk et al. conducted a discrete choice experiment (DCE) to elicit preferences for facility use for illness in a population-based sample of adults from Nimba County, Liberia (33). They found that having a high quality physical examination and availability of medicines were the highest predictors of facility use. Building on previous work, I investigated whether preferences for facility use varied based on lifetime PTE experience.

## **Methods:**

### *Study description*

This analysis used data from a population-based study carried out in Nimba County, between November and December, 2008, described elsewhere (23, 44, 83). Briefly, a sample of men and women was obtained via a three-stage sampling design. Fifty (50) rural census enumeration areas were selected in the first stage; the probability of selection was proportional to the size of the rural areas. The second stage consisted of generating lists of households; 30 were randomly selected and in the third stage, Kish tables were used to select one respondent from each household. A respondent was only eligible if he or she was age 18 or older and a permanent resident of the household.

A consent document and structured questionnaire were developed in English and translated and back translated into Liberian English by Liberian study personnel. A pilot of the survey was implemented and 75 pre-tests were carried out for survey refinement and confirming of accuracy of translation. Two-week training sessions were conducted with the interviewers to assure adequate training. To ensure data quality, five percent of interviews were observed and three percent were chosen for re-interview at random. Written, informed consent was obtained from all participants. The Institutional Review Boards of the University of Michigan and Columbia University reviewed and approved the study protocol. The structured questionnaire obtained information about (a) demographics, (b) household wealth, (c) potentially traumatic event experience, and (d) a discrete choice experiment.

### *Demographics*

Age, sex, marital status, ethnicity, literacy, and wealth were measured. Age was dichotomized based on the median, while marital status was grouped into two categories based on whether the

respondent was married and cohabitating, widowed, divorced, separated, or never married. I categorized ethnicity into Mano, Gio, or other (Mandingo, Kpelle, Krahn, Bassa, or other). Literacy was ascertained through ease of reading; those who could read easily were considered literate while those who could read with difficulty or not at all were not considered literate. An asset index was used to generate an estimate of wealth, based on methods that have been used extensively in low-income countries (84). The ownership several material assets owned by each household was measured; these variables were then included in a principal components analysis to create an asset index, which was then categorized into tertiles.

#### *Potentially traumatic event exposure*

Lifetime PTE experience was measured using the Harvard Trauma Questionnaire (HTQ), which consists of a list of 39 stated stressful life events and has been used widely in low-income country settings (51, 86). Three approaches were considered to categorizing lifetime PTE experience: event type, an approach using principal components analysis, and an ordinal exposure, which was chosen as the most appropriate measure for the main exposure. Appendix B includes a thorough discussion of the thought process and analysis that was conducted to make this choice. Briefly, the ordinal exposure approach provided the least subjective method and eliminated exposure overlap so that mutually exclusive comparison groups could be created. I obtained the ordinal measure of lifetime PTE experience by summing the number of HTQ items endorsed, then estimating quartiles of this sum. Dummy variables of the quartiles were used in the final analysis.

#### *Discrete choice experiment*

The DCE was designed to estimate the attributes associated with choosing a health care clinic when sick. It has been described elsewhere (83). Briefly, based on the literature, discussions with key personnel from the Ministry of Health as well as local health care providers, and focus groups with local individuals living in villages not selected for the study, the following attributes were selected for inclusion in the experiment: waiting time (30 minutes, 2 hours, 4 hours), respectful treatment (clinic workers respect you, clinic workers do not respect you), availability of medicines (needed medicines are always in stock, needed medicines are not always in stock), quality of the physical exam (the nurse examines you carefully, the nurse does not examine you carefully), and cost (50 Liberian dollars (LD), 200 LD, 500 LD,

1,000 LD, and 1,500 LD). Using Sawtooth Software, scenarios to include in the experiment were identified based on a combination of the above attributes; five versions of seven choice tasks were obtained that maximized orthogonality and level balance, with overlap among attribute levels minimized (105). One fixed choice task was fielded to all respondents, in order to assess internal predictive model validity. Appendix D, Figure 1 diagrams the above steps. As this population had a known low literacy rate, pictorial descriptions of the scenarios for each choice task were used. Although this approach was not validated, debriefings with interviewers indicated that participants were able to understand complete the experiment (83).

#### *Outcome measures*

During the DCE, respondents were shown final eight clinic choice tasks and were asked to choose the clinic they would use to obtain care when sick out of three options: Clinic A, Clinic B, or an opt-out choice representing a traditional healer. A sample card used for this experiment is shown in Appendix D, Figure 2.

There were three possible choices that respondents could make during the DCE, Clinic A, B, or the opt-out choice of traditional healer. Random utility theory posits that respondents will choose the scenario that confers the highest utility, or value. The choices of respondents are then used to estimate preferences (utilities or values) for each attribute. The process for this estimation is described below in the statistical analysis section.

#### *Statistical analysis*

The main analysis for this study consisted of several steps. First, I ran univariable estimates of all demographic and wealth variables. Second, I used a mixed logit model to estimate utilities, or values, for each of the attributes in order to understand the association between each attribute and clinic choice. This process has been described elsewhere (83).

Briefly, the likelihood of choosing Clinic A, Clinic B, or the traditional healer opt-out (the outcomes) is estimated using a linear additive function of the attributes of one clinic, conditional on attributes of the other clinic, having the additional choice of a traditional healer as an opt-out. The utility for each individual for each scenario in each choice task is equal to a vector of attributes and a vector of beta coefficients for each attribute, as well as a stochastic component. For the outcome of the traditional

healer opt-out, all attribute levels were set to 0. If the equation is conditioned on the vector of beta coefficients, a standard multinomial model is obtained, and the probability of choosing a scenario in each choice task for each individual, based on a vector of attributes and a vector of beta coefficients, is estimable using a simulated maximum likelihood estimator (106). Thus, the choices of respondents (Clinic A, Clinic B, or the traditional healer opt-out) are linked to the beta coefficients for each attribute in a method similar to other models like multinomial logistic regression.

A mixed logit model is a generalization of the standard logit model; the parameters associated with the attribute levels used in the DCE vary randomly across individuals, which takes into account differences in preferences between individuals. Thus, the results are better able to capture realistic behavior of respondents (107). The model can also be extended to take into account individual level variables, such as PTE experience, that may be of interest, in addition to the attributes that describe the scenarios in each choice task. Interaction terms between these individual level variables and attributes can be included in the equation to assess whether the beta coefficients for each attribute vary based on the presence of the individual level variable. Equations for the mixed logit model, including a model that takes into account individual level variables, are shown in Appendix E.

I estimated a main effects model to understand the overall association between attributes and clinic choice. From this model, I obtained the mean coefficient as well as a standard deviation, which is used as a measure of preference differences in the population that can influence the magnitude and direction of preferences. Each attribute level has a coefficient that represents the gain or loss in value from moving from the referent level of the attribute to the modeled level. I also estimated four separate models with interaction terms between each of the attributes and each quartile of lifetime PTE experience, to understand whether the relation between attributes and clinic choice varied based on lifetime PTE experience. In each model, I included the opt-out of a traditional healer and treated the cost attribute as fixed while the other attributes were treated as random variables.

Lastly, I obtained predicted probabilities from the main effects model and used them to estimate the predicted uptake of five model clinics compared to a baseline formal health clinic that is currently available in rural Liberia. The model clinics chosen are shown in Appendix D, Table 1.

One limitation of DCEs is the assumption that individuals consider all attributes across the

alternatives presented to them and trade off between these attributes, choosing the scenario they most prefer. However, evidence suggests that some individuals apply alternative decision making approaches, for example, always choosing an alternative that has a particular attribute or attributes, without evaluating the differences between alternatives (108). Although random utility theory is generally robust to such violations, I repeated the analysis by removing individuals that were dominant responders – that is, respondents who always chose a clinic that had necessary medicines always in stock and where nurses conducted careful examinations (109).

All analyses were carried out using STATA SE 12 (87). Only participants with non-missing data for lifetime PTE experience were included in the analysis.

### **Results:**

Of the 1,464 individuals eligible respondents, 1,434 (98%) completed the survey. Of those, 1,431 completed the DCE. Of those, 1,319 (91.9%) had complete lifetime PTE experience information. Table 1 shows respondent demographic characteristics and the distribution of the lifetime PTE experience quartiles. The median respondent age was 38 and the majority of respondents were male (53.9%). Sixty-four point three percent (64.3%) were unmarried. The most common ethnicity reported was Gio (55.9%). Literacy was low, with 26.4 % respondents reporting the ability to read with ease.

Table 2 shows results from the main effects model. These have been discussed extensively elsewhere (83). Briefly, high-quality physical examinations ( $\beta = 3.62$ ,  $p < 0.05$ ) and availability of medicines were the highest predictors of preference for a clinic. A negative preference was found for cost ( $\beta = 1.71$ ,  $p < 0.05$ ) as well as the traditional healer opt-out (0.38,  $p < 0.05$ ). In the model with dominant responders removed, similar results were observed, though the associations between a high-quality physical examination, medication availability, and clinic preference were smaller in magnitude. Standard deviations were significantly different from the null and indicated that preferences were different across the population.

Tables 3 through 6 show results from models interacting lifetime PTE experience quartiles with attributes. Table 1 shows results from a model with an interaction term between the first quartile (0 to 12 events) of lifetime PTE experience and attributes. In this model, with dominant responders removed, I found that those who experienced 0 to 12 lifetime PTEs had a greater preference for respectful treatment

by the clinic staff ( $\beta = 0.3$ ,  $p < 0.05$ ), but lower preference for a high – quality physical examination ( $\beta = 0.22$ ,  $p < 0.05$ ) compared to those experienced more than 12 lifetime PTEs. Lastly, preference for a traditional healer was negative ( $\beta = -1.27$ ,  $p < 0.05$ ), indicating that experience of 0 to 12 lifetime PTEs was associated with lower preference for traditional care compared to those with more than 12 lifetime PTEs.

Table 4 shows estimates from a model with an interaction term between the second quartile (13 to 16 events) of lifetime PTE experience and attributes. In this model, I did not find a significant interaction between experience of 13 to 16 lifetime PTEs and attributes, meaning that preferences did not vary when comparing those who experienced 13 to 16 events to those who experienced 0 to 12, 17 to 20, and more than 20 lifetime PTEs.

Results from a model including an interaction term between experience of 17 to 20 lifetime PTEs and attributes are shown in table 5. I found that preference for government management of a facility was lower ( $\beta = -0.26$ ,  $p < 0.05$ ) among those who experienced 17 to 20 lifetime events compared to those who experienced 0 to 12, 13 to 16, and more than 20 lifetime PTEs. Experience of 17 to 20 events was not associated with any other attributes.

Table 6 shows results from a model with an interaction between experience of than 20 lifetime PTEs and attributes. In this model, those who experienced more than 20 lifetime events were had a lower preference for having clinicians respecting them ( $\beta = -0.3$ ,  $p < 0.05$ ), a higher preference for a high quality exam ( $\beta = 0.43$ ,  $p < 0.05$ ) and a higher preference for a traditional healer ( $\beta = 1.21$ ,  $p < 0.05$ ) compared to those who experienced 0 to 12, 13 to 16, and 17 to 20 lifetime PTEs.

Table 7 shows model clinic uptake results using predicted probabilities obtained from a main effects model with respondents with dominant preferences excluded. The proportion of the population predicted to choose model clinics 1 to 5 increased with addition of attributes most associated with facility preference as compared to the baseline clinic.

## **Discussion**

Using a discrete choice experiment, I found that preferences for facility choice differed based on lifetime PTE experience in a population-based sample of adults from Nimba County, Liberia. Specifically, I found that those who experienced the fewest lifetime PTEs had higher preference for respectful

treatment by the clinic staff, and a lower preference for both a high quality physical exam and a traditional healer compared to those reporting more lifetime PTEs. Those who experienced the highest amount of lifetime PTEs had a lower preference for respectful treatment by the clinic staff, a higher preference for a quality medical examination, and a higher preference for a traditional healer compared to those who experienced fewer lifetime PTEs. Lastly, improving facility quality by having medications in stock and providing quality physical exams increased predicted clinic uptake.

That preferences for facility choice can vary based on lifetime PTE experience is consistent with other findings that report a potential role for PTEs in shaping preferences for health care. Although I am not aware of another study that has assessed the relation between lifetime PTE experiences and preferences for health care, a few studies have compared preferences for care between those endorsing one type of event to those not endorsing that event. For example, a study by Christofides et al. conducted on a community sample of South African women compared preferences for health services of women who reported a past rape to women who did not report this event (65). Those who reported a past rape had higher preference for availability of HIV prophylaxis and a sensitive provider trained in counseling compared to those who did not report a past rape. Given the mental and physical health vulnerability of those experiencing rape, or a similar event involving the exchange of force, it is expected that these individuals would prefer appropriate medical services as well as staff specially trained in treating them. Another study of patients using services in an emergency department in Seattle found that experience of sexual assault and feeling a threat to life, were associated with preferences for counseling services (62). While the findings from these studies may not be directly compared to the findings I present here because they are focused on sexual assault, my work suggests that differences in preferences based on PTE experiences may not be limited to experience of sexual assault. Thus, these findings suggest that considering lifetime PTE experience in studies of preferences for care, specifically since experience of PTEs and use of services are linked, may also better reveal the health care needs and expectations of populations, especially of those most vulnerable.

The finding that respondents prefer respectful treatment by providers is consistent with research that has noted the importance of providing a service that recognizes the value and dignity of the patient. Studies conducted on population-based samples in Tanzania and Ethiopia have shown high preferences



for providers with positive attitudes and good interpersonal skills (24, 25). That those who experienced the highest amount of events had lower preference and those who experienced the fewest events had higher preference for respectful treatment can be partially explained by psychopathology, which often follows exposure to PTEs. Paczkowski et al. reported a negative association between depression, post-traumatic stress disorder and preferences for a provider with a positive attitude (66). Symptoms of depressed mood, anhedonia, and pessimism may be associated with lower expectations of or even negative perceptions of respect (110). Those with these symptoms, especially depressed mood and pessimism, are more likely to have lower self-worth or self-esteem; thus, they may not be able to link respectful treatment to a positive health service experience either because they believe they do not deserve it or they are unable to recognize or understand its value (111, 112). Additionally, such symptoms, coupled together with increased experience of events involving the exchange of force such as rape or combat, may lead individuals to trust providers less, and thereby be less concerned about, or even suspicious of, respectful treatment (113). Thus, those with more experience of PTEs may be less able to understand the value of respectful treatment, have low expectation of respectful treatment, and be less concerned about the interpersonal skills of their provider compared to those who experience fewer events.

My findings regarding preference for a high quality medical exam support a growing body of literature that shows that patients in low-income countries desire high quality care (24, 25, 114, 115). That I noted a significant interaction in the negative direction between experience of the fewest PTEs and preference for a high quality medical exam and a significant interaction in the positive direction between experience of the most PTEs and preference for a high quality medical exam may be partially explained by the increased experience in the highest PTE group of violent events as well as injuries. Among those who experienced the highest number of PTEs, 78.4%, 61.4%, and 52% of respondents reported a beating to the body, knifing or axing, or a serious injury from fighting due to war, respectively, compared to 11.1%, 3.9%, and 9.8%, respectively, of respondents who the fewest number of events. Events such as those listed above are more likely involve lasting health effects and require a more thorough physical examination (21). Given that the prevalence of such events is highest among those who experienced the highest number of events, due to medical necessity, this group of respondents may prefer a clinic that

offers a high quality exam more compared to those who experienced 0 to 12 events. Those who report fewer events may not have the same health needs prompting them to seek a high quality medical exam; as such, they have a lower preference for this attribute compared to those reporting more events. Thus, although the overall sample preferred clinics that offered a high quality medical exam, some differences were noted based on lifetime PTE experience.

Overall, respondents had a lower preference for the traditional healer opt-out; however, those who experienced the fewest events had a lower preference compared to those who experienced more events, while who experienced the most events had a higher preference for the traditional healer opt-out compared to those experiencing fewer events. Although I am not aware of any study I can directly compare these findings to, there is a limited literature that has assessed the role of the traditional healer in LICs. Often, traditional healers are used to provide relief from psychopathology, as well as physical ailments. A qualitative study conducted in Ghana on the use of traditional healers for mental health noted that one reason for use was the belief that psychopathology resulted from spiritual or supernatural reasons and traditional healers were better trained in the knowledge of treatment for such conditions (31). In addition to any recommendation for treatment, traditional healers also provide some informal counseling services, such as positive comments, listening, and talking through problems that could uncover the root of the psychological ailment (31). Although I did not directly estimate the prevalence of any mental disorder in my analysis, the association between lifetime PTE experience and psychopathology has been long established (116). As those with the most experience of PTEs are much more likely to endorse one or more mental disorders, it is likely that their higher preference for the traditional healer opt-out reflects their belief that a traditional healer may be an appropriate choice. In addition, while the adequacy and efficacy of these healers is still being debated, they may give patients more attention, have shorter wait times, and have drugs available compared to providers in formal health care settings. For individuals with the highest physical and mental health sequelae, most likely those with the highest event experience, such accessibility and care as found in traditional healers can be appealing, regardless of whether the treatments are effective. The preferences of those with the fewest events may not be driven as much by psychopathology and the perceived or real need for more attentive care; thus,

compared to those with more experience of events, their preference for the traditional healer opt-out was lower.

Results pertaining to preference for availability of medicines differed from those obtained by Paczkowski et al. in their study of preferences for obstetric care among a population-based sample of Ethiopian women (66). I did not find a significant interaction between lifetime experience of PTEs and availability of medications while Paczkowski et al. repeated a negative association between depressive symptoms and PTSD and availability of equipment and medication. While this study did not directly capture psychopathology, it is likely that a high proportion of individuals with the highest traumatic event experience endorsed some symptoms of poor mental health (117, 118). Results pertaining to preference heterogeneity for respectful treatment were similar to those reported by Paczkowski et al. (66). Thus, the use of lifetime PTEs as the exposure of interest cannot fully explain the null results I obtained between lifetime PTEs and preference for medication availability in this study. Two factors, however, may provide some insight. First, Paczkowski et al. used a slightly different attribute, availability of medicines and equipment, as their measure of clinic medical readiness, and this may account for some of the null findings. Second their study was conducted on a sample of women who were told to choose the clinic where they would like to deliver their next child. In a country with high maternal mortality, such as Ethiopia, the importance of the availability of medication and equipment during labor and delivery can be invaluable. The negative interaction between this attribute and psychopathology might have been the result of an inability to form a cognitive link between the availability of life saving equipment that might be necessary during delivery and facility quality (111). It may be that such an association can only be found in individuals with psychological illness following PTE experience, rather than just symptoms of them. As the majority of individuals exposed to traumatic events do not often meet the full diagnostic criteria for mood/anxiety disorder, this may also partially explain these null findings.

My main findings for predicted uptake of simulated clinics were in accordance with estimated mean associations between each attribute and clinic choice. Clinic 3, with a high quality medical exam and clinic 2, with assured availability of medications had the highest predicted uptakes, 71.4% and 62.2%, respectively, compared to the baseline clinic with neither, in model clinics where only one attribute was changed. Not surprisingly, the clinic with the highest predicted uptake was clinic 5 (84.7%), which

included all of the attributes used in this study. All of the attributes I changed in the simulations were positively associated with facility choice, so it is likely that improvements in any aspect of care that was tested are likely to be received well by the majority of the population. However, results from predicted uptake models suggest that focusing on training formal care providers in performing quality medical exams and ensuring that all clinics are adequately stocked with medications will have the most influence on increasing use of formal clinics.

This study had several limitations. First, the measure of lifetime PTE experience was not validated in this population, though the HTQ has shown good validity and reliability in samples from low-income countries and was specifically designed to measure traumatic events in low-income countries with a recent history of conflict (51, 86). Second, I did not directly estimate psychopathology in this analysis, mainly PTSD, which could have been invaluable in helping explain some of the results. However, it is likely that the highest quartile of PTE experience captured the majority of individuals with a mental illness, so this limitation is not as concerning (117, 118). Third, I was unable to externally validate the choice data, meaning that I do not know whether individuals would choose the same facility in reality as in the experiment. Fourth, DCEs assume that individuals make rational choices and choose the alternative with the maximum utility. Further, DCEs assume that individuals consider all attributes across the alternatives presented to them and tradeoff between these attributes, choosing the alternative they most prefer. However, evidence suggests that some individuals apply alternative decision making approaches, for example, always choosing an alternative that has a particular attribute or attributes, without evaluating the differences between alternatives (108, 109). Although random utility theory is generally robust to violations, such as the presence of irrational responses and non-compensatory decision-making, it is likely that some of the analysis reflects the influence of dominant responders who do not trade off when making facility choices. To address this limitation, I removed dominant responders from the analysis and based all inference on results obtained with these individuals removed. Fifth, the preferred distribution of parameters for mixed logit models remains undecided (100). Sixth, the amount of variability that is a result of true preference heterogeneity versus a result of the scale of attributes is currently being debated (100); thus, I could not directly compare findings from the interaction models to one another. Seventh, although the literature and health professionals informed the choice for attributes and levels used in this

experiment, it is possible that others important for facility choice were overlooked. Lastly, this experiment was conducted on a sample of adults in rural Liberia, and these findings are likely not generalizable to other populations.

These limitations notwithstanding, I found that preferences for two main indicators of quality, respectful treatment and quality of the medical exam, differed based on lifetime experience of PTEs. I also found that preferences for the traditional healer opt-out differed based on lifetime experience of PTEs. My findings suggest that two spectrums of facility preference exist among those with PTEs, one defined by low experience of PTEs and one defined by high experience of PTEs. Those with the highest experience are likely to be the highest users of care, and appear to prefer clinics that can offer a high quality examination. Their preferences for a traditional healer may be driven by their need for treatment of psychological symptoms or poor physical health. Care offered at a clinic that is a far walk, may not have medications available, and may not offer mental health care may be perceived as less beneficial than care offered by a traditional healer. While trained psychiatrists and psychologists would probably provide the most effective care for psychopathology, it is unlikely that the current rate for psychiatrists in Liberia, 2 per 10 million residents, will increase in the near future (89). Additionally, only 12% of nearest formal facilities provide mental health care (23). While the government in Liberia should provide training in mental health care to primary care providers, and improve facility quality so exam quality is better, the potential for training traditional healers in screening for mental health problems and providing limited counseling or care services should be investigated through research studies. Potentially, traditional healers could conduct these services and then refer the patient to formal care. However, any referral for mental health or other reasons may not be successful if formal care is not improved. Overall, the formal care system needs to improve quality of services to be responsive to the health care needs of those with PTEs.

Table 1: Demographic characteristics and lifetime potential traumatic event (PTE) experience in a population-based sample of adults from Nimba County, Liberia, 2008 (n=1434)\*

Variable	n (%) <sup>†</sup>
38 and older <sup>‡</sup>	704 (50.6)
Female	641 (46.1)
Married	497 (35.7)
Ethnicity	
Mano	530 (38.1)
Gio	778 (55.9)
Other	83 (6)
Reads easily	367 (26.4)
Wealth tertile <sup>§</sup>	
Lowest tertile	466 (33.5)
Middle tertile	461 (33.2)
Highest tertile	462 (33.3)
Lifetime traumatic event experience	
First quartile (0 to 12 events)	354 (25.45)
Second quartile (13 to 16 events)	333 (23.94)
Third quartile (17 to 20 events)	338 (24.30)
Fourth quartile (more than 20 events)	366 (26.31)

\* Totals may not add up due to missing data

<sup>†</sup> Data is n(%) unless otherwise specified

<sup>‡</sup> Based on greater than the median value

<sup>§</sup> Constructed using principal components analysis on a set of 18 household wealth indicators

Table 2: Mixed logit model results for the main effects model in a sample of adults from Nimba County, Liberia (n=1434)

Attributes	All respondents				Excluding respondents with dominant preferences			
	Mean	SE	SD	SE	Mean	SE	SD	SE
Waiting time (continuous in hrs.)	0.004	0.02	0.14*	0.04	-0.01	0.02	0.21*	0.03
Clinic staff show respect	0.35*	0.06	1.13*	0.07	0.39*	0.07	1.22*	0.07
Medicines are always available	1.71*	0.08	1.91*	0.09	1.12*	0.06	1.05*	0.07
High-quality physical examination	3.62*	0.12	2.61*	0.11	1.54*	0.06	-0.81*	0.07
Government manages facility	0.13*	0.05	0.69*	0.08	0.15*	0.06	0.82*	0.08
Cost (continuous in 1000 LD)	-0.36*	0.05			-0.37*	0.06		
Traditional healer opt out	-0.38*	0.09			-0.42*	0.09		
Model diagnostics								
Number of respondents	1,431				688			
Number of observations	34,344				16,512			
Log likelihood	-5,332.40				-3,978			
Likelihood ratio $\chi^2$	2,267.80				592.6			

\* p < 0.05

Table 3: Mixed logit model results including an interaction between lifetime potentially traumatic event (PTE) experience of 0 to 12 events and discrete choice experiment attributes in a sample of adults from Nimba County, Liberia (n=1434)

	All respondents				Excluding respondents with dominant preferences			
	Mean	SE	SD	SE	Mean	SE	SD	SE
Main effects								
Attributes								
Waiting time (continuous in hrs.)	-0.004	0.02	0.1*	0.04	-0.01	0.02	0.14*	0.03
Clinic staff show respect	0.3*	0.06	1.04*	0.07	0.3*	0.07	1.05*	0.07
Medicines are always available	1.72*	0.09	1.76*	0.08	1.08*	0.07	0.87*	0.07
High-quality physical examination	3.59*	0.13	2.38*	0.11	1.53*	0.07	0.56*	0.07
Government manages facility	0.13*	0.06	0.59*	0.09	0.16*	0.07	0.68*	0.08
Cost (continuous in 1000 LD)	-0.42	0.06			-0.43*	0.06		
Traditional healer opt out	-0.29*	0.11			-0.37*	0.1		
0 to 12 PTEs X								
Waiting time (continuous in hrs.)	0.03	0.04			0.02	0.04		
Clinic staff show respect	0.28*	0.12			0.3*	0.14		
Medicines are always available	-0.01	0.16			-0.04	0.12		
High-quality physical examination	-0.28	0.2			-0.22*	0.11		
Government manages facility	-0.05	0.12			-0.05	0.13		
Cost (continuous in 1000 LD)	0.19	0.12			0.19	0.12		
Traditional healer opt out	-1.31*	0.25			-1.27*	0.24		
Model diagnostics								
Number of respondents	1391				658			
Number of observations	33384				15792			
Log likelihood	-5018.1				-3675.3			
Likelihood ratio $X^2$	1761				313.1			

\* p < 0.05



Table 4: Mixed logit model results including an interaction between lifetime potentially traumatic event (PTE) experience of 13 to 16 events and discrete choice experiment attributes in a sample of adults from Nimba County, Liberia (n=1434)

	All respondents				Excluding respondents with dominant preferences			
	Mean	SE	SD	SE	Mean	SE	SD	SE
Main effects								
Attributes								
Waiting time (continuous in hrs.)	0.01	0.02	0.13*	0.03	-0.001	0.02	0.14*	0.03
Clinic staff show respect	0.38*	0.06	1.05*	0.07	0.4*	0.07	1.08*	0.07
Medicines are always available	1.76*	0.09	1.76*	0.08	1.07*	0.07	0.87*	0.07
High-quality physical examination	3.52*	0.13	2.39*	0.11	1.5*	0.07	0.56*	0.07
Government manages facility	0.09	0.06	0.58*	0.09	0.11	0.06	0.67*	0.08
Cost (continuous in 1000 LD)	-0.38*	0.06			-0.39*	0.06		
Traditional healer opt out	-0.5*	0.11			-0.56*	0.11		
13 to 16 PTEs X								
Waiting time (continuous in hrs.)	-0.02	0.04			-0.02	0.04		
Clinic staff show respect	-0.05	0.13			-0.07	0.14		
Medicines are always available	-0.18	0.17			-0.02	0.13		
High-quality physical examination	0.00	0.2			-0.13	0.11		
Government manages facility	0.1	0.12			0.12	0.13		
Cost (continuous in 1000 LD)	0.04	0.12			0.04	0.12		
Traditional healer opt out	-0.15	0.22			-0.14	0.21		
Model diagnostics								
Number of respondents	1391				658			
Number of observations	33384				15792			
Log likelihood	-5052				-3707.8			
Likelihood ratio $X^2$	1768.5				327.8			

\* p < 0.05

Table 5: Mixed logit model results including an interaction between experiencing 17 to 20 lifetime potentially traumatic events (PTE) and discrete choice experiment attributes in a sample of adults from Nimba County, Liberia (n=1434)

	All respondents				Excluding respondents with dominant preferences			
	Mean	SE	SD	SE	Mean	SE	SD	SE
Main effects								
Attributes								
Waiting time (continuous in hrs.)	0.003	0.02	0.13*	0.03	-0.01	0.02	0.14*	0.03
Clinic staff show respect	0.36*	0.06	1.06*	0.07	0.37*	0.07	1.08*	0.07
Medicines are always available	1.7*	0.09	1.77*	0.08	1.08*	0.07	0.88*	0.07
High-quality physical examination	3.55*	0.13	2.39*	0.11	1.48*	0.07	0.56*	0.07
Government manages facility	0.18*	0.06	0.59*	0.09	0.21*	0.06	0.67*	0.08
Cost (continuous in 1000 LD)	-0.36*	0.06			-0.38*	0.06		
Traditional healer opt out	-0.48*	0.11			-0.54*	0.11		
17 to 20 PTEs X								
Waiting time (continuous in hrs.)	0.0008	0.04			-0.006	0.04		
Clinic staff show respect	0.04	0.13			0.04	0.14		
Medicines are always available	0.07	0.17			-0.06	0.13		
High-quality physical examination	-0.07	0.2			-0.03	0.12		
Government manages facility	-0.24*	0.12			-0.26*	0.13		
Cost (continuous in 1000 LD)	-0.02	0.12			-0.03	0.13		
Traditional healer opt out	-0.23	0.22			-0.21	0.21		
Model diagnostics								
Number of respondents	1391				658			
Number of observations	33384				15792			
Log likelihood	-5051				-3706.7			
Likelihood ratio $X^2$	1771.7				328.7			

\*  $p < 0.05$

Table 6: Mixed logit model results including an interaction between experiencing more than 20 lifetime potentially traumatic events (PTE) and discrete choice experiment attributes in a sample of adults from Nimba County, Liberia (n=1434)

	All respondents				Excluding respondents with dominant preferences			
	Mean	SE	SD	SE	Mean	SE	SD	SE
Main effects								
Attributes								
Waiting time (continuous in hrs.)	0.00	0.02	0.1*	0.04	-0.008	0.02	0.14*	0.03
Clinic staff show respect	0.44*	0.06	-1.04*	0.07	0.45*	0.07	1.06*	0.07
Medicines are always available	1.66*	0.09	1.77*	0.09	1.03*	0.07	0.88*	0.07
High-quality physical examination	3.4*	0.13	2.43*	0.11	1.37*	0.06	0.56*	0.07
Government manages facility	0.08	0.06	-0.61*	0.08	0.1	0.06	0.67*	0.08
Cost (continuous in 1000 LD)	-0.32*	0.06			-0.33*	0.06		
Traditional healer opt out	-0.92*	0.11			-0.96*	0.11		
More than 20 PTEs X								
Waiting time (continuous in hrs.)	-0.01	0.04			0.004	0.04		
Clinic staff show respect	-0.29*	0.12			-0.3*	0.14		
Medicines are always available	0.16	0.16			0.15	0.13		
High-quality physical examination	0.51*	0.19			0.43*	0.12		
Government manages facility	0.19	0.12			0.2	0.13		
Cost (continuous in 1000 LD)	-0.21	0.12			-0.21	0.12		
Traditional healer opt out	1.27*	0.21			1.21*	0.21		
Model diagnostics								
Number of respondents	1391				658			
Number of observations	33384				15792			
Log likelihood	-5014.3				-3671			
Likelihood ratio $X^2$	1759.3				311.9			

\* p < 0.05

Table 7: Descriptions of model clinics used to generate predicted uptake among a population-based sample of adults from Nimba County, Liberia, 2008 (n = 658)

Scenario	Predicted uptake*
	Total sample (n=658)
Model clinic 1 <sup>†</sup>	47.8
Model clinic 2 <sup>‡</sup>	62.2
Model clinic 3 <sup>§</sup>	71.4
Model clinic 4 <sup>¶</sup>	42.3
Model clinic 5 <sup>**</sup>	84.7

\* Based on model excluding dominant respondents

<sup>†</sup> Wait time four hours, clinic workers respect you, cost 1,000 Liberian dollars (LD)

<sup>‡</sup> Wait time four hours, medications always available, cost 1,000 Liberian dollars (LD)

<sup>§</sup> Wait time four hours, nurse examines you carefully, cost 1,000 Liberian dollars (LD)

<sup>¶</sup> Wait time four hours, government manages the facility, cost 1,000 Liberian dollars (LD)

<sup>\*\*</sup> Wait time four hours, all other attributes included, cost 1,000 Liberian dollars (LD)

## CHAPTER 4: CONCLUSIONS

## **Aims**

This dissertation had three aims. First, I attempted a systematic review of the association between potentially traumatic events (PTE) and health care service use in low and lower-middle income countries (LIC; LMIC). Second, using cross sectional, population-based data, I assessed the relation between lifetime PTEs and past year use of formal and informal health services in adults from Nimba County, Liberia. Lastly, using data from a discrete choice experiment from the same sample of adults from Nimba County, I estimated the association between lifetime PTEs and preferences for health care services.

## **Summary of results**

I identified two studies on the association between PTEs and health care service use in LICs, highlighting an unfortunate gap in the literature, and made several recommendations for future research. Studies should use validated measures of PTEs and focus on a range of events, instead of one specific type, as this will provide inform our general understanding of the association between PTEs and health care service use. Studies conducted in countries with informal and formal care systems need to assess the relations between PTE experience and both forms of health care use in order to gain a more complete picture of service use, which may prove helpful for improving formal care. Lastly, in order to understand the service use patterns of individuals with and without PTE experience, studies should elicit preference for care and assess heterogeneity for preferences based on PTE experience to inform health system responsiveness.

I reported that lifetime PTE experience was associated with both formal and informal health care service use. These findings suggest that individuals who experience several PTEs compared to those who experience fewer may view informal and formal care as complementary, perhaps because the formal care system may not be completely responsive to their health care needs. Specifically, the formal care system may not be able to respond to needs for mental health care services or treatments, and access may also be a problem. Despite this, not all individuals used both services; among those who used no informal care, I found a positive association between having the highest experience of PTEs and use of formal care. This suggests that not all individuals view the two care systems as complementary and some may rely solely on care from the formal care system, perhaps because they are better able to obtain

formal care compared to others or are unable to obtain informal care as easily as others.

Lastly, results from the discrete choice experiment showed that those with fewer PTEs had higher preference for respectful treatment, lower preference for quality examinations, and a traditional healer opt-out when making a choice for a formal health facility compared to those with more PTEs. Conversely, those who experienced more events had lower preference for respectful treatment and higher preference for a high quality exam and the traditional healer opt-out compared to those with fewer events. These preference differences may be due to the need for a higher quality exam and treatment of psychopathology among those with a high lifetime PTE experience, as these individuals are more likely to have poor physical and mental health problems as a result of their PTE experience. Individuals who experience several events may prefer the services of traditional healer, as their care is perceived to be more attentive and especially useful for treatment of mental health problems compared to care found in formal care clinics.

Results from Chapters 1 through 3 have several limitations. First, it is possible that I may have not identified every published study on the association between PTEs and health care use; however, I searched several databases and used a variety of search terms, so this possibly is small. Second, analyses for Chapters 2 and 3 were based on cross-sectional data and establishing temporality was not possible. Third, the HTQ was not validated for use with the Liberian population; however, studies in other low-income countries have shown good validity and reliability. Fourth, all individual level data was based on self-reports, and misclassification is possible. However, misclassification is routine in observational studies using self-report data. Fifth, I did not present estimates of mental health, which may have been helpful in explaining some of the results I found. Sixth, while data from the discrete choice experiment is useful in estimating individuals stated preference, individuals may make different choices in reality and external validation is required to further understand the extent to which this occurs. Lastly, findings from these analyses are from a population in rural Liberia, and it is unlikely that they can be generalized to other settings.

### **Significance**

Despite these limitations, my findings have several significant implications for public health. First, while several studies have been carried out linking PTE experience and health care seeking, few have

explored the associations between lifetime PTE experience and formal and informal service use. Results indicate that individuals who experience PTEs may complement their formal care with informal service. This suggests that the formal health system may not be completely responsive to health care needs for most individuals, especially where mental health is concerned. However, I noted a significant relationship between PTE experience and formal care use among individuals who did not use informal care services. A lower availability of traditional healers may prompt individuals to seek formal care. Future work needs to be done to help policymakers and providers further understand why some individuals who experience PTEs use both types of care and others only rely on formal care.

Second, my results indicate high use of informal care services and, in some individuals with a high experience of PTEs, a preference for traditional healers. Although more work needs to be carried out on the role that psychopathology has in the link between PTE experience and use of traditional health, informal care providers probably fill a crucial role in mental health care. Further studies that explore the extent of this role, and whether some informal care providers like traditional healers can be trained to screen for mental health problems and provide limited counseling services are needed. Of course, not all individuals may use informal care for mental health reasons; others may use it because of the short wait times, the longer provider-patient interaction, and in the case of using black baggers or pharmacists, access to medication without having to go to a formal care clinic. Further work understanding other uses of informal care may prove beneficial in informing formal health system responsiveness.

Lastly, this work was carried out using a population-based sample in a post-conflict, LIC. Very few studies using such samples have been conducted on the association between PTEs and health care service use. However, it is critical that we conduct this type of research in these settings because the experience of PTEs, the health care systems, and factors associated with both are very different compared to what is found in high-income countries. Countries seeking to rebuild health systems and improve their responsiveness should use evidence-based studies to inform their thinking. More studies that ascertain the service use and preference patterns of individuals, especially those who are high users and rely most on the system, need to be done in LICs and LMICs to aid policymakers and providers in their task.



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## **Appendix A: Mechanisms linking PTE experience to health care service use**

There are four major pathways that may link experience of PTEs to health care service use: a direct pathway, and three indirect pathways through psychopathology, chronic stress, and risk behavior. The direct pathway links experience of events that require immediate medical care, such as violent events like gun wounds and injuries from events like major motor vehicle accidents, to health service use. A second major pathway is indirect through the development of psychopathology, especially PTSD, as a result of the PTE experience, which can have several mental and physical health effects, leading to an increased use of health services. There are several hypothesized mechanisms through which experience of a PTE can lead to PTSD. One such mechanism involves the process of allostasis, which postulates that individuals encounter a stressor that results in physiologic responses, involving the central and peripheral nervous, endocrine, and immunologic systems, designed to cope with these stressors and return the body to homeostasis (12, 71). Allostatic load is the combined effect of cycling through allostasis, and may result in strain in the above mentioned systems (12, 71). Those individuals who are unable to return the body to homeostasis, most likely because they cannot forget or have become sensitized to the stressor, are those who are likely to develop PTSD (72). Indeed, cued reactivity to reminders of the initial PTE is characteristic of the disorder, highlighting that a prolonged stress response likely occurs due to the inability to cope with the original exposure. Thus, a prolonged stress response by the body may result in an increased allostatic load, which may then lead to several of the endocrine, brain, and nervous system changes that are associated with PTSD.

This prolonged stress response, as a result of PTSD or other psychopathology, may lead to poor physical health outcomes, and thus, increased health service use. The physiologic responses involved in allostasis include the nervous, endocrine, and immunologic systems; responses of these systems have the potential to, in turn, affect several other systems including cardiovascular and metabolic (12). Prolonged activation of stress response, may therefore lead to prolonged strain on the body that can lead to physical illness. Supporting this notion is that PTSD is associated with several physical illnesses (73). For example, Boscarino et al. reported that PTSD symptoms in a sample of twin pairs from the Vietnam Era Twin Registry were associated with an increased risk of rheumatoid arthritis (74). PTSD was also associated with increased the risk of hypertension in the National Comorbidity Study (75). Lastly, in a

sample of low socioeconomic status (SES) individuals, PTSD was associated an increased likelihood of metabolic syndrome (119). It is likely that PTSD mediates some, but not all, of the effect of traumatic events on physical health. In a study of 109 female Vietnam War veterans, Friedman et al. found that PTSD mediated 56% of the association between exposure to PTEs and current health status (12). Lastly, Wagner et al. found the relationship between future health status and exposure to combat related traumatic events decreased when adjusted for PTSD in a sample of Gulf War veterans (120).

Other indirect pathways to poor physical health and subsequent health service use do not act completely through psychopathology. Two of these indirect paths include chronic stress and risk behaviors. An increase in chronic stress can result in two main ways. Individuals exposed to a PTE may develop symptoms of distress but not meet the diagnostic criteria for PTSD or for other disorders. In these individuals, physiologic reactivity may still occur as a result of this distress, leading to an increase in allostatic load and subsequent physical illness despite no diagnosed psychopathology being present in these individuals. Additionally, individuals may exhibit cued reactivity to a trigger related to the original trauma but are not consciously aware of the reactivity (68). Thus, the physiologic response is affected, but this occurs outside of the individual's awareness. Lastly, individuals may exhibit poor behavioral coping strategies as a result of traumatic event experience, such as increased substance use and other risk taking, which in turn causes a decline in physical health (12, 68). This may, in turn, increase use of health services.

## **Appendix B: Categorization of PTE experience**

For AIM 2 and AIM 3, I considered several methods of categorizing potentially traumatic event (PTE) experience, as measured by the Harvard Trauma Questionnaire (HTQ; see Table 1) including a nominal exposure where events were grouped based on the type of trauma (assaultive violence/ other injury/shocking event, learning about trauma to others, and sudden, unexpected death of a close friend or relative), using principal components analysis (PCA) to identify the HTQ items with the highest scoring factors, and an ordinal exposure, where HTQ items were summed up, and divided into quartiles. Each of these methods included strengths and limitations, which were fully considered when choosing the final exposure method used in the main analysis for AIM 2 and AIM 3.

### *Grouping based on event type*

In order to group lifetime potentially traumatic event (PTE) experience into categories of assaultive violence, injury/other shocking event, learning about trauma to others, and sudden, unexpected death of a close friend or relative, several steps were taken. First, I grouped each of the Harvard Trauma Questionnaire items according to each of the three categories noted above, using Breslau et al. as a guide (see Table 1). I was unable to find an event that I could consider as learning about traumas to others in the HTQ. Therefore, I excluded learning about trauma to others as a category. Second, univariable statistics were generated to assess the distribution of each HTQ item (see Table 1), in order to inform categorization for the three PTE types (assaultive violence, injury/other shocking event, sudden, unexpected loss of a close friend or relative). As apparent from these univariable statistics, there was much overlap between the three types and it was impossible to create completely mutually exclusive exposure categories of assaultive violence, injury/other-shocking event. Therefore, for the third step, I summed up the HTQ events in each of the three categories, obtained the median of the number of HTQ events experienced in each category, described in Table 3, and then created a main PTE exposure based on whether or an individual met the median for exposure. I assumed a hierarchy of severity. Those individuals who had greater than the median experience of assaultive violence (4 events) were considered exposed to assaultive violence. Those individuals who had less than the median experience of assaultive violence were considered unexposed. Of these individuals unexposed to assaultive violence, those who had greater than the median experience of injury/other shocking events (12 events)

were considered exposed to injury/other shocking event. Those who had less than the median experience of injury/other shocking event were considered unexposed. Of these individuals unexposed to injury/other shocking event, those who had greater than the median experience of sudden, unexpected death of a close friend or relative (1 event) were considered exposed to sudden, unexpected death of a close friend or relative. Those who did not have greater than the median experience of sudden, unexpected death of a close friend or relative constituted the final exposure category. These individuals were considered unexposed to assaultive violence, injury/other shocking event, and sudden, unexpected death of a close friend or relative. The distribution of this exposure is shown in Table 3.

#### *Grouping based on PCA*

Another approach was to understand what HTQ items were associated with having high lifetime PTE experience, while maximizing the variation in the data. In order to group the exposure in this manner, I used PCA, which estimates the linear combination of variables that explain the most variation in the data as well as identifies the variables that are most associated with increasing values of the principal component. One use of PCA is to measure wealth in low-income countries where information on income and consumption is not readily available (84). All HTQ items were included in the analysis and the first principal component was used for the analysis, as is the standard. Results are shown in Table 2. I created tertiles of the resulting PTE index. I also obtained a list of eigenvectors, and, using the approach described in Filmer and Pritchett, I divided the eigenvectors of each HTQ item by the standard deviation of the mean of that HTQ item (84). I then visually inspected the values to identify pattern. There were six items that clustered with similar scoring factors, ranging from 0.64 to 0.61, shown in Table 3. The interpretation of these scoring factors is as follows: an individual who was forced to physically harm someone who was not a friend or family member had a trauma index that was 0.64 points higher compared to someone who did not experience this event. Overall, these six HTQ items were the ones that were most associated with having high lifetime PTE experience. Individuals who endorsed any of these six items were considered exposed based on this approach, while individuals who did not experience any of these six items were considered unexposed. The distribution of this exposure is shown in Table 3.

#### *Grouping based on ordinal measure*

I created an ordinal measure of exposure based on the sum of HTQ items. Once the sum was obtained, I created quartiles of exposure, and then created dummy variables from these quartiles. The distribution of this exposure is shown in Table 3.

#### *Strengths and limitations of each approach*

Each approach used to categorize lifetime PTE experience in a meaningful way had strengths and limitations. Comparative assessments of all three measures are shown in Tables 3 and 4.

Categorizing based on event type allows one to assess the severity of each event, as it was presumed that an assaultive violent event would be a more severe PTE compared to sudden, unexpected loss of a close friend or relative. In addition, using this measure would have better allowed me to understand the association between type of event and health care use. Specifically, I would have been able to compare the health care use of someone experiencing an assaultive violent event to someone experiencing the sudden death of a close friend or relative, where care might not necessarily be expected. However, this approach had several limitations that prevented its full implementation in this dissertation. First, I was unable to obtain mutually exclusive categories of exposure. In this sample, almost all of the respondents were exposed to an assaultive violent event or an injury/other shocking event. Therefore, proper comparison groups were very difficult to establish. In this approach, someone not meeting the exposure to assaultive violence was not in reality unexposed to assaultive violence; they simply did not have more than the median experience of assaultive violent events. Since having proper comparison groups is essential in epidemiology to establish a contrast between the exposed and unexposed, I found this approach problematic. Second, this approach presumed a hierarchy of severity; it was presumed that assaultive violence indicated a more severe PTE experience than an injury/other shocking event. There is evidence to support this claim, however, it is a presumption nonetheless (48, 67, 121). This assumption may be assessed by measuring the agreement between the hierarchy and a respondent's worst event. However, respondents' worst events were not ascertained and so I could not carry out such a sensitivity analysis. Lastly, grouping events into these types using the HTQ was difficult. It was not apparent whether disappearance or kidnapping of a child should have been grouped as a sudden, unexpected death of a close friend or relative or as an injury/other shocking event. Taken

together, the limitations of this approach outweighed the strengths, and I did not use it for the final AIM 2 or AIM 3 analyses.

Using the PCA approach identified a measure that would best maximize the variability of PTE experience in this sample, which, given the overlap of PTE experience as noted above, would be useful. In addition, I would be able to capture some understanding of severity by identifying items that were most associated with having high lifetime PTE experience. In this way, I was able to maximize variation while measuring severity, but based on a quantitative measure, instead of a qualitative assessment, as discussed above with event type. However, this approach had three limitations. First, as shown in Table 4, the distribution of individuals who endorsed the six items with the highest eigenvector/SD values and those who did not did not differ for every event type as it did for grouping based on event type and the ordinal measure. Thus, although the PCA approach had a distribution that was closely associated with the distributions for event type and ordinal exposure, the ability to achieve proper group comparison was hindered because individuals did not differ as much on some HTQ events as they did using the other two approaches. Second, the grouping used in this measure treats all individuals who did not experience any of the six items as unexposed, but since these individuals could have experienced other, very different items, they should be further subdivided. If I used tertiles of the first principal component (as shown in Table 2), I could have three groups of exposure, but I would lose the ability to use items as a way of identifying individuals who are most likely to have high lifetime PTE experience. Lastly, the interpretation of the measure, as it applies to PTE experience, is not straightforward. It is not immediately clear what being in the highest tertile of lifetime PTE experience means, as it applies to event type, severity, and the number of events respondents experienced. Thus, for these reasons, I decided not to use this measure.

Lastly, I used an ordinal exposure as a measure of lifetime PTE experience. This measure grouped individuals based solely on the number of events, divided into quartiles. This measure was able to establish mutually exclusive groups, alleviating the problem of the former two approaches. In addition, since those with more events tend to have a more severe lifetime PTE experience, as shown in this data (see Tables 3 and 4), this measure was also able to capture a sense of severity using a quantitative, rather than a qualitative measure. However, this approach had some limitations. First, while this approach avoided subjectivity noted in the event type approach, each event was weighted the same in its potential

association with service use, something that does not likely bear out in reality. However, I was able to capture an estimate of severity by using quartiles, and the distribution of the ordinal measure was closely associated with the distributions of the event type and PCA approach, thus alleviating some concerns of this limitation. Second, this measure was unable to identify unexpected compared to implicit use of services, as grouping by event type would have allowed me to assess. To address this limitation, I conducted a sensitivity analysis by removing individuals exposed to events that were the most likely to be implicitly associated with health care seeking. This analysis can be found in the main document.

Taken together, the strengths of the ordinal measure outweighed the limitations. While the other measures considered important facets of lifetime PTE experience, their limitations made them difficult to implement in the main analysis. Thus, I decided on using the ordinal measure for all main and sensitivity analyses in both AIM 2 and AIM 3.

Table 1: Exposure to Harvard Trauma Questionnaire (HTQ) potentially traumatic events (PTE) in a population-based sample of adults from Nimba County, Liberia, 2008

Items	Total sample (n = 1263)
<b>Assaultive violence*</b>	<b>n (%)</b>
Combat situation (e.g. shelling, grenades, or shots being fired at or near you)	1186 (93.9)
Beating to the body	557 (44.1)
Rape	49 (3.9)
Marriage by abduction or running away with	89 (7)
Other types of sexual abuse	117 (9.3)
Knifing or axing	318 (25.2)
Torture	521 (41.3)
Serious physical injury from fighting due to war	357 (28.3)
Forced labor (like a slave)	765 (60.6)
Extortion or robbery	923 (73.1)
Kidnapped	181 (14.3)
<b>Other injury/shocking<sup>†</sup></b>	
Lack of shelter	1155 (91.4)
Lack of food or water	1189 (94.1)
Ill health without access to medical care (sick and couldn't get to a clinic or hospital)	1190 (94.2)
Confiscation (seizing) or destruction of personal property	1161 (91.9)
Forced leaving/departure under dangerous conditions	1232 (97.5)
Imprisonment	605 (47.9)
Brainwashing	617 (48.9)
Forced to hide	1153 (91.3)
Other forced separation from family members	813 (64.4)
Forced to find and bury bodies	240 (19)
Enforced isolation from others (Forced to be apart from others)	819 (64.8)
Someone was forced to betray you and placed you at risk of death or injury	428 (33.9)
Prevented from burying someone	239 (18.9)
Forced to desecrate or destroy the bodies or graves of deceased persons	89 (7)
Forced to physically harm family member or friend	167 (13.2)
Forced to physically harm someone who is not a family member, or friend	206 (16.3)
Forced to destroy someone else's property or possessions	257 (20.3)
Forced to betray family member, or friend placing them at risk of death or injury	155 (12.3)
Forced to betray someone who is not family or friend placing them at risk of death or injury	182 (14.4)
Disappearance or kidnapping of spouse	94 (7.4)
Disappearance or kidnapping of child	115 (9.1)
Disappearance or kidnapping of other family member or friend	586 (46.4)
Serious physical injury of family member or friend due to war	755 (59.8)
Witness beatings to head or body	1135 (89.9)
Witness torture	1137 (90)
<b>Sudden, unexpected death of a close friend or relative<sup>‡</sup></b>	
Murder, or death due to violence, of spouse	76 (6)



Murder, or death due to violence, of child	118 (9.3)
Murder, or death due to violence, of other family member or friend	612 (48.5)

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\* This category of traumatic event exposure includes events such as rape, other sexual assault, combat, mugging, badly beaten, held captive, tortured, shot, and stabbed (13); median in the total sample was 4

† This category includes events like serious motor vehicle accident, any other type of serious accident or injury, experiencing a fire, man-made, or natural disaster, life-threatening illness, a child being diagnosed with a life-threatening illness, witnessing someone killed or maimed, and unexpectedly discovering a dead body (13); median in the total sample was 12

‡ This category includes only one type of event, the sudden, unexpected death of a close friend or relative (13); median in the total sample was 1

Table 2: Principal components analysis (PCA) of the Harvard Trauma Questionnaire (HTQ) items in a population-based sample of adults from Nimba County, Liberia, 2008 (n=1263)

HTQ Item	Values obtained from the first principal component				Means				
	Eigenvector	Mean	SD	Eigen vector/SD	PTE index*			Top six Eigenvector/SD values†	
					Lowest tertile	Middle tertile	Highest tertile	No	Yes
Forced to destroy someone else's property or possessions	0.25	0.2	0.4	0.64	0.005 (0.005)	0.055 (0.055)	0.551 (0.551)	0 (0)	0.646 (0.646)
Forced to physically harm someone who is not a family member, or friend	0.23	0.16	0.36	0.64	0.005 (0.005)	0.05 (0.05)	0.435 (0.435)	0 (0)	0.518 (0.518)
Forced to betray someone who is not family or friend placing them at risk of death or injury	0.22	0.14	0.35	0.64	0.01 (0.01)	0.036 (0.036)	0.387 (0.387)	0 (0)	0.457 (0.457)
Forced to betray family member, or friend placing them at risk of death or injury	0.21	0.12	0.32	0.64	0.01 (0.01)	0.033 (0.033)	0.325 (0.325)	0 (0)	0.389 (0.389)
Forced to desecrate or destroy the bodies or graves of deceased persons	0.16	0.07	0.25	0.62	0.002 (0.002)	0.029 (0.029)	0.181 (0.181)	0 (0)	0.224 (0.224)
Forced to physically harm family member or friend	0.21	0.13	0.34	0.61	0.01 (0.01)	0.038 (0.038)	0.349 (0.349)	0 (0)	0.42 (0.42)
Forced to find and bury bodies	0.21	0.19	0.39	0.54	0.019 (0.019)	0.081 (0.081)	0.47 (0.47)	0.087 (0.087)	0.415 (0.415)
Forced leaving/departure under dangerous conditions	0.08	0.98	0.15	0.53	0.936 (0.936)	0.995 (0.995)	0.995 (0.995)	0.97 (0.97)	0.987 (0.987)
Kidnapped	0.17	0.14	0.35	0.5	0.01 (0.01)	0.081 (0.081)	0.34 (0.34)	0.08 (0.08)	0.281 (0.281)
Torture	0.24	0.42	0.49	0.49	0.052 (0.052)	0.373 (0.373)	0.812 (0.812)	0.299 (0.299)	0.658 (0.658)
Someone was forced to betray you and placed you at risk of death or injury	0.23	0.32	0.47	0.49	0.057 (0.057)	0.257 (0.257)	0.703 (0.703)	0.201 (0.201)	0.638 (0.638)
Combat situation (e.g. shelling, grenades, or shots being fired at or near you)	0.12	0.94	0.24	0.49	0.843 (0.843)	0.979 (0.979)	0.995 (0.995)	0.921 (0.921)	0.977 (0.977)
Knifing or axing	0.21	0.24	0.43	0.48	0.033 (0.033)	0.152 (0.152)	0.57 (0.57)	0.164 (0.164)	0.442 (0.442)
Witness beatings to head or body	0.13	0.9	0.3	0.45	0.755 (0.755)	0.952 (0.952)	0.988 (0.988)	0.868 (0.868)	0.965 (0.965)
Forced labor (like a slave)	0.22	0.6	0.49	0.44	0.247 (0.247)	0.656 (0.656)	0.914 (0.914)	0.51 (0.51)	0.814 (0.814)

Forced to hide	0.12	0.92	0.28	0.44	0.781 (0.781)	0.979 (0.979)	0.979 (0.979)	0.891 (0.891)	0.96 (0.96)
Witness torture	0.13	0.9	0.3	0.43	0.762 (0.762)	0.95 (0.95)	0.988 (0.988)	0.872 (0.872)	0.962 (0.962)
Imprisonment	0.21	0.46	0.5	0.42	0.114 (0.114)	0.525 (0.525)	0.798 (0.798)	0.387 (0.387)	0.678 (0.678)
Beating to the body	0.2	0.44	0.5	0.41	0.121 (0.121)	0.437 (0.437)	0.765 (0.765)	0.341 (0.341)	0.658 (0.658)
Enforced isolation from others (Forced to be apart from others)	0.2	0.63	0.48	0.41	0.285 (0.285)	0.758 (0.758)	0.903 (0.903)	0.576 (0.576)	0.807 (0.807)
Extortion or robbery	0.18	0.73	0.44	0.4	0.428 (0.428)	0.836 (0.836)	0.929 (0.929)	0.676 (0.676)	0.849 (0.849)
Prevented from burying someone	0.16	0.19	0.39	0.4	0.029 (0.029)	0.164 (0.164)	0.375 (0.375)	0.141 (0.141)	0.294 (0.294)
Brainwashing	0.2	0.48	0.5	0.39	0.188 (0.188)	0.477 (0.477)	0.8 (0.8)	0.38 (0.38)	0.724 (0.724)
Other forced separation from family members	0.18	0.63	0.48	0.37	0.361 (0.361)	0.677 (0.677)	0.893 (0.893)	0.562 (0.562)	0.822 (0.822)
Ill health without access to medical care (Sick and couldn't get to a clinic or hospital)	0.09	0.93	0.26	0.36	0.865 (0.865)	0.971 (0.971)	0.99 (0.99)	0.921 (0.921)	0.987 (0.987)
Lack of food or water	0.08	0.93	0.25	0.34	0.872 (0.872)	0.981 (0.981)	0.971 (0.971)	0.934 (0.934)	0.957 (0.957)
Lack of shelter	0.09	0.91	0.28	0.33	0.829 (0.829)	0.955 (0.955)	0.96 (0.96)	0.904 (0.904)	0.937 (0.937)
Confiscation (seizing) or destruction of personal property	0.09	0.91	0.29	0.33	0.838 (0.838)	0.948 (0.948)	0.971 (0.971)	0.904 (0.904)	0.952 (0.952)
Disappearance or kidnapping of spouse	0.09	0.07	0.26	0.33	0.019 (0.019)	0.057 (0.057)	0.147 (0.147)	0.058 (0.058)	0.111 (0.111)
Serious physical injury of family member or friend due to war	0.15	0.57	0.49	0.31	0.366 (0.366)	0.622 (0.622)	0.805 (0.805)	0.519 (0.519)	0.769 (0.769)
Serious physical injury from fighting due to war	0.14	0.28	0.45	0.31	0.1 (0.1)	0.249 (0.249)	0.499 (0.499)	0.195 (0.195)	0.472 (0.472)
Rape	0.05	0.04	0.19	0.29	0.005 (0.005)	0.033 (0.033)	0.078 (0.078)	0.035 (0.035)	0.048 (0.048)
Marriage by abduction or running away with	0.06	0.07	0.25	0.24	0.029 (0.029)	0.05 (0.05)	0.133 (0.133)	0.053 (0.053)	0.108 (0.108)
Disappearance or kidnapping of other family member or friend	0.11	0.44	0.5	0.23	0.292 (0.292)	0.487 (0.487)	0.613 (0.613)	0.425 (0.425)	0.548 (0.548)
Murder, or death due to violence, of spouse	0.05	0.06	0.24	0.23	0.024 (0.024)	0.064 (0.064)	0.093 (0.093)	0.051 (0.051)	0.08 (0.08)
Murder, or death due to violence, of other family member or friend	0.11	0.47	0.5	0.22	0.337 (0.337)	0.496 (0.496)	0.62 (0.62)	0.452 (0.452)	0.555 (0.555)
Disappearance or kidnapping of child	0.06	0.09	0.28	0.2	0.038 (0.038)	0.09 (0.09)	0.145 (0.145)	0.091 (0.091)	0.09 (0.09)
Other types of sexual abuse	0.06	0.09	0.29	0.19	0.033 (0.033)	0.086 (0.086)	0.159 (0.159)	0.082 (0.082)	0.116 (0.116)
Murder, or death due to	0.05	0.09	0.28	0.19	0.036 (0.036)	0.114 (0.114)	0.131 (0.131)	0.086 (0.086)	0.111 (0.111)

violence, of child

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\* A value for each respondent was calculated by first obtaining the difference between each HTQ item and the mean of that item, dividing the difference by the standard deviation of each HTQ item mean, and multiplying the resulting expression by the eigenvector for that item. SAS proc princomp was used. The index was then divided into tertiles to compare means across each tertile. The first principal component was used and it explained 17.8% of the variation in lifetime PTE experience.

† The HTQ items most associated with having high lifetime PTE exposure were chosen based on dividing the Eigenvector by the stand deviations (84). Those with a value above 0.6 were chosen and six items listed in the table met this criterion. Respondents who experienced any of the six items were considered exposed whereas respondents who did not report any of those items were considered unexposed.

Table 3: Distribution of lifetime potentially traumatic events (PTE)\*, using the Harvard Trauma Questionnaire, in a population-based sample of adults from Nimba County, Liberia, 2008

Lifetime PTE measurement	Event type†					Endorsed any six items with high eigenvector/SD values‡		Ordinal exposure§			
	Total (n = 1263)	Unexposed (n = 329)	Sudden, unexpected death (n = 225)	Injury/other shocking event (n = 186)	Assaultive violence (n = 523)	No (n = 865)	Yes (n = 398)	First quartile (0 to 12 events; n = 305)	Second quartile (13 to 16 events; n = 304)	Third quartile (17 to 20 events; n = 312)	Fourth quartile (21 to 35 events; n = 342)
Event type											
Unexposed	329 (26)	-	-	-	-	303 (92.1)	26 (7.9)¶	217 (65.96)	112 (34.04)	0 (0)	0 (0)**
Sudden, unexpected death	225 (17.8)	-	-	-	-	209 (92.89)	16 (7.11)	82 (36.44)	129 (57.33)	14 (6.22)	0 (0)
Injury/other shocking event	186 (14.7)	-	-	-	-	104 (55.91)	82 (44.09)	0 (0)	27 (14.52)	123 (66.13)	36 (19.35)
Assaultive violence	523 (41.4)	-	-	-	-	249 (47.61)	274 (52.39)	6 (1.15)	36 (6.88)	175 (33.46)	306 (58.51)
Endorsed any six items with high eigenvector/SD values											
No	865 (68.5)	303 (35.03)	209 (24.16)	104 (12.02)	249 (28.79)	-	-	297 (34.34)	261 (30.17)	222 (25.66)	85 (9.83)††
Yes	398 (31.5)	26 (6.53)	16 (4.02)	82 (20.6)	274 (68.84)	-	-	8 (2.01)	43 (10.8)	90 (22.61)	257 (64.57)
Ordinal exposure											
First quartile (0 to 12 events)	305 (24.1)	217 (71.15)	82 (26.89)	0 (0)	6 (1.97)	297 (97.38)	8 (2.62)	-	-	-	-
Second quartile (13 to 16 events)	304 (24.1)	112 (36.84)	129 (42.43)	27 (8.88)	36 (11.84)	261 (85.86)	43 (14.14)	-	-	-	-
Third quartile (17 to 20 events)	312 (24.7)	0 (0)	14 (4.49)	123 (39.42)	175 (56.09)	222 (71.15)	90 (28.85)	-	-	-	-
Fourth quartile (21 to 35 events)	342 (27.1)	0 (0)	0 (0)	36 (10.53)	306 (89.47)	85 (24.85)	257 (75.15)	-	-	-	-

\* Data is n (%)

† I summed up the HTQ events in each of the three categories, obtained the median of the number of HTQ events experienced in each category, described in Table 3, and then created a main PTE exposure based on whether or an individual met the median for exposure. I assumed a hierarchy of severity. Those individuals who had greater than the median experience of assaultive violence (4 events) were considered exposed to assaultive violence. Those individuals who had less than the median experience of assaultive violence were considered unexposed. Of these individuals unexposed to assaultive violence, those who had greater than the median experience of injury/other shocking events (12 events) were considered exposed to injury/other shocking event. Those who had less than the median experience of injury/other shocking event were considered unexposed. Of these individuals unexposed to injury/other shocking event, those who had greater than the median experience of sudden, unexpected death of a close friend or relative (1 event) were considered exposed to sudden, unexpected death of a close friend or relative. Those who did not have greater than the median experience of sudden, unexpected death of a close friend or relative constituted the final exposure category of unexposed

<sup>‡</sup> The HTQ items most associated with having high lifetime PTE exposure were chosen based on dividing the Eigenvector by the stand deviations (84). Those with a value above 0.6 were chosen and six items (Forced to destroy property, physically harm unknown person, betray unknown person, betray known person, desecrate graves, forced to physically harm known person) met this criteria. Respondents who experienced any of the six items were considered exposed whereas respondents who did not report any of those items were considered unexposed.

<sup>§</sup> I created an ordinal measure of exposure based on the sum of HTQ items. Once the sum was obtained, I created quartiles of exposure, and then created dummy variables from these quartiles.

<sup>¶</sup> Chi-square measuring the association between event type measure and the PCA measure was significant at  $p < 0.0001$

<sup>\*\*</sup> Chi-square measuring the association between event type measure and the ordinal was significant at  $p < 0.0001$ ; The Pearson correlation between these two measures was 0.83 with a p-value  $< 0.0001$

<sup>††</sup> Chi-square measuring the association between the PCA measure and the ordinal was significant at  $p < 0.0001$

Table 4: Exposure to Harvard Trauma Questionnaire (HTQ) potentially traumatic events (PTE), stratified by three categorization approaches, in a population-based sample of adults from Nimba County, Liberia, 2008\*

Categories of PTE experience	Total sample (n = 1263)	Event type <sup>†¶</sup>				Endorsed any six items with high eigenvector/SD values <sup>‡</sup>			Ordinal exposure <sup>§¶</sup>			
		Unexposed (n = 329)	Sudden, unexpected death (n = 225)	Injury/other shocking event (n = 186)	Assaultive violence (n = 523)	No (n=865)	Yes (n=398)	p-value	First quartile (0 to 12 events; n = 305)	Second quartile (13 to 16 events; n = 304)	Third quartile (17 to 20 events; n = 312)	Fourth quartile (21 to 35 events; n = 342)
<b>Assaultive violence</b>												
Combat situation	1186 (93.9)	279 (84.8)	203 (90.2)	184 (98.9)	520 (99.4)	797 (92.1)	389 (97.7)	0.0674	246 (80.7)	290 (95.4)	309 (99)	341 (99.7)
Beating	557 (44.1)	52 (15.8)	33 (14.7)	34 (18.3)	438 (83.7)	295 (34.1)	262 (65.8)	0.0019	34 (11.1)	78 (25.7)	177 (56.7)	268 (78.4)
Rape	49 (3.9)	1 (0.3)	0 (0)	1 (0.5)	47 (9)	30 (3.5)	19 (4.8)	0.3069	2 (0.7)	1 (0.3)	14 (4.5)	32 (9.4)
Marriage by abduction	89 (7)	9 (2.7)	2 (0.9)	5 (2.7)	99 (18.9)	71 (8.2)	46 (11.6)	0.0039	6 (2)	18 (5.9)	32 (10.3)	61 (17.8)
Other sexual abuse	117 (9.3)	9 (2.7)	7 (3.1)	6 (3.2)	72 (13.8)	46 (5.3)	43 (10.8)	0.0729	4 (1.3)	12 (3.9)	20 (6.4)	53 (15.5)
Knifing or axing	318 (25.2)	10 (3)	18 (8)	13 (7)	288 (55.1)	142 (16.4)	176 (44.2)	p <0.0001	12 (3.9)	22 (7.2)	74 (23.7)	210 (61.4)
Torture	521 (41.3)	34 (10.3)	11 (4.9)	35 (18.8)	434 (83)	259 (29.9)	262 (65.8)	p <0.0001	11 (3.6)	60 (19.7)	165 (52.9)	285 (83.3)
Serious physical injury from war	357 (28.3)	56 (17)	74 (32.9)	22 (11.8)	268 (51.2)	169 (19.5)	188 (47.2)	p <0.0001	30 (9.8)	56 (18.4)	93 (29.8)	178 (52)
Forced labor	765 (60.6)	100 (30.4)	106 (47.1)	106 (57)	485 (92.7)	441 (51)	324 (81.4)	p <0.0001	57 (18.7)	149 (49)	238 (76.3)	321 (93.9)
Extortion or robbery	923 (73.1)	175 (53.2)	9 (4)	144 (77.4)	498 (95.2)	585 (67.6)	338 (84.9)	p <0.0001	110 (36.1)	212 (69.7)	276 (88.5)	325 (95)
Kidnapped	181 (14.3)	6 (1.8)	203 (90.2)	10 (5.4)	156 (29.8)	69 (8)	112 (28.1)	p <0.0001	0 (0)	16 (5.3)	34 (10.9)	131 (38.3)
<b>Other injury/shocking</b>												
Lack of shelter	1155 (91.4)	276 (83.9)	203 (90.2)	181 (97.3)	495 (94.6)	782 (90.4)	373 (93.7)	0.0813	238 (78)	290 (95.4)	294 (94.2)	333 (97.4)
Lack of food or water	1189 (94.1)	292 (88.8)	208 (92.4)	182 (97.8)	507 (96.9)	808 (93.4)	381 (95.7)	0.0833	256 (83.9)	293 (96.4)	305 (97.8)	335 (98)
Ill health without access to medical care	1190 (94.2)	289 (87.8)	213 (94.7)	180 (96.8)	508 (97.1)	797 (92.1)	393 (98.7)	p <0.0001	257 (84.3)	291 (95.7)	302 (96.8)	340 (99.4)

Confiscation or destruction of property	1161 (91.9)	284 (86.3)	192 (85.3)	181 (97.3)	504 (96.4)	782 (90.4)	379 (95.2)	0.0042	246 (80.7)	279 (91.8)	302 (96.8)	334 (97.7)
Forced departure under dangerous conditions	1232 (97.5)	311 (94.5)	217 (96.4)	184 (98.9)	520 (99.4)	839 (97)	393 (98.7)	0.0956	279 (91.5)	301 (99)	312 (100)	340 (99.4)
Imprisonment	605 (47.9)	65 (19.8)	41 (18.2)	112 (60.2)	387 (74)	335 (38.7)	270 (67.8)	p <0.0001	25 (8.2)	110 (36.2)	186 (59.6)	284 (83)
Brainwashing	617 (48.9)	94 (28.6)	45 (20)	110 (59.1)	368 (70.4)	329 (38)	288 (72.4)	p <0.0001	49 (16.1)	115 (37.8)	173 (55.4)	280 (81.9)
Forced to hide	1153 (91.3)	265 (80.5)	194 (86.2)	183 (98.4)	511 (97.7)	771 (89.1)	382 (96)	0.0004	224 (73.4)	288 (94.7)	307 (98.4)	334 (97.7)
Other forced separation	813 (64.4)	134 (40.7)	101 (44.9)	161 (86.6)	417 (79.7)	486 (56.2)	327 (82.2)	p <0.0001	96 (31.5)	168 (55.3)	232 (74.4)	317 (92.7)
Forced to find and bury bodies	240 (19)	11 (3.3)	6 (2.7)	36 (19.4)	187 (35.8)	75 (8.7)	165 (41.5)	p <0.0001	8 (2.6)	12 (3.9)	55 (17.6)	165 (48.2)
Enforced isolation from others	819 (64.8)	122 (37.1)	91 (40.4)	171 (91.9)	435 (83.2)	498 (57.6)	321 (80.7)	p <0.0001	63 (20.7)	183 (60.2)	260 (83.3)	313 (91.5)
Someone was forced to betray you	428 (33.9)	34 (10.3)	12 (5.3)	91 (48.9)	291 (55.6)	174 (20.1)	254 (63.8)	p <0.0001	16 (5.2)	45 (14.8)	118 (37.8)	249 (72.8)
Prevented from burying someone	239 (18.9)	13 (4)	8 (3.6)	63 (33.9)	155 (29.6)	122 (14.1)	117 (29.4)	p <0.0001	4 (1.3)	20 (6.6)	80 (25.6)	135 (39.5)
Forced to desecrate bodies	89 (7)	3 (0.9)	1 (0.4)	17 (9.1)	68 (13)	0 (0)	89 (22.4)	p <0.0001	1 (0.3)	5 (1.6)	12 (3.8)	71 (20.8)
Forced to physically harm family member or friend	167 (13.2)	5 (1.5)	6 (2.7)	26 (14)	130 (24.9)	0 (0)	167 (42)	p <0.0001	3 (1)	10 (3.3)	20 (6.4)	134 (39.2)
Forced to physically harm someone who is not a family member, or friend	206 (16.3)	7 (2.1)	3 (1.3)	42 (22.6)	154 (29.4)	0 (0)	206 (51.8)	p <0.0001	1 (0.3)	12 (3.9)	30 (9.6)	163 (47.7)
Forced to destroy someone else's property	257 (20.3)	4 (1.2)	2 (0.9)	55 (29.6)	196 (37.5)	0 (0)	257 (64.6)	p <0.0001	0 (0)	9 (3)	47 (15.1)	201 (58.8)
Forced to betray family member, or friend	155 (12.3)	6 (1.8)	2 (0.9)	31 (16.7)	116 (22.2)	0 (0)	155 (38.9)	p <0.0001	2 (0.7)	9 (3)	21 (6.7)	123 (36)
Forced to betray someone who is not family or friend	182 (14.4)	7 (2.1)	5 (2.2)	39 (21)	131 (25)	0 (0)	182 (45.7)	p <0.0001	3 (1)	12 (3.9)	22 (7.1)	145 (42.4)



Disappearance of spouse	94 (7.4)	6 (1.8)	6 (2.7)	20 (10.8)	62 (11.9)	50 (5.8)	44 (11.1)	0.0026	6 (2)	6 (2)	19 (6.1)	63 (18.4)
Disappearance of child	115 (9.1)	7 (2.1)	17 (7.6)	28 (15.1)	63 (12)	79 (9.1)	36 (9)	0.9648	6 (2)	17 (5.6)	29 (9.3)	63 (18.4)
Disappearance of other family member or friend	586 (46.4)	49 (14.9)	136 (60.4)	133 (71.5)	268 (51.2)	368 (42.5)	218 (54.8)	0.0022	64 (21)	135 (44.4)	152 (48.7)	235 (68.7)
Serious physical injury from war of family member	755 (59.8)	92 (28)	136 (60.4)	156 (83.9)	371 (70.9)	449 (51.9)	306 (76.9)	p <0.0001	85 (27.9)	167 (54.9)	205 (65.7)	298 (87.1)
Witness beatings	1135 (89.9)	251 (76.3)	199 (88.4)	185 (99.5)	500 (95.6)	751 (86.8)	384 (96.5)	p <0.0001	216 (70.8)	277 (91.1)	302 (96.8)	340 (99.4)
Witness torture	1137 (90)	255 (77.5)	200 (88.9)	182 (97.8)	500 (95.6)	754 (87.2)	383 (96.2)	p <0.0001	218 (71.5)	277 (91.1)	303 (97.1)	339 (99.1)
Unexpected death												
Murder, or death due to violence, of spouse	76 (6)	0 (0)	19 (8.4)	14 (7.5)	43 (8.2)	44 (5.1)	32 (8)	0.0276	4 (1.3)	13 (4.3)	20 (6.4)	39 (11.4)
Murder, or death due to violence, of child	118 (9.3)	0 (0)	30 (13.3)	34 (18.3)	54 (10.3)	74 (8.6)	44 (11.1)	0.2116	4 (1.3)	21 (6.9)	36 (11.5)	57 (16.7)
Murder, or death due to violence, of other family member or friend	612 (48.5)	0 (0)	215 (95.6)	122 (65.6)	275 (52.6)	391 (45.2)	221 (55.5)	0.0064	78 (25.6)	139 (45.7)	160 (51.3)	235 (68.7)

\* Data is n (%)

<sup>†</sup> I summed up the HTQ events in each of the three categories, obtained the median of the number of HTQ events experienced in each category, described in Table 3, and then created a main PTE exposure based on whether or an individual met the median for exposure. I assumed a hierarchy of severity. Those individuals who had greater than the median experience of assaultive violence (4 events) were considered exposed to assaultive violence. Those individuals who had less than the median experience of assaultive violence were considered unexposed. Of these individuals unexposed to assaultive violence, those who had greater than the median experience of injury/other shocking events (12 events) were considered exposed to injury/other shocking event. Those who had less than the median experience of injury/other shocking event were considered unexposed. Of these individuals unexposed to injury/other shocking event, those who had greater than the median experience of sudden, unexpected death of a close friend or relative (1 event) were considered exposed to sudden, unexpected death of a close friend or relative. Those who did not have greater than the median experience of sudden, unexpected death of a close friend or relative constituted the final exposure category of unexposed

<sup>‡</sup> The HTQ items most associated with having high lifetime PTE exposure were chosen based on dividing the Eigenvector by the stand deviations (84). Those with a value above 0.6 were chosen and six items (Forced to destroy property, physically harm unknown person, betray unknown person, betray known person, desecrate graves, forced to physically harm known person) met this criteria. Respondents who experienced any of the six items were considered exposed whereas respondents who did not report any of those items were considered unexposed.

<sup>§</sup> I created an ordinal measure of exposure based on the sum of HTQ items. Once the sum was obtained, I created quartiles of exposure, and then created dummy variables from these quartiles.

<sup>¶</sup> Pearson Chi-square significant for all items at p<0.001

## Appendix C: Confounding, Bivariable associations, and Sensitivity analyses

Table 1: Bivariable associations between lifetime potentially traumatic event (PTE)\* experience, past year informal<sup>†</sup> and formal<sup>‡</sup> care utilization and potential confounders in a population based sample of adults from Nimba County, Liberia, 2008 (n=1263)

	PTE exposure <sup>§</sup>			Informal health care		Formal health care		Informal and formal care
	Second quartile (13 to 16 events)	Third quartile (17 to 20 events)	Highest quartile (21 to 35 events)	Number of informal care visits	Highest tertile (greater than 20 visits)	Number of formal care visits	Highest tertile (greater than 4 visits)	Highest tertile (greater than 20 informal and 4 formal care visits)
	OR (95% CI) <sup>¶</sup>	OR (95% CI) <sup>¶</sup>	OR (95% CI) <sup>¶</sup>	IRR (95% CI) <sup>**</sup>	OR (95% CI) <sup>††</sup>	IRR (95% CI) <sup>**</sup>	OR (95% CI) <sup>††</sup>	OR (95% CI) <sup>††</sup>
Age 38 or greater	1.21 (0.89, 1.64)	1.57 (1.12, 2.18)	1.14 (0.81, 1.62)	1.27 (1.01, 1.6)	1.3 (0.97, 1.73)	0.89 (0.76, 1.04)	0.68 (0.53, 0.88)	1.1 (0.75, 1.61)
Female	0.97 (0.73, 1.28)	0.58 (0.43, 0.79)	0.29 (0.21, 0.39)	1.01 (0.84, 1.22)	0.98 (0.78, 1.22)	1.48 (1.25, 1.74)	1.87 (1.5, 2.32)	1.22 (0.87, 1.72)
Married	1.3 (0.92, 1.83)	1.57 (1.1, 2.25)	1.46 (1.01, 2.1)	0.79 (0.64, 0.97)	1 (0.76, 1.32)	0.9 (0.77, 1.06)	0.81 (0.63, 1.06)	0.76 (0.5, 1.16)
Ethnicity								
Mano	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Gio	1.49 (0.99, 2.23)	1.57 (1.07, 2.32)	1.31 (0.77, 2.21)	2.48 (1.52, 4.07)	2.34 (1.09, 5.04)	1.47 (1.08, 2.01)	1.67 (0.95, 2.94)	2.67 (1.11, 6.43)
Other	1.04 (0.53, 2.03)	1.05 (0.64, 1.69)	1.84 (1.02, 3.32)	1.6 (1.16, 2.21)	2 (1.11, 3.6)	0.86 (0.48, 1.54)	0.71 (0.34, 1.49)	1.18 (0.45, 3.06)
Reads with ease	0.97 (0.65, 1.44)	1.26 (0.83, 1.92)	1.49 (0.93, 2.41)	0.69 (0.5, 0.95)	0.75 (0.49, 1.13)	0.91 (0.72, 1.16)	0.81 (0.58, 1.13)	0.92 (0.58, 1.46)
Wealth								
Poorest quintile	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Middle quintile	0.97 (0.61, 1.53)	0.85 (0.54, 1.33)	0.79 (0.49, 1.29)	0.63 (0.44, 0.9)	0.59 (0.36, 0.96)	0.94 (0.71, 1.25)	1.04 (0.67, 1.63)	0.73 (0.4, 1.33)
Wealthiest quintile	0.83 (0.55, 1.26)	0.9 (0.59, 1.38)	0.67 (0.4, 1.14)	0.84 (0.56, 1.28)	0.78 (0.45, 1.35)	1 (0.77, 1.3)	1.11 (0.75, 1.64)	0.97 (0.57, 1.65)
Nearest health facility charges a fee	1.11 (0.83, 1.48)	0.91 (0.65, 1.27)	1.09 (0.71, 1.68)	0.68 (0.47, 1.01)	0.86 (0.43, 1.75)	0.47 (0.35, 0.63)	0.38 (0.22, 0.66)	0.31 (0.15, 0.64)
Time to walk to nearest clinic, hours	0.99 (0.91, 1.08)	1 (0.93, 1.08)	1.06 (0.98, 1.16)	0.95 (0.86, 1.05)	1 (0.87, 1.16)	0.88 (0.83, 0.93)	0.82 (0.72, 0.94)	0.85 (0.69, 1.04)

\* As measured by the Harvard Trauma Questionnaire (HTQ)

<sup>†</sup> Visits to a traditional healer, spiritual healer, black bagger, or pharmacist in the past year

<sup>‡</sup> Visits to a clinic or hospital in the past year

<sup>§</sup> Referent is exposure to the first quartile, 0 to 12 events

<sup>¶</sup> Results based on a bivariable multinomial logistic regression model;

\*\* Results based on a bivariable negative binomial regression model

†† Results based on a bivariable logistic regression model

Table 2: Bivariable associations between lifetime potentially traumatic event (PTE)\* experience, with item "ill health without access to medical care removed", and potential confounders in a population based sample of adults from Nimba County, Liberia, 2008 (n=1263)

	PTE exposure <sup>†</sup>		
	Second quartile (13 to 16 events)	Third quartile (17 to 20 events)	Highest quartile (21 to 35 events)
	OR (95% CI) <sup>‡</sup>	OR (95% CI) <sup>‡</sup>	OR (95% CI) <sup>‡</sup>
Age 38 or greater	1.26 (0.95, 1.68)	1.58 (1.14, 2.2)	1.19 (0.85, 1.66)
Female	0.95 (0.72, 1.25)	0.58 (0.43, 0.79)	0.28 (0.2, 0.39)
Married	1.35 (0.96, 1.88)	1.61 (1.15, 2.26)	1.5 (1.04, 2.16)
Ethnicity			
Mano	Ref	Ref	Ref
Gio	1.5 (1, 2.25)	1.58 (1.07, 2.34)	1.31 (0.78, 2.2)
Other	1.01 (0.52, 1.97)	1.03 (0.64, 1.66)	1.8 (1.0, 3.24)
Reads with ease	0.92 (0.61, 1.37)	1.21 (0.8, 1.85)	1.49 (0.92, 2.41)
Wealth			
Poorest quintile	Ref	Ref	Ref
Middle quintile	0.89 (0.57, 1.38)	0.88 (0.58, 1.32)	0.81 (0.53, 1.26)
Wealthiest quintile	0.82 (0.53, 1.26)	0.98 (0.64, 1.49)	0.7 (0.41, 1.19)
Nearest health facility charges a fee	1.11 (0.8, 1.54)	0.92 (0.64, 1.34)	1.13 (0.76, 1.7)
Time to walk to nearest clinic, hours	1 (0.91, 1.08)	1 (0.93, 1.08)	1.07 (0.98, 1.16)

\* As measured by the Harvard Trauma Questionnaire (HTQ)

<sup>†</sup> Referent is exposure to the first quartile, 0 to 12 events

<sup>‡</sup> Results based on a bivariable multinomial logistic regression model

Table 3: Bivariable associations between potentially traumatic event (PTE) experience and health care utilization in a population-based sample of adults from Nimba County, Liberia, 2008 (n = 1263)

PTE experience	Informal health care*		Formal health care†		Informal and formal care
	Number of informal care visits IRR (95% CI)‡	Highest tertile of informal visits (greater than 20 visits) OR (95% CI)§	Number of formal care visits IRR (95% CI)‡	Highest tertile of formal visits (greater than 4 visits) OR (95% CI)§	Highest tertile of formal and informal visits (greater than 20 informal and 4 formal care visits) OR (95% CI)§
Lowest quartile (1 to 12 events)	Ref	Ref	Ref	Ref	Ref
Second quartile (13 to 16 events)	1.7 (1.26, 2.31)	1.74 (1.18, 2.56)	1.3 (1, 1.69)	1.32 (0.86, 2.02)	1.87 (1.07, 3.25)
Third quartile (17 to 20 events)	1.78 (1.3, 2.43)	2.26 (1.46, 3.49)	1.37 (1.11, 1.69)	1.54 (1.09, 2.18)	2.42 (1.5, 3.9)
Highest quartile (21 to 35 events)	2.02 (1.46, 2.81)	2.25 (1.5, 3.38)	1.25 (0.98, 1.57)	1.55 (1.02, 2.35)	2 (1.14, 3.48)

\* Number of visits to a traditional healer, spiritual healer, black bagger, or pharmacist in the past year

† Number of visits to a clinic or hospital in the past year

‡ Results based on a multivariable negative binomial regression model

§ Results based on a multivariable logistic regression model

Table 4: Demographic, stratified by past year informal care visits\*, in a population-based sample of adults from Nimba County, Liberia, 2008 (n=1263)

Variable	No informal care visits in the past year (n = 91)	At least one informal care visit in the past year (n = 1172)	p-value
	n (%)	n (%)	
38 and older <sup>†</sup>	34 (37.6)	590 (49.7)	0.0279
Female	45 (49.5)	534 (45.6)	0.3821
Married	37 (40.7)	418 (35.7)	0.3981
Ethnicity			
Mano	64 (70.3)	424 (36.2)	0.0002
Gio	22 (24.2)	674 (57.5)	
Other	5 (5.5)	74 (6.3)	
Reads easily	25 (27.5)	299 (25.5)	0.7683
Wealth tertile <sup>‡</sup>			
Lowest tertile	27 (29.7)	394 (33.6)	0.0463
Middle tertile	41 (45.1)	380 (32.4)	
Highest tertile	23 (25.3)	398 (34)	
Nearest facility charges fee	7 (7.7)	133 (11.3)	0.4457
Distance to nearest clinic, mean (SE)	2.3 (0.29)	2.4 (0.33)	0.795
Number of traditional healers in village, mean (SE)	1.3 (0.22)	2.3 (0.32)	0.004

\* Care given by a traditional healer, spiritual healer, black bagger, pharmacist, or traditional midwife

<sup>†</sup> Based on greater than the median value

<sup>‡</sup> Constructed using principle components analysis on a set of 18 household wealth indicators

Appendix D: Discrete choice experiment description

Figure 1: Diagram of the methodology used to create the discrete choice experiment used in this analysis

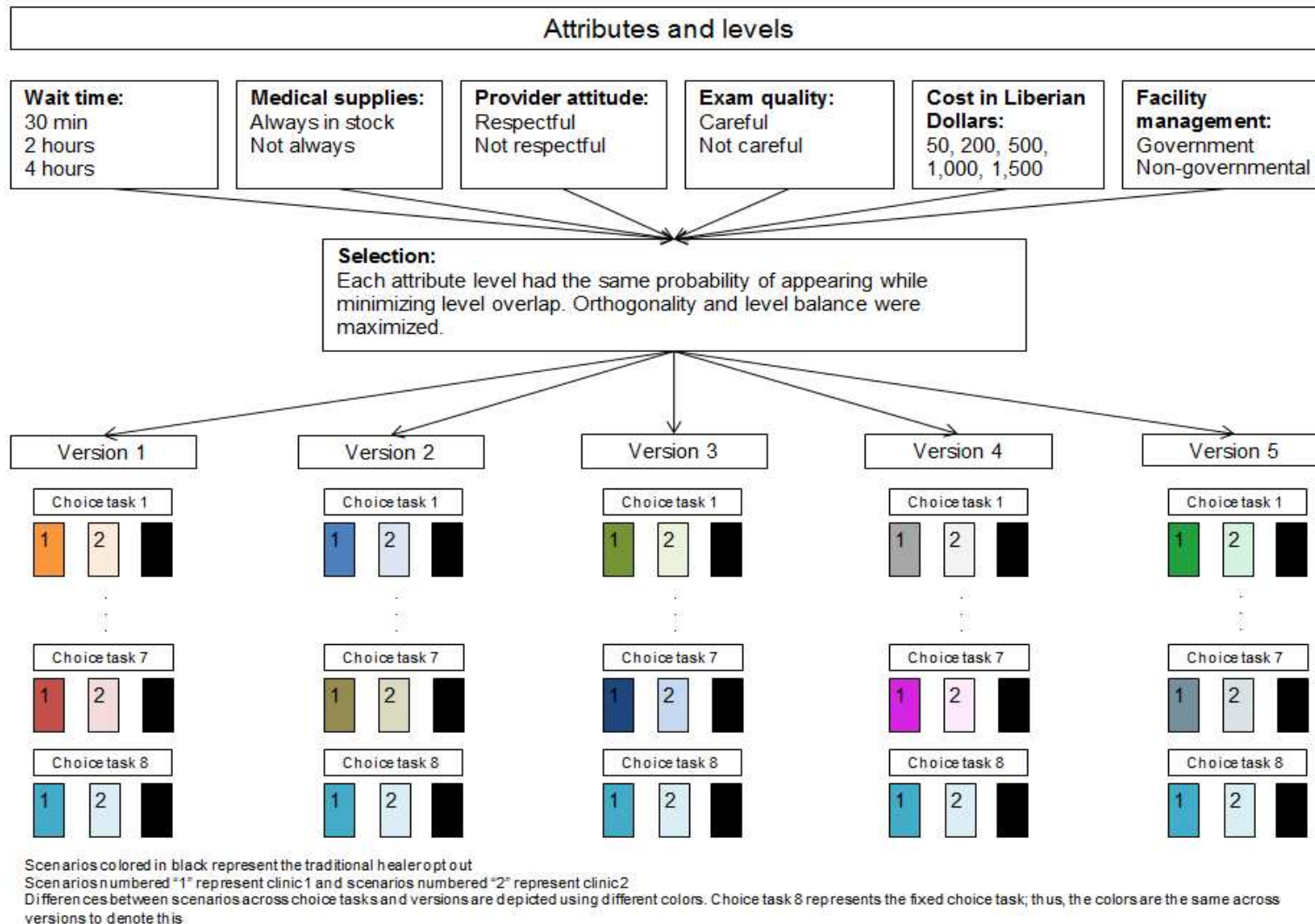


Figure 2: Example of a choice task, with three scenarios (Clinic 1, Clinic 2, and Traditional healer), used in a discrete choice experiment carried out in a population-based sample of adults from Nimba County, Liberia, 2008

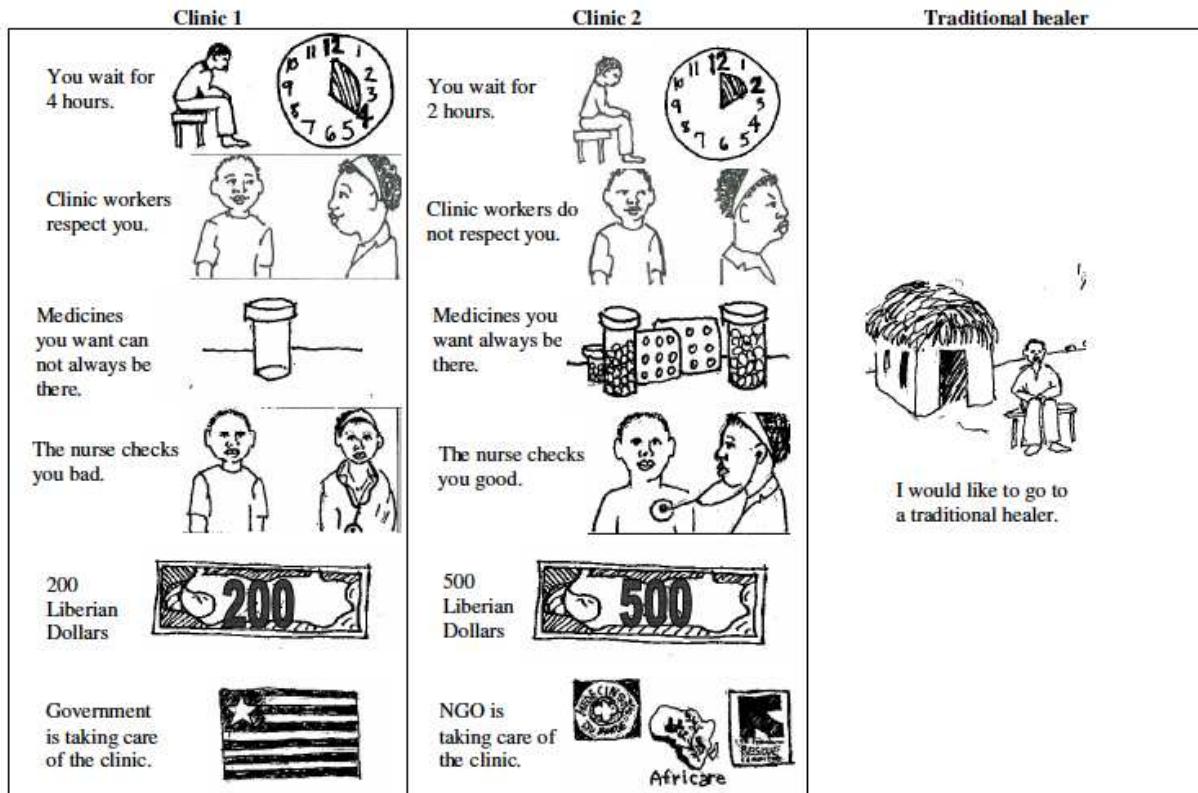




Table 1: Descriptions of model clinics used to generate predicted uptake among a population-based sample of adults from Nimba County, Liberia, 2008 (n = 1,431)

Attributes						
Scenario	Waiting time	Respect	Medications	Physical exam	Government management	Cost (LD*)
Baseline clinic	4 hours	No	No	No	No	1,000
Model clinic 1	4 hours	Yes	No	No	No	1,000
Model clinic 2	4 hours	No	Yes	No	No	1,000
Model clinic 3	4 hours	No	No	Yes	No	1,000
Model clinic 4	4 hours	No	No	No	Yes	1,000
Model clinic 5	4 hours	Yes	Yes	Yes	Yes	1,000

## Appendix E: Mixed logit model description

I used a mixed logit model to assess whether preferences for health facility differ based on traumatic event exposure. The outcome will consist of three alternatives per choice task, facility A, B, or traditional healer, which is treated as constant in the model. The value, or utility, that each individual  $i$  gets from alternative  $j$  in choice task  $k$  can be portioned into systematic and stochastic portions (122, 123). The observed explanatory variables will consist of the facility attributes that describe each alternative as well as individual potentially traumatic event (PTE) experience. The unobserved variables will be represented by the stochastic component. Respondents choose the alternative that has the highest utility. The utility for each alternative is a function of a  $l + 1$  vector of explanatory variables ( $X'_{ijk}$ ) and coefficients ( $\beta_i$ ) and is shown by equation:

$$U_{ijk} = X'_{ijk}\beta_i + \varepsilon_{ijk}$$

The probability that individual  $i$  chooses alternative  $j$  in choice task  $k$  is shown below:

$$P_{ijk} = \frac{e^{X'_{ijk}\beta_i}}{\sum_l e^{X'_{ijl}\beta_i}}$$

It is possible to extend this model further to assess whether preferences for a health facility vary by PTE experience

$$B_{il} = Z'_i\beta_l + \sigma_l\omega_{li}, l = 1, \dots, L$$

Where  $Z'_i$  is a vector of observed PTE experience of respondent  $i$ ,  $\beta_l$  is a vector of parameters and  $\sigma_l\omega_{li}$  is the unobserved, or stochastic, heterogeneity. The mixed logit model was used to assess whether PTE experience quartiles were associated with preferences for facility choice (facility A, facility B, or traditional healer). I created interaction terms between each quartile of PTE experience and each facility attribute. The final mixed logit models included all attributes of the DCE as well as the interaction term between each quartile and each attribute, for a total of five models: a main effects model, including only the attributes, a model with interaction terms between the first quartile of PTE experience (0 to 12 events) and all attributes, a model with interaction terms between the second quartile of PTE experience (13 to 16 events) and all attributes, interaction terms between the third quartile of PTE experience (17 to 20 events) and all attributes, and interaction terms between the last quartile of PTE experience (more than 20 events) and all attributes. From these models, I obtained the average coefficient of each facility attribute,

which shows how predictive each attribute is of preferences for a particular clinic. I also obtained how these average coefficients vary based on each quartile of PTE experience.

## Glossary

**Assaultive violence:** This category of traumatic event exposure includes events such as rape, other sexual assault, combat, mugging, badly beaten, held captived, tortured, shot, and stabbed (48).

**Choice task:** Describes the set of **scenarios** that is shown to respondents. In the DCE described in this proposal, each choice task includes two **scenarios**, Clinic 1 and Clinic 2, as well as an opt out **scenario** of traditional healer.

**Formal care:** Formal care refers to care received from clinics or hospitals (33).

**Informal care:** Informal care refers to care received from country doctors, spiritual healers, black baggers, pharmacists, or traditional midwives. Country doctors are considered traditional healers that use indigenous medicines to cure health problems, spiritual healers are specifically involved in issues related to mental health, while black baggers are traveling pharmacists (33).

**Kish Tables:** A method using a pre-determined table of random numbers to identify which member in a household should be interviewed for a study.

**Learning about trauma to others:** This category includes learning about traumatic events that occurred to others, including sexual assault, physical attack, and serious injuries (48).

**Other injury or shocking experience:** This category includes events like serious motor vehicle accident, any other type of serious accident or injury, experiencing a fire, man-made, or natural disaster, life-threatening illness, a child being diagnosed with a life-threatening illness, witnessing someone killed or maimed, and unexpectedly discovering a dead body (48).

**Principal components analysis (PCA):** A method in which a set of correlated variables are transformed into values of linearly uncorrelated variables, with the first of these values accounting for the most variability in the data as possible (84).

**Potentially traumatic event (PTE):** Any event in which a person experiences an actual or perceived threat to life, or physical integrity of him/herself or others that is also accompanied by feelings of fear, helplessness, or horror (1).

**Post-traumatic stress disorder:** A mental health conditions that can follow experience of a PTE, defined by symptoms of reexperiencing, avoidance, and hyperarousal (1).

**Scenario:** Describes the set of attributes and levels that characterize the health clinic that is shown to respondents. Otherwise known as an alternative.

**Sudden, unexpected death of a close friend or relative:** This category includes only one event, the sudden, unexpected death of a close friend or relative (48)

**Utilities:** A numerical value that indicates preferences (desires or wants) for goods or services.