

The association between living conditions and health among Syrian refugee children in informal tented settlements in Lebanon

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ABSTRACT

Background This cross-sectional study explores the relationship between housing, social wellbeing, access to services and health among a population of Syrian refugee children in Lebanon.

Methods We surveyed 1902 Syrian refugee households living in informal tented settlements in Lebanon in 2017. Logistic regressions assessed relationships between housing problems, socioeconomic deprivation, social environment and health.

Results Of the 8284 children in the study, 33.0% had at least one health problem. A considerable number of households (43.1%) had > 8 housing problems. Children in these households had higher odds to have three or more health problems compared to children in households with < 6 housing problems (adjusted odds ratio [AOR], 2.39; confidence interval [CI], 1.50–3.81). Nearly three-quarters (74.3%) of households were severely food insecure. Children in these households had higher odds to have one health problem than those in food secure households (AOR, 1.75; CI, 1.11–2.76). There was a significant positive association between households that reported being unhappy with their neighbourhood and the number of children with health problems in those households.

Conclusions This study highlights the association between the physical and social living conditions and refugee children's health. Without multidimensional interventions that consider improvements to living conditions, the health of young Syrian refugees will continue to worsen.

Keywords housing, public health, refugees

Introduction

Access to safe and clean housing is a human right fundamental to the health and wellbeing of refugees.¹ Refugees, forced to flee their homes, families and livelihoods, often struggle to find decent housing in host countries.² Access to quality housing is particularly difficult for the most economically disadvantaged refugees who are reliant on humanitarian assistance to cover the cost of rent and other basic necessities.³ These conditions describe the reality for many Syrian refugees living in Lebanon persevering through great adversity. In an effort to better understand and advocate for the needs of refugees, this paper explores the relationship between housing, social wellbeing, access to services and health among Syrian refugee children living in Lebanon.

Housing and health

The connection between housing conditions and physical and mental health is well established in the literature.^{1,4,5} Poor housing conditions like cold, dampness and poor ventilation are associated with respiratory diseases and lung infections and are linked to excess winter mortality.⁶ Other housing characteristics (e.g. type of waste disposal, water service, food storage, pests) may result in a multitude of health problems, including other chronic and infectious diseases.⁷ Housing

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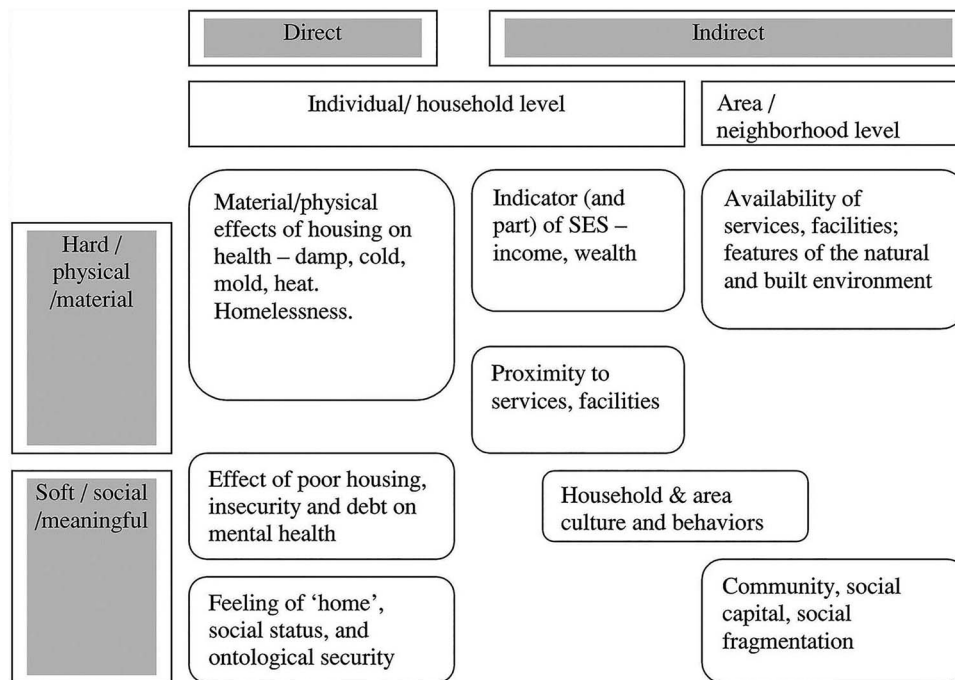


Fig. 1 Housing and public health framework⁶.

environments presenting safety risks have been linked with physical injuries, such as those resulting from fires, falling and accidents, particularly among children and the elderly.⁸ While housing directly affects health, it also functions as a powerful social determinant of health with downstream effects.^{5,6}

Shaw⁶ developed a conceptual framework (Fig. 1) that explains the ways in which housing affects health. The framework presents health as affected through both ‘hard’ (physical/material) and ‘soft’ (social/meaningful) pathways. Hard pathways include aspects of the physical environment (e.g. heating, ventilation, crowding, access to services, public sanitation). Soft pathways are mediated by perceptions and social experience (e.g. not feeling at ‘home’, social status, community and social capital) that may promote psychological strain and poor mental health. Shaw’s framework identifies spatial dimensions to these pathways. Specifically, there are ‘direct’ (at the individual/household level) and ‘indirect’ (in the neighbourhood/area) routes through which hard and soft pathways influence health. This study applies Shaw’s framework as an analytical lens through which to understand the relationship between housing and the wellbeing of Syrian refugee children.

Syrian refugees in Lebanon

In 2015, Lebanon became the country with the highest number of refugees per capita as it hosts more than 1 million

Syrian refugees living among a Lebanese population of over 4 million.⁹ Approximately 952,562 Syrian refugees reside in Lebanon, with more than half (55.4%) under 18 years of age.¹⁰ These numbers released by the United Nations High Commissioner for Refugees (UNHCR) include only the refugees that have registered with the organization, but some sources estimate that the total number of Syrians in Lebanon is nearer to 1.5 million.¹¹ The population of Syrian refugees surged in Lebanon from the start of the Syrian conflict in 2011 through 2016.¹⁰

The Lebanese context is more complex than that of other countries hosting refugees since it is not a signatory to the 1951 Geneva Convention and its 1967 Protocol, which provide basic rights for refugees. Instead, the Lebanese government works with the UNHCR through a Memorandum of Understanding that grants asylum seekers temporary residence with minimal social protections.¹² The influx of refugees into Lebanon put a strain on the country’s economic, social and political landscape.¹³ This has led to a climate of hostility towards refugees whom Lebanese nationals view as competition for jobs and social services.¹⁴ Echoing these views, the Lebanese government has instituted policies limiting refugee access to work opportunities and other forms of social support.¹³ Moreover, it was hesitant to build official refugee camps because of fears that Syrian resettlement may be long-term and affect the balance of power within the country.¹³ This resulted in the proliferation of informal

settlements that do not meet the requirements of safe and healthy housing.

The living conditions in the informal settlements have uniquely affected Syrian children who experience multiple forms of deprivation, including poverty, food insecurity, social marginalization and hazardous living conditions.^{14,15} These conditions undermine the health of vulnerable Syrian children residing in Lebanon.

Research objectives

Housing has been identified as one of the main factors affecting the physical and mental health of refugees.^{1,16} For Syrian refugees in Lebanon, housing and health conditions are evidently tied to their deprivation and intimately reliant on their status as refugees. Among Syrian refugees residing in Lebanon in 2017, 34% live in makeshift communities known as informal tented settlements or non-residential structures (like garages).¹⁷ The highest concentration of Syrian refugees in Lebanon reside in the Beqaa region in the eastern part of the country (340,512 individuals).¹⁰ About 77% of refugees living in Beqaa, the site of the present study, are housed within informal tented settlements in remote and deprived areas.¹⁸ These refugees are among the most vulnerable in the country as they are subject to harsh weather conditions and other life-threatening hazards. Research on the health of refugees and children living in poor quality housing is scarce, as most of the literature focuses on resettlement efforts in wealthier Western nations.¹ This paper offers a contribution to the scholarly discourse at the intersections of refugee studies, housing and health. Using Shaw's framework, it explores the relationship between housing, social wellbeing, access to services and health among a population of Syrian refugee children in Lebanon.

Methods

This research is based on a cross-sectional survey conducted in 2017 with Syrian refugees living in informal tented settlements in Lebanon's Beqaa Valley. The 2017 study investigated child labour among Syrian refugees in Lebanon. More information on the methodological approach of the study can be found in a previously published paper.¹⁵

Out of 3748 informal tented settlements in the Beqaa, a random sample of 153 informal tented settlements (see Fig. 2a) was selected from the Interagency Mapping Platform, a database for information on Syrian refugees living in informal tented settlements across Lebanon.¹⁹ We recruited 33 fieldworkers, who attended a 7-day training workshop, and selected 27 for fieldwork. Data collection commenced on 14 August 2017 and was completed on 27 November 2017.

Field staff coordinated with a local 'shaweesh', a community gatekeeper who connects migrant workers with employers,²⁰ in each area to identify households in the sampling frame with working children between the ages of 4 and 18. The female homemaker in each household was interviewed in the survey since previous research experiences in Lebanon found that female homemakers are generally more knowledgeable about household affairs than other residents.²¹ Information on children's (0–18 years) life experiences in Lebanon was collected. We surveyed 1902 households where 8284 children (0–18 years) lived.

Questionnaire and measures

A household questionnaire was developed and administered through face-to-face interviews with the female homemaker in colloquial Arabic. It included sections on the health status of all household members, household income, housing conditions, food security, awareness about presence of social services, being cautious when dealing with others, trusting merchants and feeling happy in the neighbourhood.

We used a number of indicators that reflect the components of Shaw's model (Fig. 1). To describe the characteristics of housing, an index of housing problems was developed using 14 items including insect and rodent infestation, water leakage from the tent, holes and cracks in the walls, humidity and others describing housing conditions^{4,22,23} (see Appendix). Each item was given a score of one, so the maximum score was 14. We categorized the housing problem index into three categories: six problems or less, seven to eight problems and more than eight problems. Monthly household income and food security were used to describe income and wealth. Monthly household income was used as a continuous variable. Food security was measured through (i) the Reduced Coping Strategies Index (RCSI),²⁴ which includes 5 individual coping behaviours, and (ii) an adapted version of the Livelihood Coping Strategy Index²⁵ using 10 long-term coping strategies including selling household goods, borrowing money to purchase food, withdrawing children from school and others (see Appendix). We categorized food security into three categories: food secure, food insecure and severely food insecure.

Awareness about social services (yes, no) was used as a proxy measure of availability of services in the neighbourhood in Shaw's model. The indicators describing caution and trust in dealing with others (yes, no) were used as proxies for social capital and cohesion.^{26,27} In addition, the indicator describing being happy in the neighbourhood (yes, no) was used as a proxy for the sense of belonging to the neighbourhood.^{6,28}

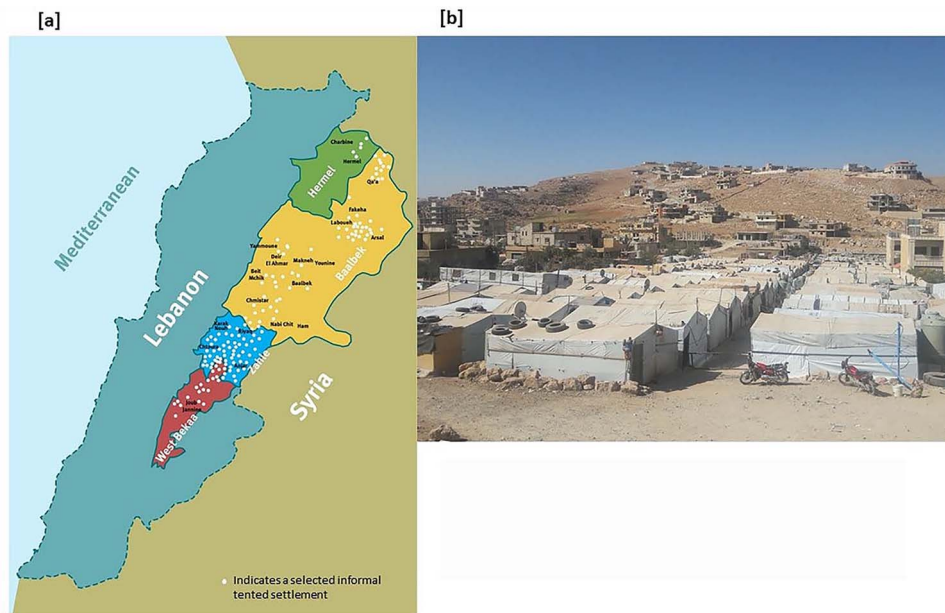


Fig. 2 Informal tented settlements in the Beqaa, Lebanon, 2017. (a) Map of selected informal tented settlements. (b) Group of tents in a settlement.

This study assessed health through self-reports of chronic and acute illness (3-month prevalence) and disability. Homemakers were asked about the prevalence of health problems among household members. When a health problem was reported for each household member, the homemaker was asked to specify which illness was present based on a list provided by the interviewer.

For the purposes of analysis, we categorized health data such that each household member was identified as having zero to one, only two or three or more health problems (since the counts of health problems were minimal above three).

Independent variables were adapted from Shaw's housing and health framework (Fig. 1),⁶ which described household/neighbourhood and physical/social pathways through which housing affects health. The following indicators were utilized:

- Physical/household: household income per capita, food insecurity, housing problems
- Physical/neighbourhood: awareness of available social services
- Social/household: feeling happy with the neighbourhood
- Social/neighbourhood: cautious when dealing with people; trusting merchants

Statistical analysis

We performed a descriptive analysis of all household members 18 years and younger. The analysis reports included data

on demographics, health, housing characteristics and wealth indicators. Frequencies and percentages were reported for categorical data and means and standard deviations (SD) for continuous data. The relationship between these measures and health was assessed using cross-tabulations and six logistic regression models (one for each health indicator as per Tables 2 and 3), adjusting for the district, sex and age of the household member and for the effect of clustering at the household level. We considered an alpha value of 0.05 as statistically significant and conducted all analyses on Stata 15.0 (StataCorp).

Results

Among the 1902 households surveyed, the average household had 6.7 members including 4.36 children. The monthly household income per capita was 50.7 USD compared to a monthly per capita expenditure of 119.7 USD, which puts households in debt and makes them dependent on cash assistance provided by the UN and other international organizations to cover their expenses.¹⁷ The mean age of household heads was 42.8 years. About 40% were reading illiterate, while about 21% had completed any formal education beyond primary school (data not tabled). Of the 8284 children, the mean age was 9.8 years, 50.9% were male, and 55.5% were actively working. Their sociodemographic characteristics are presented in Table 1.

A third ($n = 2736$, 33.0%) of the children were reported by homemakers to have had a health problem. The prevalence

Table 1 Sociodemographic characteristics of the study population: children (0–18 years) in 1902 Syrian refugee households in informal tented settlements, Beqaa Valley, Lebanon, 2017 ($N = 8284$)^a

Characteristics	N	%
Age, years (mean, SD)	9.8 (4.9)	
Age, years		
0–4	1689	20.4
5–10	2934	35.4
11–14	2272	27.4
15–18	1389	16.8
Sex		
Male	4216	50.9
Female	4068	49.1
Marital status		
Single	8068	97.4
Married	170	2.1
Engaged	31	0.4
Other ^b	15	0.1
Working status		
No	3689	44.5
Yes	4595	55.5

^aData collected by researchers at the American University of Beirut between August and November 2017

^bIncludes divorced, separated, and widowed

of chronic illness was 11.9% ($n = 985$), while the prevalence of acute illness in the last 3 months was 24.2% ($n = 2005$). The most common chronic illnesses were allergies and asthma ($n = 198$), eye problems ($n = 116$) and anaemia ($n = 95$). The most prevalent acute illnesses were cold and flu ($n = 1364$), fever ($n = 898$) and diarrhoea ($n = 260$) (data not tabled).

Around 98% of the households lived in makeshift tents, primarily made of fabric (see Fig. 2b). A considerable number of households (43.1%) had greater than eight housing problems, 39.6% had seven to eight housing problems, and 17.3% had zero to six housing problems. The most common housing problems were having insects inside the home (95.1%), humidity (92.7%) and having rats or mice inside the home (91.3%). A full list of housing problems can be found in Appendix. Nearly three-quarters of households (74.3%) were severely food insecure, 21.1% were food insecure, and 4.6% were food secure (data not tabled).

Tables 2 and 3 present associations between health and hard/physical and soft/social housing indicators. All four dimensions of Shaw's framework were associated with health, but this was inconsistent across health indicators. Regarding hard/physical pathways, households reporting increased

housing problems had higher odds to have children with an acute illness in the last 3 months. Housing problems were also connected to multi-morbidity, and the magnitude of association was larger with more health problems. For example, children living in dwellings with more than eight housing problems had higher odds to have two health problems (adjusted odds ratio [AOR], 1.75; confidence interval [CI], 1.25–2.47) and to have three health problems (AOR, 2.39; CI, 1.50–3.81) than those living in households with six or less housing problems (Table 3). The prevalence of adverse health problems also increased with worsening food security status; this was statistically significant only in one model presented in Table 3. Here, children living in households experiencing severe food insecurity had higher odds to have one health problem than those living in food secure households (AOR: 1.75, CI: 1.11–2.76) (Table 3).

Neighbourhood aspects of the physical environment were also associated with health. Lower rates of chronic illness, but higher rates of acute illness, were associated with being unaware of local social services for Syrian refugees. For example, children living in households that were unaware of local social services were at lower odds to have a chronic illness (AOR, 0.80; CI, 0.66–0.97) than those who were aware of such services (Table 2). Multi-morbidity returned mixed results, where children had higher odds to have two health problems when their households were unaware of services (AOR, 1.30; CI, 1.01–1.66) (Table 3). Lack of awareness of these services did not significantly affect multi-morbidity otherwise.

Soft/social pathways were significantly associated with adverse health conditions. At the household level, not feeling 'happy in the neighbourhood' was associated with having any health problem (AOR, 1.54; CI, 1.32–1.81), a chronic illness (AOR, 1.31; CI, 0.10–1.54) and an acute illness (AOR, 1.63; CI, 1.34–1.97). A similar trend was present in the analysis on multi-morbidity. Children living in households that reported being unhappy with the neighbourhood had higher odds to have two health problems (AOR: 1.63, CI: 1.31–2.01) and higher odds to have three or more health problems (AOR, 1.70; CI, 1.30–2.22) than children living in households that reported being happy with the neighbourhood (Table 3).

The neighbourhood social environment was also significantly associated with individual health and multi-morbidity. Children living in households who reported not being cautious when dealing with people outside of their home had lower odds of having any health problem (AOR, 0.53; CI, 0.38–0.74), having a chronic illnesses (AOR, 0.61; CI, 0.43–0.85) and having a recent acute illness (AOR, 0.43; CI, 0.26–0.69) than those living in households who reported being cautious (Table 2).

Table 2 Association between living conditions and poor health in the study population: children (0–18 years) in 1902 Syrian refugee households in informal tented settlements, Beqaa Valley, Lebanon, 2017 (N = 8284)^a

Living conditions	Any health problem (N = 2736, 33.0%)		Any chronic illness (N = 985, 11.9%)		Acute illness in the last 3 months (N = 2005, 24.2%)	
	% (N)	AOR (95% CI)	% (N)	AOR (95% CI)	% (N)	AOR (95% CI)
Physical (individual/household level)						
Monthly household income per capita, USD	—	0.99 (0.99–1.00)***	—	0.99 (0.99–0.99)*	—	1.00 (0.99–1.00)
Housing problems						
0–6 problems	26.4 (348)	1.00	11.7 (154)	1.00	15.8 (208)	1.00
7–8 problems	31.7 (1064)	1.26 (0.99–1.60)	11.1 (372)	0.88 (0.70–1.11)	23.0 (773)	1.60 (1.17–2.20)**
>8 problems	36.7 (1324)	1.51 (1.19–1.91)**	12.7 (459)	0.99 (0.79–1.25)	28.4 (1024)	2.05 (1.51–2.79)***
Food security						
Food secure	20.1 (72)	1.00	8.1 (29)	1.00	13.4 (48)	1.00
Food insecure	25.6 (457)	1.25 (0.80–1.97)	9.9 (176)	1.14 (0.70–1.86)	17.8 (317)	1.29 (0.71–2.33)
Severely food insecure	35.9 (2207)	1.51 (0.98–2.31)	12.7 (780)	1.30 (0.82–2.08)	26.7 (1640)	1.54 (0.88–2.70)
Physical (area/neighbourhood level)						
Aware of services for Syrian refugees						
Yes	31.5 (519)	1.00	14.5 (239)	1.00	20.2 (333)	1.00
No	33.4 (2217)	1.04 (0.86–1.26)	11.2 (746)	0.80 (0.66–0.97)*	25.2 (1672)	1.24 (0.98–1.58)
Social (individual/household level)						
Happy in the neighbourhood						
Yes	27.9 (1376)	1.00	10.2 (505)	1.00	19.5 (963)	1.00
No	40.6 (1360)	1.54 (1.32–1.81)***	14.4 (480)	1.31 (1.10–1.54)**	31.1 (1042)	1.63 (1.34–1.97)***
Social (area/neighbourhood level)						
Cautious and alert when dealing with people in the neighbourhood						
Yes	34.9 (2615)	1.00	12.5 (937)	1.00	25.9 (1937)	1.00
No	15.3 (121)	0.53 (0.38–0.74)***	6.1 (48)	0.61 (0.43–0.85)**	8.6 (68)	0.43 (0.26–0.69)**
Trust merchants and store owners in the neighbourhood						
Yes	33.8 (1675)	1.00	11.9 (590)	1.00	24.9 (1235)	1.00
No	31.9 (1059)	0.91 (0.77–1.07)	11.9 (395)	0.99 (0.84–1.18)	23.1 (768)	0.90 (0.73–1.10)

^aData collected by researchers at the American University of Beirut between August and November 2017* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$; model clustered at household level and adjusted for all variables in the table in addition to district, age and sex

Discussion

Main findings of this study

Our findings support the use of Shaw's framework as an analytical tool to understand and interpret the relationship between housing and health. Shaw's framework operationalizes the effects of proximal and distal factors within the lived environment and their effects on health. Our findings showed that elements of the social environment at both the household and neighbourhood levels were strongly associated with poor child health. The material/physical aspects of housing were also associated with poor health. The most common chronic and acute illnesses were respiratory illnesses. Also, severe food insecurity was significantly associated with poor health.

What is already known on this topic

The percentage of Syrian refugees living in informal settlements across Lebanon has increased from 17% in 2017 to 19% in 2018.¹⁷ Shelters housing these refugees have been described as hazardous, structurally dangerous and lacking in basic needs such as water, electricity and appropriate sanitation facilities.¹⁸ Previous studies^{29,30} have reported on the housing and health conditions of Syrian refugees living in informal tented settlements; however studies adopting a multidimensional approach that includes the social and physical living environment and its effects on health are lacking in the literature.

What this study adds

The health profile of this sample is fairly inconsistent with what might be expected among other populations of similar age. Children in our sample had lower reported rates of chronic illness (11.9%) than found elsewhere in the literature. For example, the prevalence of chronic illnesses was 16.6% for children living in the USA,³¹ 18% among adolescents in New Zealand³² and 19% among school-aged children in Portugal.³³ This likely relates to a lack of access to comprehensive health services that might detect and diagnose chronic illnesses at an earlier point over the life course of responding children. If in fact the prevalence of chronic illness is largely underreported, then multi-morbidity is also likely understated.

The main hard factors affecting health were physical housing conditions, with the strongest associations to the prevalence of acute illnesses and multi-morbidity. These results confirm previous research linking poor housing to acute illnesses.^{34,35} Further, a higher prevalence of acute illnesses within households with more housing problems may explain why these households reported higher rates of multi-morbidity among child residents. A recent review

of studies evaluating the effect of housing improvements on health found that minor housing improvement, such as modifications to household heating and ventilation technologies, significantly affected the prevalence of acute illnesses and mortality.³⁶ Numerous studies have documented cost-effective and suitable improvement strategies that may be applicable in this context, for example, installing a deployable, lightweight, insulating floor inside refugee tents,³⁷ providing households with improved water supply,³⁸ introducing urine diverting toilets³⁹ and adopting labyrinth path design for improved visibility inside camps.⁴⁰ One challenge to the practicality of housing improvements is the temporary nature of informal tented settlements. Interventions must consider types of housing improvements that are sustainable, appropriate and acceptable by the host communities given current political tensions in the country. Recently, some 1500 Syrian refugees living in informal tented settlements on the banks of the Litani River, the longest river in Lebanon and a principal water resource in the country, were evicted from their tents for dumping sewage directly into the river, which is used for irrigation.^{41–43} Although refugee camps are only one of many sources of pollution in an area housing a number of industries in the Beqaa,⁴⁴ these evictions reveal how refugee housing conditions and poor sanitation infrastructure could become intertwined with political, social and environmental factors that increase the precariousness of vulnerable populations.

The analysis found significant associations between physical factors in the neighbourhood environment and health. A seemingly counterintuitive finding is the lower rate of children with chronic illnesses among households unaware of local refugee services. A possible explanation for this result is that households with chronically ill children are more likely to seek out services for treatment than households without chronically ill children.

The findings also point to the salience of social factors both at the individual and neighbourhood levels. Children who lived in households that reported feeling unhappy with the neighbourhood experienced poorer health across the board. This result may reflect a dynamic where members in households with children experiencing health problems are less likely to report being happy about their situation. Future studies may want to employ qualitative research to explore the difference between place-related happiness and the psychological strain of illness and the degree to which illness affects the quality of life.

The finding linking poor health in children with households' perceptions of the need to approach neighbours with caution has many potential explanations and implications. This indicator serves as a proxy for an aspect of the social

neighbourhood environment, namely, social cohesion/fragmentation.^{26,27} This may be related to previous incidents where informal tented settlements were targeted for removal because of tensions or security concerns.⁴⁵ Children living in households reporting this indicator may have experienced trauma that has ramifications for their wellbeing. Similarly, perceiving the need for caution may reflect living in areas where discrimination is common enough to affect children's engagement in health protective behaviours, such as outdoor physical and social activity. If residents are reluctant to leave their homes, they may stay within overcrowded domiciles, increasing their exposure to environmental health risks.

Limitations of this study

As a cross-sectional study, this research cannot make causal inferences about the associations identified. Further, the study had design limitations that may have affected the findings. Specifically, self-reports of health, particularly of chronic illness, may be unreliable given the study population's limited access to adequate health-care services that identify health problems in children. Moreover, all health conditions were given equal weighting in the construction of health indicators not accounting for the seriousness of the health problem. A potential area of sampling bias was the focus of this research on households with working children. This likely biased the sample towards the most socioeconomically vulnerable households among the Syrian refugee population in the country, thus limiting generalizability. In fact, the pervasive conditions of deprivation among responding households presented a challenge in the analysis, as many households were quite homogenous in the types of housing problems and poverty conditions they reported.

Conclusion

In the context of the protracted Syrian war, children are among the most vulnerable refugees. This is especially the case for refugees living in informal makeshift shelters. Such housing is inadequate and dangerous thus negatively affecting the health of residents and threatening their lives. Moreover, this research confirms the value of recognizing the physical and social pathways and proximal and distal factors mediating the relationship between housing and health. Without multidimensional interventions that consider improvements to housing and living conditions, the health of young Syrian refugees will continue to worsen. Such interventions could target the living conditions of refugees on multiple levels: the physical housing and infrastructure, access to services, food security and the neighbourhood environment.

Supplementary data

Supplementary data are available at the *Journal of Public Health* online.

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References

- Ziersch A, Due C. A mixed methods systematic review of studies examining the relationship between housing and health for people from refugee and asylum seeking backgrounds. *Soc Sci Med* 2018;**213**:199–219.
- Phillips D. Moving towards integration: The housing of asylum seekers and refugees in Britain. *Hous Stud* 2006;**21**(4):539–53.
- United Nations High Commissioner for Refugees, *Danish Refugee Council. Understanding Alternatives to Cash Assistance: Danish Refugee Council* 2017 Retrieved from: <https://bit.ly/2Aowf5v>.
- Habib RR, Mikati D, Hojeij S *et al.* Associations between poor living conditions and multi-morbidity among Syrian migrant agricultural workers in Lebanon. *Eur J Public Health* 2016;**26**(6):1039–44.
- Marmot M, Friel S, Bell R *et al.* Closing the gap in a generation: health equity through action on the social determinants of health. *Lancet* 2008;**372**(9650):1661–9.
- Shaw M. Housing and public health. *Annu Rev Public Health* 2004;**25**(1):397–418.
- Krieger J, Higgins DL. Housing and health: time again for public health action. *Am J Public Health* 2002;**92**(5):758–68.
- Gibson M, Petticrew M, Bambra C *et al.* Housing and health inequalities: a synthesis of systematic reviews of interventions aimed at different pathways linking housing and health. *Health Place* 2011;**17**(1):175–84.
- United Nations High Commissioner for Refugees. *Refugees from Syria: Lebanon: UNHCR*. 2015 Retrieved from: <https://bit.ly/2JeH9gO>.
- United Nations High Commissioner for Refugees. *UNHCR Syria Regional Refugee Response, Lebanon*. 2019. <https://bit.ly/2IUEfxo> (13 March 2019, date last accessed).

- 11 European Civil Protection and Humanitarian Aid Operations. *Lebanon Factsheet*. 2019. <https://bit.ly/2rWQTEH> (17 June 2019, date last accessed).
- 12 United Nations High Commissioner for Refugees. *Country Operations Plan*. Lebanon: UNHCR Regional Office in Lebanon, 2003.
- 13 Yahya M. *Refugees In The Making Of An Arab Regional Disorder*. Beirut, Lebanon: Carnegie Endowment for International Peace, 2015. Retrieved from: <https://bit.ly/2CExmPx>.
- 14 Küppers B, Ruhmann A. *Because We Struggle to Survive: Child Labor Among Refugees of the Syrian Conflict*. Germany: Terre Des Hommes, 2016. Retrieved from: <https://bit.ly/2SiAtm3>.
- 15 Habib RR, Ziadee M, Abi Younes E *et al*. Displacement, deprivation and hard work among Syrian refugee children in Lebanon. *BMJ Glob Health* 2019;**4**(1):e001122.
- 16 Ziersch A, Due C, Walsh M, *et al*. *Belonging begins at home: Housing, social inclusion and health and wellbeing for people from refugee and asylum seeking backgrounds*. Adelaide: Flinders Press, 2017. Retrieved from: <https://bit.ly/2kpj6zi>.
- 17 World Food Programme, United Nations Children's Fund, United Nations High Commissioner for Refugees. *Vulnerability Assessment of Syrian Refugees in Lebanon* WFP, UNICEF, UNHCR 2018. Retrieved from: <https://bit.ly/2R7XDyq>.
- 18 Government of Lebanon, United Nations High Commissioner for Refugees. *LEBANON CRISIS RESPONSE PLAN 2017-2020 (2018 update): United Nations Lebanon* 2018. Retrieved from: <https://bit.ly/2kC5qp9>.
- 19 Reliefweb. *Lebanon: Inter-Agency Mapping Platform December 2017*. 2018. <https://bit.ly/2Mn1WyG> (11 September 2018, date last accessed).
- 20 The Freedom Fund. *Struggling to survive: Slavery and exploitation of Syrian refugees in Lebanon: The Freedom Fund* 2016. Retrieved from: <https://bit.ly/2qv2vhp>.
- 21 Habib RR, Hojeij S, Elzein K *et al*. Associations between life conditions and multi-morbidity in marginalized populations: the case of Palestinian refugees. *Eur J Public Health* 2014;**24**(5):727–33.
- 22 Habib RR, Yassin N, Ghanawi J *et al*. Double jeopardy: assessing the association between internal displacement, housing quality and chronic illness in a low-income neighborhood. *J Public Health* 2011;**19**(2):171–82.
- 23 Habib RR, Mahfoud Z, Fawaz M *et al*. Housing quality and ill health in a disadvantaged urban community. *Public Health* 2009;**123**(2): 174–81.
- 24 Maxwell D, Caldwell R. *The Coping Strategies Index: Field Methods Manual*. USA: WFP, 2008. Retrieved from: <https://bit.ly/2WS4EXk>.
- 25 World Food Programme. *Consolidated Approach for Reporting Indicators of Food Security (CARI): WFP* 2014. Retrieved from: <https://bit.ly/2JuH5rV>.
- 26 Berkman LF, Kawachi I. *Social Capital, Social Cohesion, and Health*. In: Berkman LF, Kawachi I, Glymour MM editors. *Social Epidemiology*. 2 ed. Oxford, UK: Oxford University Press; 2015. p. 290–319.
- 27 Rodgers J, Valuev AV, Hswen Y, Subramanian SV. Social capital and physical health: An updated review of the literature for 2007–2018. *Social Science & Medicine* 2019; **236**: 112360
- 28 Young AF, Russell A, Powers JR. The sense of belonging to a neighbourhood: can it be measured and is it related to health and well being in older women? *Soc Sci Med* 2004;**59**(12):2627–37.
- 29 World Food Programme, United Nations Children's Fund, United Nations High Commissioner for Refugees. *Vulnerability assessment of Syrian Refugees in Lebanon: WFP, UNICEF, UNHCR* 2017 Retrieved from: <https://bit.ly/2qKyw50>.
- 30 Doocy S, Lyles E, Hanquart B *et al*. Prevalence, care-seeking, and health service utilization for non-communicable diseases among Syrian refugees and host communities in Lebanon. *Confl Heal* 2016;**10**(1):21.
- 31 Van Cleave J, Gortmaker SL, Perrin JM. Dynamics of obesity and chronic health conditions among children and youth. *JAMA* 2010;**303**(7):623–30.
- 32 Denny S, de Silva M, Fleming T *et al*. The prevalence of chronic health conditions impacting on daily functioning and the association with emotional well-being among a national sample of high school students. *JAH* 2014;**54**(4):410–5.
- 33 Santos T, de Matos MG, Simões C, MdC M. Psychological well-being and chronic condition in Portuguese adolescents. *Int J Adolesc Youth* 2015;**20**(3):334–45.
- 34 Koskinen OM, Husman TM, Meklin TM, Nevalainen AI. The relationship between moisture or mould observations in houses and the state of health of their occupants. *Eur Respir J* 1999;**14**(6):1363–7.
- 35 Makene C. *Housing-related Risk Factors for Respiratory Disease in Low Cost Housing Settlements in Johannesburg*. South Africa: Faculty of Health Sciences-School of Public Health, University of the Witwatersrand, 2008.
- 36 Thomson H, Thomas S, Sellstrom E, Petticrew M. The health impacts of housing improvement: A systematic review of intervention studies from 1887 to 2007. *Am J Public Health* 2009;**99**(Suppl 3):S681–92.
- 37 Greene TJ, Chao CA. Assessing the impact of durable flooring structures on refugee sleep quality and duration. *J Humanitarian Eng* 2018;**6**(1):27–36.
- 38 Aiga H, Umenai T. Impact of improvement of water supply on household economy in a squatter area of Manila. *Soc Sci Med* 2002;**55**(4):627–41.
- 39 Nyoka R, Foote AD, Woods E *et al*. Sanitation practices and perceptions in Kakuma refugee camp, Kenya: comparing the status quo with a novel service-based approach. *PLoS One* 2017;**12**(7):e0180864.
- 40 Chambers SN, Jacobs WJ, Lindberg C. Maze or labyrinth: identifying PTSD stressors in the built space of Zaatari and Calais refugee camps. *Prof Geogr* 2018;**70**(4):552–65.
- 41 Vohra A. Dozens of Syrian refugees evicted in Lebanon anti-pollution drive. *AlJazeera* 27 April 2019;
- 42 Zaatari MISF. Litani River authority bulldoze refugee tents in Zahrani. *The Daily Star* 17 February 2019;
- 43 Topalian N. River pollution forces Syrian refugees to relocate. *Al-Mashareq* 25 April 2019;
- 44 Holtmeier L. Despite new efforts to tackle pollution in the Litani River, challenges remain. *Executive Magazine* 21 May 2019;
- 45 Human Rights Watch. *Our Homes Are Not for Strangers: Mass Evictions of Syrian Refugees by Lebanese Municipalities*. 2018.

Appendix

Additional methodological details

Housing problems

A housing problems index^{4,22,23} was developed using the following 14 items:

- Lack of sunlight entering the house
- Lack of wind entering when windows are open
- Humidity
- Holes or cracks in the walls
- Holes or cracks in the tent ceiling
- Leakage from the tent sidewalls
- Uncovered electric wires
- Ants/cockroaches or any other insects
- Rats/mice
- Venomous insects or animals (scorpions, snakes, etc.)
- Heating the home using fuels other than gas/electricity/-solar power
- Heating water using fuels other than gas/electricity/solar power
- Cooking using fuels other than gas/electricity/solar power
- Shared or no bathroom

Food security

Food security was measured using two indices:

1. The RCSI, which includes five individual coping behaviours (eating less preferred foods, borrowing food/money from friends and relatives, limiting portions at mealtime, limiting

adult food intake and reducing the number of meals per day). The RCSI is used to measure the presence and severity of food security across different contexts and settings.²⁴

2. An adapted version of the Livelihood Coping Strategy Index²⁵ using 10 long-term coping strategies:

- Selling household goods
- Spending some or all household savings
- Buying food on credit or borrowing money to purchase food
- Borrowing money
- Selling productive assets or means of transport
- Reducing essential nonfood expenditures
- Withdrawing children from school
- Selling house or land
- Asking for money from strangers
- Accepting high risk or exploitative temporary jobs

Quality control

Following recruitment and survey completion, each household was revisited by a Quality Control Team to check whether (i) the tent was actually visited by the data collector, (ii) the female homemaker was interviewed whenever possible or was replaced by another member of the household, (iii) every working child (aged >8 to ≤18 years old) in the household was interviewed, and (iv) the month and year of birth for family members were reported according to legal papers.

The Quality Control Team detected and corrected inconsistencies in 8% ($n = 152$) of the households, mainly relating to the year of birth of household members.