Assessing the Impact of Durable Flooring Structures on Refugee Sleep Quality and Duration

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ABSTRACT: *Conflict and persecution continue to displace people from their homes adding to an already overwhelming refugee crisis worldwide. Overall, refugee health is difficult to measure objectively and is influenced by a number of factors including transient, and often inadequate, housing conditions. Emergency Floor (EF) is a quickly deployable, lightweight, insulated flooring system intended to protect temporary structures from extreme temperatures and outdoor conditions. A pilot study was conducted in two informal tented settlements in Hermel-Baalbek, Lebanon to assess how installing Emergency Floors in tented shelters impacted sleep duration and quality, indicators of overall wellness, among refugees. A baseline survey was administered, and Emergency Floors were installed in all households in both settlements in October 2016. A follow-up survey was conducted to record outcomes in April 2017. Thirty-four households consisting of 150 individuals participated in the baseline survey. Seven households were were not available for follow-up survey due to moving away from the area. The final sample yielded a total of 27 households and 120 individuals. Results indicated that sleep duration significantly increased, and sleep quality significantly improved after EF installation. Furthermore, respondents reported feeling more comfortable, warmer, safer, and cleaner when sleeping in a shelter with EF installed. These encouraging results suggest an overall increase in perceived well-being. Future research should continue monitoring floors to assess long term wear and explore additional uses for EF in other temporary structures.*

KEYWORDS: flooring, well-being, Lebanon, refugee, sleep duration, sleep quality

1 INTRODUCTION

In 2015, the world population of displaced people reached a record high of 65.3 million people (UNHCRa, 2015). The ongoing Syrian civil war has increased the number of Syrian refugees registered with the United Nations High Commissioner for Refugees (UNHCR) in neighboring Lebanon from 158,973 (January 2013) to 997,905 (October 2017). This makes Lebanon home to the highest number of Syrian refugees per capita in the world (UNHCRa, 2015; UNHCRb, 2017; UNHCRc, 2017). This increase has placed burden on governmental services for refugee aid and caused extensive overcrowding (defined as less than 4.5 square meters per person) in refugee communities (UNHCRb, 2017; UNHCRc, 2017). The "no-camp policy" adopted by the Government of Lebanon has led to refugees forming small informal tented settlements, where about 17% of the overall displaced population reside (UNHCRc, 2017). Though these ad-hoc communities do not consist of a large number of tents

overall, overcrowding within households is common (53%) and many shelters suffer from dangerous structural conditions or urgently needed repairs such as weatherproofing (UNHCRb, 2017; UNHCRc, 2017). Overcrowding paired with dilapidated tent condition can lead to uncomfortable living and sleeping conditions, especially during cold winter months.

Previous research has demonstrated that decreased sleep quality and duration are related to numerous relevant public health outcomes in the general population (Altevogt and Colten, 2006). Specifically, poor sleep quality has been linked to adverse mental health outcomes including increased levels of depression, anxiety and stress as well as physical maladies such as type 2 diabetes and even mortality (LeBlanc, 2007; Augner, 2011; Cappuccio et al., 2010; Tamakoshi and Ohno, 2004). Insufficient sleep can also negatively affect an individual's ability to adequately complete tasks and contributes to many work-related injuries (Strine, 2005; Lombardi, 2010). This is particularly applicable to refugees, who are often in debt and lack steady job-related income (UNHCRc, 2017). Additionally, since refugees tend to share resources within their communities as part of a collective coping mechanism, stress, anxiety, and depression resulting from poor sleep can potentially increase conflict between community members and harm the community's social structure (UNHCRc, 2017).

As most sleep-based research has been conducted under controlled settings in developed countries, rather than in conditions resembling refugee camp living conditions, the conjecture that lack of sleep from uncomfortable living conditions can negatively affect overall well-being is generaliszable to the refugee population. The association between sleep and numerous aspects of health make it an area of research that is ripe for further investigation.

The relationship between housing and health outcomes has been well-researched and includes direct factors such as location, building materials, overcrowding, access to water and sanitation, and ventilation (Al Khatib and Tabakhna, 2006). Many current temporary refugee shelters only have thin plastic sheet laid over the ground. This provides only minimal protection from the outside environment and does not have strong insulative properties. Discomfort from overcrowding and lack of adequate protection against

Figure 1:View of uninstalled Emergency Floor tiles

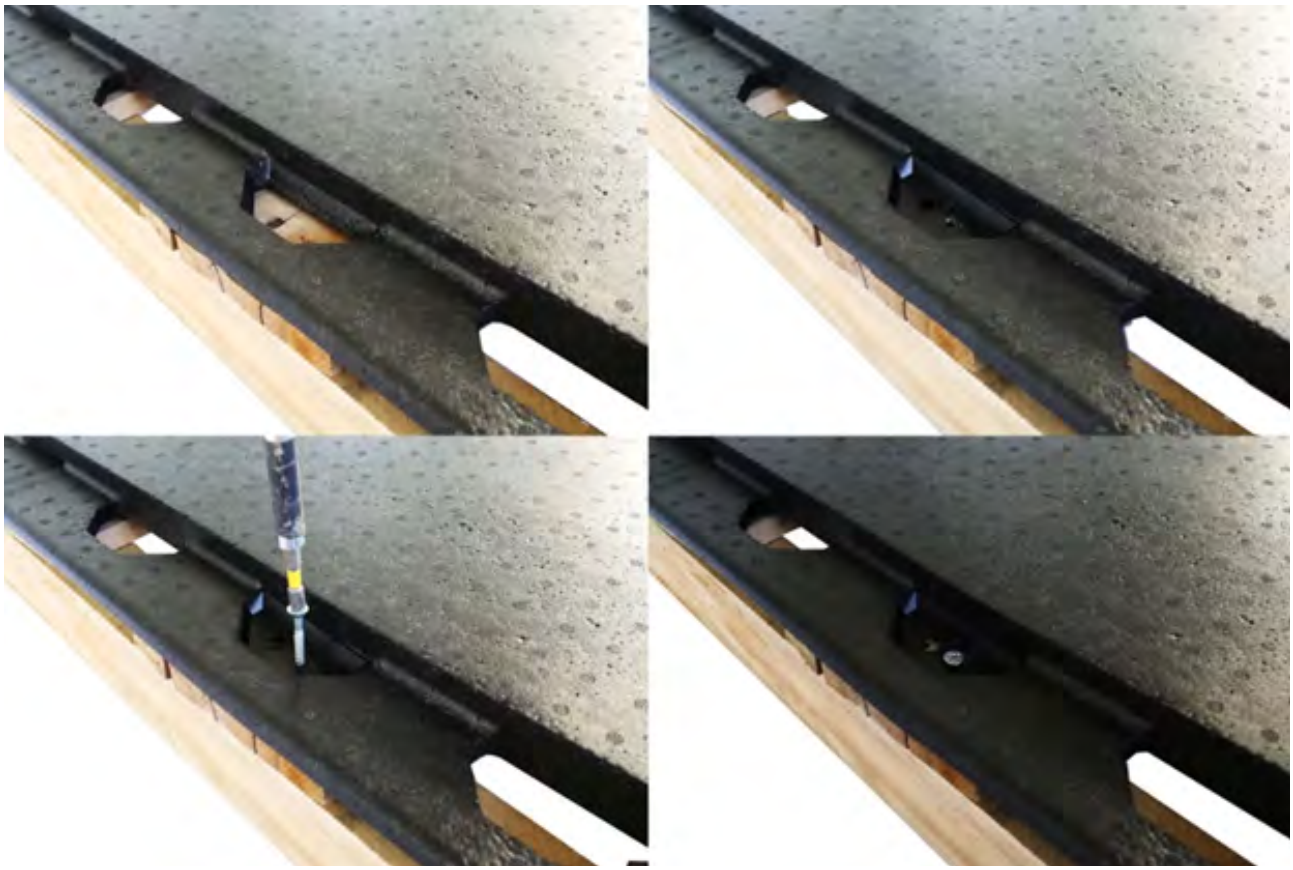

Figure 2: Installation of an Emergency Floor tile onto a wooden shipping pallet

external environments, which are commonly observed in temporary refugee settlements, undoubtedly have effect on an individual's ability to sleep well.

Whilst research has been conducted on optimal overall temporary shelter design, very little has focused specifically on shelter flooring (Ashmore et al., 2003). The goal of this study is to assess how installation of durable temporary flooring systems, like the Emergency Floor (EF), impacts sleep quality and duration, amongst displaced refugees. We hypothesise that installing durable flooring will improve sleep quality, increase sleep duration, and make a positive impact on participants living in tented refugee settlements.

1.1 Emergency Floor Details

The Emergency Floor (www.emergencyfloor.com) is a quickly deployable, lightweight, and inexpensive insulated flooring system made of expanded polypropylene. The purpose of EF is to protect temporary structures (such as refugee tents) from extreme temperatures, unwanted animals, and adverse climatic conditions such as excessive water or snow accumulation.

The EF is modular design consisting of individual tiles that can be arranged as desired and cut to fit with a common knife. Ten square meters (m^2) of Emergency Floor can be delivered and installed for approximately $200 USD. Figure 1shows an uninstalled view of the floor tiles.

Each individual EF tile weighs approximately 0.23 kg and covers 0.5 m^2. The lightweight, yet durable, material is easy to ship and can be quickly moved or relocated. The tiles are intuitive to install and can be installed without tools if necessary. In most settings, first-time users can install the floor in fewer than 10 minutes. The EF can either be installed directly on the ground or can utilise common foundation materials available in refugee settlements, including concrete slabs, sand bags, or wooden shipping pallets, as shown in Figure 2.

2 METHODS

The current study enrolled households from two tented refugee settlements in the Baalbek-Hermel Governorate of Lebanon. This Governorate is in the north-eastern portion of the country near the Syrian border and contains the highest percentage (48%) of refugees living in informal tented settlements (UNHCRb, 2017). These specific settlements were chosen based their proximity to the Syrian border, variance in topography (one was located in a flat field and the other on a hillside near a river), and

Figure 3 (top): A typical refugee shelter in the selected settlement before Emergency Floor installation

Figure 4 (bottom): The same shelter after Emergency Floor installation

total number of households contained. Funding availability allowed for EF installation in approximately 30 to 40 shelters.

Each of the 34 total households across the two settlements agreed to participate in the study and had an Emergency Floor installed in their shelter at no personal cost. A

two-part survey was administered to each household by a bilingual trained volunteer in order to collect overall demographic and health data as well as data regarding sleep quality and duration.

The survey was adapted using input from local collaborators to better gauge specific concerns unique to Lebanese informal tented settlements. The survey was written in English and then translated into Arabic by a bilingual interpreter. After a separate interpreter confirmed the accuracy of the translation, the survey was printed and administered verbally in Arabic, the participants' native tongue.

Baseline data collection and Emergency Floor installation in all participating shelters occurred in October 2016. The follow-up survey was conducted in April 2017 to determine how EF installation impacted the participants. Seven households were unavailable for follow-up survey due to moving away from the settlement. The final sample was made up of 120 individuals from 27 households. No age restrictions were enforced.

To quantify how the EF affected the sleep of the individuals sampled, the April 2017 survey recorded participants' average hours of sleep per night and asked participants to rate their quality of sleep on a scale of

Table 1: Demographic information of October 2016 (N=150) and April 2017 (N=120). Note: number of years living in settlement was rounded to the nearest year.

Parameter	**October 2016**	**April 2017**
N (individuals)	150	120
Male N (%)	69 (46.0)	55 (45.8)
Age Median [Q1, Q3]	18.50 [6.3, 30.8]	20.00 [6.0, 31.3]
Age Category (years)		
0 - 4	26 (17.3)	21 (17.5)
5 - 14	41 (27.3)	31 (25.8)
15 - 24	26 (17.3)	18 (15.0)
25 - 39	36 (24.0)	33 (27.5)
40 - 49	8 (5.3)	6 (5.0)
50 or above	13 (8.7)	11 (9.2)
Number of Years Living in Settlement N (%)		
1 or less	7 (4.7)	7 (5.8)
2	44 (29.3)	28 (23.3)
3	33 (22.0)	24 (20.0)
4	16 (10.7)	16 (13.3)
5	45 (30.0)	41 (34.2)
Missing	5 (3.3)	4 (3.3)
N (Shelters)	34	27
Individuals per shelter N (%)		
2	6 (17.7)	4 (14.8)
3	5 (14.7)	4 (14.8)
4	9 (26.5)	8 (29.6)
5	6 (17.7)	6 (22.2)
6 or more	8 (23.5)	5 (18.5)

1 to 7 before and after EF installation. The head of the household, most commonly the matriarch, provided a detailed response to the question: "How does the Emergency Floor affect your sleep?" and provided responses for any subjects unable to respond independently (such as young children).

Paired two-sample Wilcoxon Rank-Sum tests, with a two-tailed significance level of 0.05, were used to assess differences in key outcome variables (sleep quality and duration) before and after EF installation. Figure 3 and Figure 4 show the inside of a shelter before and after EF installation respectively.

3 RESULTS

Basic demographic information of the October 2016 sample of 34 households, consisting of 150 total individuals, is shown in Table 1.

Table 1 shows that there were slightly more females than males at each surveyed time-point, and that a clear majority (95.3% at baseline and 94.1% at follow-up) of the subjects had been living in their shelter for two years or more and many shelters housed six (6) or more individuals (minimum of 2, maximum of 9). The sample consisted of many young individuals and had a mean age of 21.19 years, a median age of 18.5 years, and ranged from six (6) months old to 68 years old. The first and third quartiles, representing the boundaries of the middle 50% of the data, were 6.25 years and 30.75 years respectively.

Before EF installation, 32 households reported that the only flooring system in the tent was a plastic sheet, one reported that they had a synthetic mat along with the plastic sheet, and one indoor flooring material was unreported. Participants reported an average of 9.3 hours of sleep per night (Median [IQR]= 10 [9,10]) before EF installation. After EF installation participants reported an average of 10.26 hours of sleep per night (Median [IQR] = 10 [10,11]). Figure 5 shows the distribution of self-reported average hours of sleep per night before and after the installation of the EF.

Participants scored average sleep quality on a scale of 1 to 7, with 1 representing the lowest quality and 7 representing the highest quality. Participants reported an average sleep quality score of 3.14 (Median [Q1, Q3] = 3 [2,4]) before EF installation. After EF installation participants reported an average sleep quality score of 5.83 (Median [IQR] = 5 [5,6]). Figure 6 displays the difference in sleep quality before and after EF installation.

Since the same households were interviewed at the follow up survey, the before and after groups are not independent. Upon inspection, the distribution of sleep quality and duration were not normally distributed. Therefore, two-sided paired Wilcoxon rank-sum tests were used to assess differences before and after EF installation.

Results indicated that sleep duration significantly increased ($pDuration < 0.001$) and sleep quality significantly improved ($pQuality < 0.001$) after installation of the EF ($\alpha = 0.05$). Of the 27 heads of household

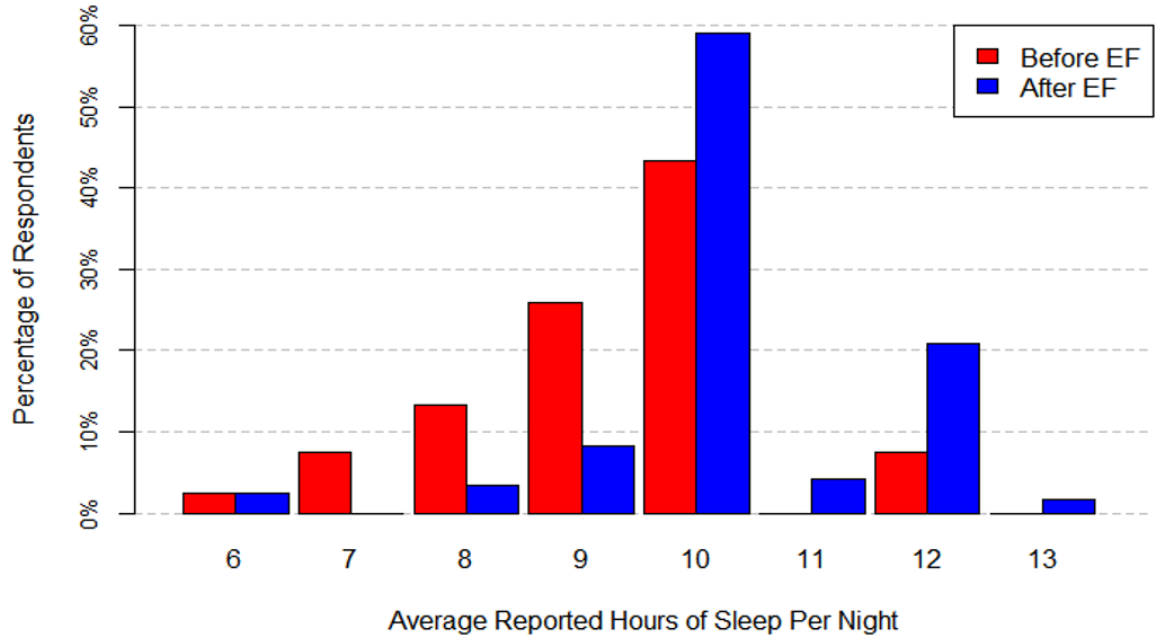

Figure 5: Self-reported average reported hours of sleep per night before (average = 9.3, median = 10, IQR = [9,10]) and after (average = 10.26, median = 10, IQR = [10,11]) EF installation

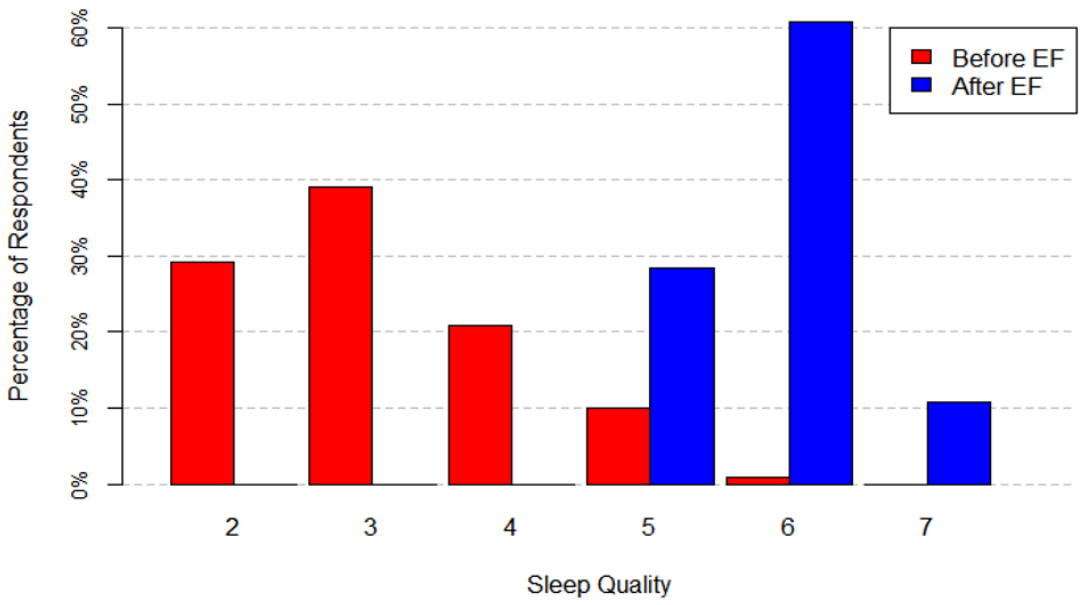

Figure 6: Self-reported sleep quality on a scale of 1 (lowest) to 7 (highest) before (average =3.14, median [Q1, Q3]= 3 [2, 4]) and after (average = 5.83, median [Q1, Q3] = 5 [5, 6]) EF installation

interviewed in the April 2017 follow-up survey, 26 (96.3%) provided a response to the question "How does the Emergency Floor affect your sleep?" which indicated that EF installation positively affected their sleep and 1 (3.7%) household decided to use the EF in the kitchen rather than sleeping area. Detailed reasons for why subjects' sleep improved included: more comfortable sleeping surface, warmer temperature inside the tent at night, easier to keep clean and dry, and feeling safer. Counts of these detailed responses are displayed in Table 2.

The temperature inside the shelter during sleeping hours depends on both outside environment and fuel consumption of the heater. Of the 27 households from which follow-up data were collected in the April 2017 survey, 13 (48.1%) reported using less fuel and 14 (51.9%) reported using the same amount of fuel after EF installation. No household reported using more fuel after EF installation. Subjects reported that the savings in fuel costs enabled them to spend more money on food, pay off debts, and buy medicine for children and elderly family members.

4 DISCUSSION

This research was completed to determine how installation of durable temporary flooring systems, like the Emergency Floor, could improve sleep quality and duration among displaced refugees. While the number of displaced people continues to rise, health and wellness for this population should be addressed from multiple sources.

The participants surveyed started without any durable or permanent flooring and instead relied on plastic sheets for a comfortable sleeping surface and protection from the outside environment. After EF installation, participants reported an increase in sleep quality as well as sleep duration, as well as positive responses to open ended questioning. These results suggest an overall increase in perceived wellness. The floor proved to be durable and only minimal damage was reported.

The current study has several notable strengths and contributions to refugee health literature. First, this is the first study, to our knowledge, which focuses on potential benefits of durable flooring installation in tented

Table 2: Detailed reasons for how EF installation affected sleep in each household

Parameter	**N**	**%**
More Comfortable	15	55.6
Cleaner	6	22.2
Warmer at Night	4	14.8
Safer	1	3.7

communities. Tented walls and ceilings are obvious, integral parts of the overall shelter, but it should be remembered that inhabitants spend most of their time in direct contact with the shelter's floor. Additionally, this study enrolled a sample that exemplifies the overall target population. Instead of relying on testing in a controlled environment with subjects who would not use the floor long-term, this study collected data from subjects likely to continue using the floor in the future. Also, the study participants assessed the floor over the course of approximately six months rather than only a few days. This extended exposure to the floor enabled the study respondents to provide a more robust opinion on how the floor affected their sleep quality and duration. Finally, conducting the survey in the participant's native language protected against information being lost in translation.

A few limitations of the study were also apparent. The most obvious limitation was the potentially unreliable nature of self-reported sleep data. However, in the absence of availability of objective measurement or confirming results with a bed-partner, self-reporting of sleep outcomes remains the most practical method of measuring sleep quality and duration (Tamakoshi and Ohno, 2004; Sharwood et al., 2012). Furthermore, since this study did not restrict participants based on age, young children may have relied on their parents to help answer questions. This could lead to high correlation of data within a household. Fatigue of the survey administrator was another area of concern, as only one community health worker administered the survey. However, no obvious mistakes were observed in the data. Additionally, the survey time frame was completed during the winter months and does not capture the complete climatic effects on camp life experienced throughout the year. However, since winter tends to cause the harshest environmental conditions for refugees, the fact that the floor performed well through the winter months suggests that it is also beneficial in other seasons.

5 CONCLUSION

Overall, this study effectively demonstrated that sleep quality and duration among refugees significantly improved after installation of a durable, temporary flooring system. Additionally, the subjects also reported positive psychological outcomes (as reported in Table 2) including feeling safer and more comfortable in their home. These results suggest that installation of durable flooring should be considered when constructing temporary shelters. Future research could also investigate other potential benefits of floor installation such as assessing disease and infection rates between households with and without floors, and a thorough assessment of how floor installation impacts fuel consumption. Incorporating randomised assignment of households to various flooring comparable systems could also be considered to assess performance across flooring type. Furthermore, installation of durable transportable flooring, such as the Emergency Floor, could be adapted for use in other temporary structures, such as forward surgical hospitals or disaster relief shelters.

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