





BMJ Open Health literacy as a key to improving weight status among Palestinian adolescents living in chronic conflict conditions: a cross-sectional study

Mohammed B A Sarhan ^{1,2}, Rika Fujiya,³ Akira Shibanuma ², Rita Giacaman,⁴ Junko Kiriya,² Akiko Kitamura ^{2,5}, Masamine Jimba ²

To cite: Sarhan MBA, Fujiya R, Shibanuma A, *et al.* Health literacy as a key to improving weight status among Palestinian adolescents living in chronic conflict conditions: a cross-sectional study. *BMJ Open* 2022;**12**:e061169. doi:10.1136/bmjopen-2022-061169

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2022-061169>).

Received 17 January 2022
Accepted 22 August 2022



© Author(s) (or their employer(s)) 2022. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

¹Graduate School of Health Management, Keio University, Fujisawa, Kanagawa, Japan

²Department of Community and Global Health, Graduate School of Medicine, The University of Tokyo, Bunkyo-ku, Tokyo, Japan

³Faculty of Nursing and Medical Care, Keio University, Fujisawa, Kanagawa, Japan

⁴Institute of Community and Public Health, Birzeit University, Birzeit, Palestine

⁵The World Bank, Washington, District of Columbia, USA

Correspondence to

Professor Masamine Jimba;
mjimba@m.u-tokyo.ac.jp

ABSTRACT

Objective To examine the moderating role of health literacy in the association between direct exposure to violence and weight status among Palestinian adolescents.

Design A household cross-sectional study conducted in 2017.

Setting A Palestinian district of the West Bank.

Participants Palestinian adolescents aged 11–16 years.

Results After excluding underweight adolescents from the 1200 who were initially recruited, the data of 1173 adolescents were analysed. A high proportion (62%) of adolescents were directly exposed to violence. The prevalence of obesity and overweight was 6.5% and 17.1%, respectively. The odds of obesity and overweight were 2.8 and 1.8 times higher among adolescents who were not exposed to domestic and school violence when they had low health literacy in the communication subscale. The odds of obesity were 62% and 57% lower among adolescents with high functional health literacy when exposed to domestic and school violence and to any form of violence, respectively. Among adolescents who were not exposed to any form of violence, those who had high health literacy in the communication subscale were 72% less likely to be obese compared with those who had low health literacy.

Conclusions Health literacy moderated the association between direct exposure to violence and weight status. When health literacy levels were higher, lower obesity rates were observed among adolescents who were directly exposed to any form of violence or exposed either to political violence only or domestic and school violence only. The results warrant further investigation of the role of health literacy in adolescent health. It is recommended that policy-makers integrate the health literacy concept into both education and health systems.

INTRODUCTION

The rapid increase in the incidence of overweight and obese individuals has branded these conditions as a global epidemic.¹ Globally, among children and adolescents aged 5–19 years, the prevalence of these conditions dramatically increased from 4% to 18% between 1975 and 2016.² In Palestine, an

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This is the first study to assess health literacy as a moderator of the association between direct exposure to violence and the weight status of adolescents in Palestine.
- ⇒ A culturally sensitive, valid and reliable scale was used to measure three important health-related constructs: communication, confusion and functional literacy.
- ⇒ It was necessary to exclude underweight adolescents (n=27) from the analysis to avoid sparse data bias.
- ⇒ Selection bias was present in this study owing to the exclusion of underweight adolescents from the analysis.
- ⇒ Conducting this study in only one Palestinian district might limit the generalisability of the results at the national level.

increase in the prevalence of overweight and obesity has also been observed over the past decade.³ A 2019 systematic review reported an average prevalence of 6% (range 4%–10%) and 15% (range 13%–17%) of obesity and overweight, respectively, among children under 18 years.⁴

An increase in body mass index (BMI) predisposes children and adolescents to long-term health-related consequences⁵; these include non-communicable diseases, such as type 2 diabetes mellitus, metabolic syndrome, cardiovascular disease and cancer.³ The development of obesity and overweight has been associated with risk factors related to lifestyle,⁶ mental health problems and various demographic factors (e.g., age, sex and education).⁷

In addition, health literacy has been reported as an important determinant of adolescents' weight status.⁸ A high level of health literacy is associated with better preventive and healthy behaviours related

to physical activity and eating habits.⁹ According to Sørensen *et al.* health literacy is defined as ‘people’s knowledge, motivation and competencies to access, understand, appraise and apply health information in order to make judgements and take decisions in everyday life concerning healthcare, disease prevention and health promotion to maintain or improve quality of life during the life course’.¹⁰

In Palestine, research has focused on the prevalence of overweight and obesity and not on the risk factors associated with these conditions.³ Limited research has investigated the risk factors for overweight and obesity among Palestinians. This includes a 2019 study that assessed the association between risk factors, including diet and physical activity, and the development of obesity and overweight in children and adolescents in the Nablus district.³ Other studies have reported that demographic and socioeconomic factors are associated with obesity and overweight.^{3 11 12}

The association between direct exposure to violence and weight is also important.^{13 14} Violence exposure entails being exposed to violent acts at home, at school, or in the community or being exposed to violence related to war, armed conflict or political disputes.¹⁵ In wars and armed conflicts, individuals exposed to violence are at risk of developing long-term health complications.¹⁶ In children, the influence of violence is lifelong and may be acquired by the next generation even after the conflict has ended.¹⁷ Exposure to violence, particularly during armed conflict, is linked to increased rates of unhealthy behaviours and unhealthy lifestyles, including poor eating habits.^{13 14} Early-life stresses may interfere with children’s growth and development. These disturbances may cause persistent changes in the autonomic nervous system and other systems that regulate energy metabolism and hunger.^{13 14}

Complicated political conditions have forced Palestinians to live in chronic warlike conditions and be exposed to violence throughout their lives.^{18 19} This contributes to significant adverse health effects, particularly among adolescents in a transitional life phase.^{19 20} However, the association between exposure to violence and weight status among Palestinian adolescents remains unclear.^{3 11 12 21}

Current research lacks evidence regarding the effect of health literacy on reducing the harm caused by exposure to violence in the case of adolescents.²² However, a study highlighted the importance of health literacy for Afghani and Congolese refugees who settled in the USA after escaping from war. Health literacy was an asset for the health of those refugees.²³ In previous research, several variables were found to moderate the association between exposure to violence and obesity among adolescents, such as the severity of the violent acts, obesity status, age, sex, race/ethnicity and socioeconomic status.²⁴ However, limited evidence is available on the moderating role of health literacy in achieving a better weight status among Palestinian adolescents exposed to various forms of violence. Therefore, this study examined health literacy

as a moderator of the association between direct exposure to violence and weight status, particularly being overweight and obese, among Palestinian adolescents.

METHODS

This manuscript used the data collected from the same sample used in our previously published study. The previous study aimed to develop an Arabic version of the Health Literacy Assessment Scale for Adolescents (HAS-A-AR).²⁵ After its psychometric properties were tested, the scale was found to have good reliability (Cronbach’s alpha, McDonald’s omega and the greatest lower bound were >0.7) and validity for measuring adolescent health literacy.²⁵ In this study, the same tool was used to evaluate the association between direct exposure to violence and the weight status of Palestinian adolescents, taking into consideration their health literacy levels.

Design and sampling

A cross-sectional household survey was conducted in the Palestinian district of the West Bank. Palestinian adolescents were recruited if they lived in Ramallah and Al Bireh District at the time of the interviews in 2017, had finished a grade between sixth and ninth, and were 11–16 years old. A multistage sampling method was employed as follows. First, the district was divided into different localities: urban, rural and refugee camps. Each locality was further divided into different locations (cities, towns and villages). Each location was then divided into a group of geographical blocks, with each block consisting of approximately 150 households. Locations and blocks were randomly selected. A systematic random sampling method was followed to choose every seventh household from the chosen blocks to be approached. The aim was to choose 20 households from around 150 households in each block. A specific starting point was chosen for approaching households within each block. The starting point was decided by referring to a specific landmark (mosque, church, school, shopping mall or health centre). The fieldworkers moved in that block circularly or horizontally based on its geography. Only one adolescent from each chosen household was interviewed randomly using the Kish grid method.²⁶ Figure 1 summarises the sampling process. The field workers approached the randomly selected households and provided all the necessary information on the research study and its importance. They also answered any questions or inquiries made by parents or the adolescents. Once the parents gave their consent for their adolescents to participate in the study, the field workers also made sure to take the approval for the interview from the adolescents.

Refugee camps were oversampled because the population is much smaller than that in urban and rural areas. Due to the unequal probabilities of choosing participants, the sample weights were calculated. The weights were the inverse value of the probability of choosing an adolescent to participate in this study. This probability resulted

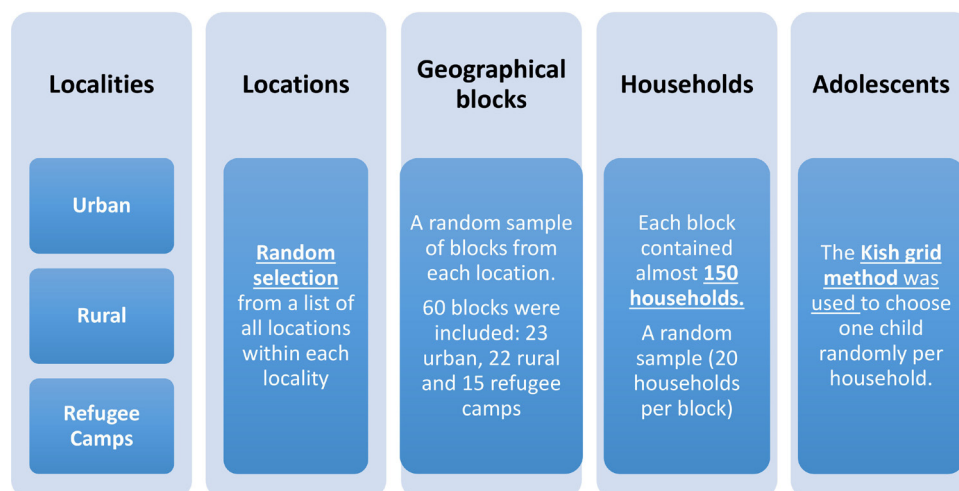


Figure 1 Summary of the sampling process.

from the multiplication of the probabilities for selecting a block within each locality, choosing a household from the block, selecting a household including at least one age-eligible adolescent and selecting a child from the household.²⁵

Variables

Outcome variable: weight status

Body weight and height were measured according to the WHO guidelines reported in the STEPS Surveillance Manual.²⁷ Height was measured in centimetres using a mobile stadiometer, Seca 217, and body weight was recorded in kilograms using the Seca 876 scale. The BMI-for-age for each adolescent was calculated using these data. Weight status was classified based on the BMI-for-age criteria provided by the WHO as a measure for children and adolescents aged 5–19 years. BMI values $>+1.0$ SD were considered overweight, while $>+2.0$ SD was classified as obese; values <-2.0 SD were classified as underweight.^{28, 29} The WHO AnthroPlus software was used for calculating the BMI-for-age Z-scores.³⁰

Main exposure variable: direct exposure to violence

Direct exposure to violence indicates being the victim of violent events, while indirect exposure indicates witnessing or hearing about violent events that affect others, including family members, friends or neighbourhoods.³¹ Direct exposure to violence was assessed by asking adapted questions from a previous study conducted among Palestinian adolescents.¹⁸ Eleven questions were asked regarding the relevant experiences in the past year (0=never, 1=exposed). The questions were divided into two components. The first encompassed five items to assess exposure to political violence by the Israeli army (physical abuse by a soldier, non-physical humiliation by a soldier, exposure to tear gas, passing checkpoints to go to school, or being unable to reach school because of a checkpoint blocking the road). The Cronbach's alpha was 0.64 for 'exposure to political violence'. The second encompassed six items to assess exposure to domestic and

school violence (physical abuse or non-physical humiliation by a family member at home, the principal or teacher, or peers at school). The Cronbach's alpha was 0.75 for 'exposure to domestic and school violence'. An additional variable that included all 11 questions was used, named 'exposure to any type of violence'. The Cronbach's alpha was 0.73 for 'exposure to any form of violence'.

Moderator variable: health literacy

The validated HAS-A-AR was used to measure health literacy. This 15-item scale has three subscales: communication, confusion and functional health literacy.²⁵ The communication subscale's main concern is oral communication and comfort while dealing with healthcare professionals and asking them questions during consultations. The confusion subscale measures adolescents' level of confusion regarding the health information they receive from healthcare professionals. Finally, functional health literacy evaluates the ability to read and understand health information.

The participants rated each item on a five-point Likert scale (always=4, usually=3, sometimes=2, rarely=1 and never=0). An additional option was added to each item during the adaptation of the scale that was previously published.²⁵ For example, the option 'I am not the one who describes my health problem to the doctor' was added to the question, 'How often can you easily describe a health problem you have to your doctor?' In terms of calculating the scores for the three subscales, all the added options were treated similar to 'never' (added option=0).²⁵ This was intended to reflect adolescents' lower involvement with healthcare professionals regarding their own health problems. Higher scores on the communication subscale indicated higher health literacy. On the contrary, a higher score on the confusion and functional health literacy subscales indicated low health literacy. The scores for each health literacy subscale were then calculated. Each participant obtained a score ranging from 0 to 20 on the communication subscale, 0 to 16 on the confusion

subscale and 0 to 24 on the functional health literacy subscale.

Each of the subscales' continuous scores was converted into a binary variable (high or low health literacy). Participants were considered to have high health literacy if they scored 15–20 on the communication subscale, 0–7 on the confusion subscale and 0–11 on the functional health literacy subscale. Otherwise, they were classified as having low health literacy. These cut-off points were determined by the original HAS-A development study and the one that validated the Arabic version.^{25 32} Binary variables were used for data analyses.

Other variables

Sources of health information

The questions were framed based on a previous study with Palestinian adolescents.³³ Adolescents were asked if they received health information from their parents, schoolteachers, friends and the media in a 'Yes/No' question format.

Diet and physical activity (basic knowledge and practice)

The adolescents were asked 10 questions regarding the types of food they considered healthy and the importance of these foods for health (online supplemental file 1). The total score was calculated by counting the number of correct answers. The Cronbach's alpha for the 10 items was 0.7. For dietary practices, adolescents were asked about their consumption of unhealthy food and drinks in the previous 24 hours. Unhealthy food types were categorised into two groups: unhealthy diet (fast food, processed food and sweets) and unhealthy drinks (sugar-sweetened beverages [SSBs] and energy drinks).

To assess basic physical activity-related knowledge, adolescents were asked about their understanding of the association between physical activity and various health-related factors, including growth and development, obesity and non-communicable diseases (online supplemental file 1). The Cronbach's alpha for the six items was 0.67. The total score was calculated by counting the number of correct answers. To assess physical activity, adolescents were asked about their frequency of exercise in 1 week.

Distress

A 12-item individual distress scale developed in Palestine was used; therefore, the scale was applicable to all Palestinians.¹⁹ The Cronbach's alpha was 0.88. Adolescents evaluated their distress on a five-point Likert scale ('not at all'=1 to 'all the time'=5), and the total score ranged from 12 to 60. Higher scores indicated higher levels of distress.

Well-being

The WHO-5 Well-Being Index was used to assess subjective psychological well-being.³⁴ The Cronbach's alpha was 0.89. The index uses a six-point Likert scale ('at no time'=0 to 'all of the time'=5), and the raw total score ranges from 0 to 25. For a standardised score, the raw score was multiplied by four to obtain a score ranging from 0 to

100. A direct relationship exists between the scores and respondents' subjective psychological well-being.³⁴

Statistical analysis

A descriptive analysis was conducted to describe the characteristics of the participants in this study. Continuous variables were presented using mean and standard deviation (SD), such as age, mental health, and diet and physical activity (practices and basic knowledge). Frequencies were used to present the categorical variables, such as demographic and socioeconomic factors. The χ^2 test was used to find the association between weight status (obese, overweight and normal) and other categorical variables. The means of the continuous variables were compared among the weight status categories.

A multinomial logistic regression model was used to identify the association of health literacy and direct exposure to any form of violence with weight status (no moderation analysis). The same analysis was repeated twice more by replacing 'direct exposure to any form of violence' with 'direct exposure to political violence only' and then with 'direct exposure to domestic and school violence only'. To measure the direct effect, the model was controlled for age, sex, locality, parents' education, internet access, diet and physical activity (basic knowledge and practices) and mental health (well-being and distress).

Next, nine multinomial logistic regression models were constructed to test our hypothesis by including the main effects and the interaction terms between each of the three variables of exposure to violence and each of the three health literacy subscales (table 1). These models evaluated whether health literacy moderated the association between direct exposure to violence and weight status (figure 2A). For example, model 1 evaluated if communication health literacy moderated the association between direct exposure to domestic and school violence and weight status. SPSS Statistics software V.24 (IBM) was used for all data analyses.

Table 1 Summary of the nine multinomial logistic regression models, including the interaction terms between direct exposure to violence and health literacy

Direct exposure to violence	Interaction with	Health literacy	Model no.
Domestic and school violence	*	Communication	Model 1
		Confusion	Model 2
		Functional	Model 3
Political violence	*	Communication	Model 4
		Confusion	Model 5
		Functional	Model 6
Any form of violence	*	Communication	Model 7
		Confusion	Model 8
		Functional	Model 9

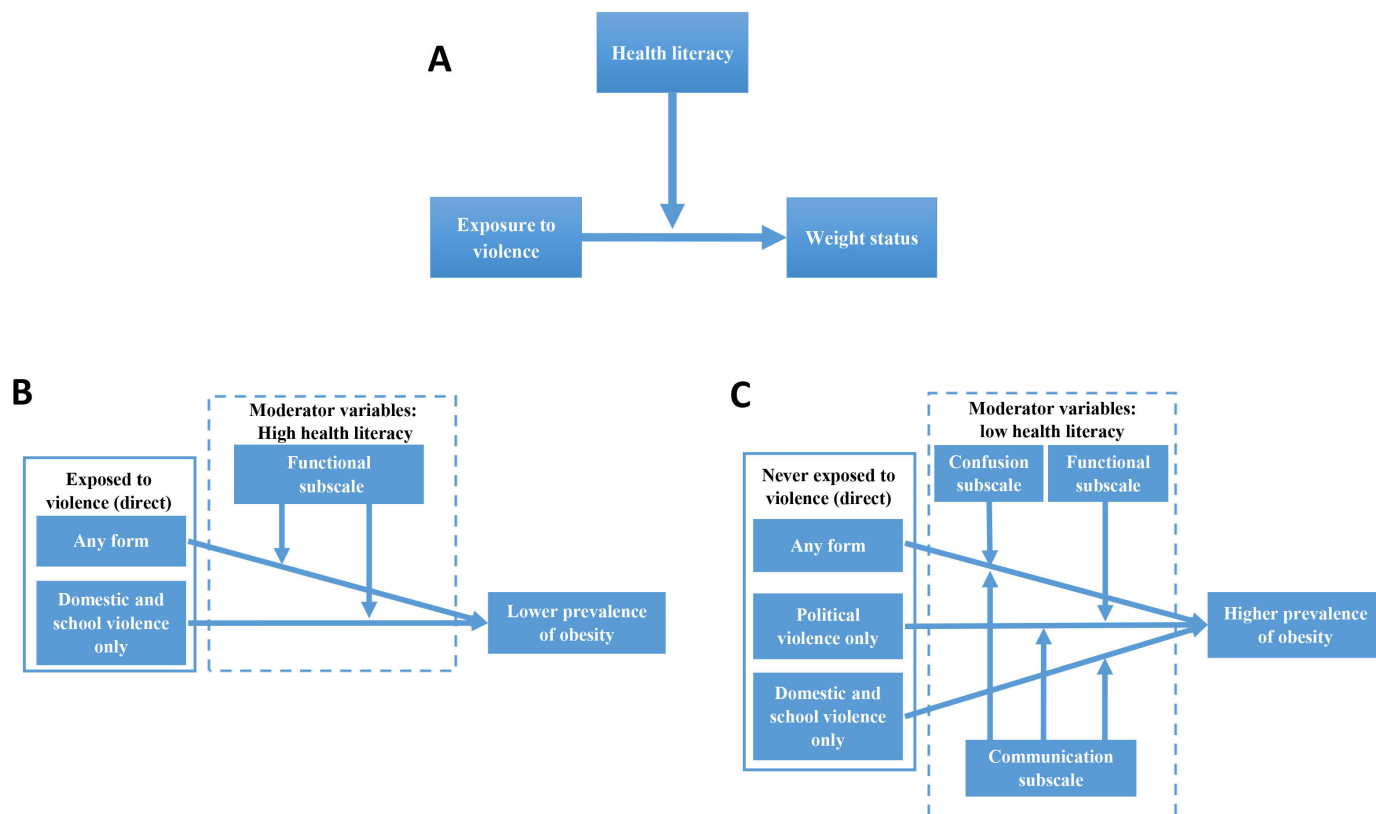


Figure 2 (A) The conceptual diagram of simple moderation. (B) High health literacy moderates the association between direct exposure to violence and lower rates of obesity. (C) Low health literacy moderating the association between never experiencing direct exposure to violence and lower rates of obesity.

Patient and public involvement

It was not appropriate or possible to involve patients or the public in the design, conduct, reporting or dissemination of our study.

RESULTS

Almost 99% of the approached adolescents agreed to participate in this study. A total of 1200 adolescent students were recruited. After excluding underweight adolescents ($n=27$), the data of 1173 adolescents were analysed; among them, 458 were from urban localities, 421 from rural localities and 294 from refugee camps. The mean age was 13.6 (SD 1.1) years. Girls accounted for 49.1% of the sample. The additional demographic and socioeconomic characteristics are summarised in [table 2](#).

Weight status

The prevalence rates of obesity and overweight were 6.5% and 17.1%, respectively, while the weight status of 76.5% of the adolescents was classified as normal. The results of the bivariate analysis are shown in online supplemental file 2. Analyses showed that the following factors were significantly associated with weight status ($p<0.05$): gender, internet access, obtaining health information from friends and media, and functional health literacy. Online supplemental file 3 shows the mean for several variables among the categories of weight status.

Direct exposure to violence

Almost 62% of the adolescents were directly exposed to political, domestic or school violence. A higher likelihood of obesity was observed among adolescents who did not experience direct exposure to any form of violence (odds ratio [OR] 2.0, 95% confidence interval [CI] 1.1 to 3.6), or those who were not exposed to domestic and school violence only (OR 1.9, 95% CI 1.1 to 3.4) ([table 3](#)).

Health literacy

The proportion of obese adolescents with low functional health literacy was 10.3%, whereas 5.5% of obese adolescents had high health literacy. Regression analysis showed that adolescents with high functional health literacy had lower obesity levels (OR 0.4, 95% CI 0.2 to 0.8) ([table 3](#)).

Results of moderation analysis

The results of the multinomial logistic regression analysis showed how the interaction between direct exposure to violence and health literacy was associated with weight status ([table 4](#), [figure 2B,C](#)).

Interaction of health literacy with domestic and school violence

The odds of obesity and overweight were 2.8 and 1.8 times higher among adolescents who were not exposed to domestic and school violence when they had low health literacy in the communication subscale. The odds of obesity were 62% lower among adolescents with high

**Table 2** Characteristics of adolescents

Variable	Categories	N	%*
Gender	Boys	576	49.1
	Girls	597	50.9
Age group (years)	11 to 12	21	1.8
	12 to <13	385	32.8
	13 to <14	269	22.9
	14 to <15	287	24.5
	15 to 16	211	17.9
Locality	Urban	458	39.0
	Rural	421	35.9
	Refugee camp	294	25.1
Class graduated from last year	Sixth grade	367	31.3
	Seventh grade	267	22.8
	Eighth grade	280	23.9
	Ninth grade	250	21.4
	Left school	7	0.6
Mother's educational level	High school or lower	340	28.9
	Higher than high school	834	71.1
Father's educational level	High school or lower	279	23.8
	Higher than high school	894	76.2
Mother's employment status	Employed	349	29.7
	Unemployed/do not know	824	70.3
Father's employment status	Employed	1078	91.9
	Unemployed/do not know	94	8.1
Internet access	Yes	1015	86.5
	No	159	13.5
Direct exposure to any form of violence	Yes	719	62.2
	No	438	37.8
Direct exposure to domestic and school violence	Yes	660	56.5
	No	508	43.5
Direct exposure to political violence	Yes	189	16.3
	No	972	83.7
Weight status	Normal	897	76.5
	Overweight	200	17.1
	Obesity	76	6.5

*Weighted percentages.

functional health literacy when exposed to domestic and school violence.

Interaction of health literacy with political violence

The odds of obesity were 4.5 times higher among adolescents who were not exposed to political violence when they had low health literacy in the communication subscale. Moreover, the odds of obesity were 4.2 times higher among adolescents who were not exposed to political violence when they had low functional health literacy.

Table 3 Multinomial logistic regression model (without the moderation analysis) showing the factors associated with weight status

Variables	Weight status*	
	Obesity	Overweight
	OR (95% CI)	OR (95% CI)
Health literacy: Communication (high)†	0.9 (0.5 to 1.5)	0.9 (0.60 to 1.20)
Health literacy: Confusion (high)†	1.4 (0.8 to 2.6)	1.4 (0.9 to 2.1)
Health literacy: Functional (high)†	0.4 (0.2 to 0.8)§	0.9 (0.6 to 1.5)
Direct exposure to any form of violence (No)‡	2.0 (1.1 to 3.6)§	1.5 (1.01 to 2.1)§
Direct exposure to political violence (no)‡	2.0 (0.9 to 4.4)	1.3 (0.8 to 2.2)
Direct exposure to domestic and school violence (no)‡	1.9 (1.1 to 3.4)§	1.4 (1.0 to 2.0)

The model was controlled for age, gender, locality, parents' education, internet access, diet and physical activity (basic knowledge and practices), and mental health (well-being and distress).
 *The reference category is 'normal'.
 †The reference category is 'low'.
 ‡The reference category is 'yes'.
 §P<0.05.

Interaction of health literacy with any form of violence

The odds of obesity and overweight were 3.2 and 1.7 times higher among adolescents who were not exposed to any form of violence when they had low health literacy in the communication subscale. Among adolescents who were not exposed to any form of violence, those who had high health literacy in the communication subscale were 72% less likely to be obese than those who had low health literacy. The odds of obesity were three times higher among adolescents who were not exposed to any form of violence when they had low health literacy in the confusion subscale. Moreover, the odds of obesity were 57% lower among adolescents with high functional health literacy even when they were exposed to violence. Further details are shown in [table 4](#).

Other factors associated with weight status

The mean basic dietary knowledge score was 8.1 (SD 1.4), while the mean basic physical activity knowledge score was 4.9 (SD 1.3). Basic dietary and physical activity knowledge were not statistically associated with weight status. Almost 79% of adolescents reported consuming SSBs, while 21.6% reported consuming unhealthy food the day before the interview. Direct exposure to violence was associated with higher consumption of SSBs (OR 1.77, 95% CI 1.34 to 2.35). Consequently, a higher prevalence of overweight was observed among adolescents who reported consuming SSBs (OR 1.61, 95% CI 1.06 to 2.45). Adolescents' distress mean score was 20.8 (SD 7.7), while the well-being mean score was 69.5 (SD 23). Neither

Table 4 Interaction of health literacy with direct exposure to violence and its association with weight status

Variables	Political violence		Domestic and school violence		Any form of violence	
	Obesity	Overweight	Obesity	Over-weight	Obesity	Overweight
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Communication*						
High HL	3.8 (0.7 to 20)	0.5 (0.2 to 1.3)	1.3 (0.6 to 2.7)	1.0 (0.7 to 1.7)	1.5 (0.7 to 2.9)	1.0 (0.6 to 1.5)
No ETV	4.5† (1.002 to 20)	1.1 (0.6 to 2.0)	2.8† (1.4 to 5.7)	1.8† (1.1 to 2.9)	3.2† (1.5 to 6.6)	1.7† (1.1 to 2.8)
High HL and no ETV	0.2 (0.03 to 1.1)	1.8 (0.7 to 4.9)	0.4 (0.1 to 1.1)	0.6 (0.3 to 1.2)	0.28† (0.1 to 0.8)	0.8 (0.4 to 1.5)
Confusion*						
High HL	5.2 (0.7 to 39)	0.7 (0.3 to 1.8)	1.3 (0.6 to 2.7)	0.9 (0.6 to 1.5)	1.4 (0.7 to 2.9)	1.0 (0.6 to 1.5)
No ETV	6.2 (0.9 to 42)	0.9 (0.4 to 1.7)	2.4 (0.9 to 6.1)	0.6 (0.3 to 1.3)	3.0† (1.2 to 7.9)	0.6 (0.3 to 1.4)
High HL and no ETV	0.2 (0.02 to 1.4)	2.1 (0.8 to 5.7)	0.7 (0.2 to 2.1)	3.1† (1.4 to 7.0)	0.5 (0.2 to 1.6)	3.1† (1.3 to 7.7)
Functional*						
High HL	1.2 (0.3 to 5.9)	1.3 (0.5 to 3.5)	0.38† (0.2 to 0.8)	0.7 (0.4 to 1.3)	0.43† (0.2 to 0.9)	0.9 (0.5 to 1.5)
No ETV	4.2† (1.02 to 17)	1.8 (0.7 to 4.5)	1.3 (0.5 to 3.4)	0.7 (0.3 to 1.6)	1.8 (0.6 to 5.0)	1.0 (0.4 to 2.5)
High HL and no ETV	0.3 (0.1 to 1.6)	0.7 (0.2 to 2.1)	1.7 (0.6 to 5.3)	2.5 (1.0 to 6.2)	1.2 (0.4 to 3.8)	1.6 (0.6 to 4.1)

*Low HL and ETV is the reference category.
 †P<0.05.
 ETV, exposure to violence; HL, health literacy.

distress nor well-being had a statistically significant association with weight status.

A lower prevalence of obesity was observed in those who obtained information from the media (OR 0.44, 95% CI 0.26 to 0.75). In contrast, there was an increased prevalence of overweight among adolescents who obtained health information from their friends (OR 1.62, 95% CI 1.18 to 2.22). Obesity was more common among boys than girls (OR 1.97, 95% CI 1.21 to 3.19).

DISCUSSION

This study investigated whether health literacy moderates the association between direct exposure to violence and weight status among Palestinian adolescents. When adolescents had higher levels of health literacy, lower obesity rates were observed among those who were directly exposed to any form of violence or were exposed to either political violence only or domestic and school violence. It was also shown that many adolescents were directly exposed to violence. This violence exposure was associated with unhealthy consumption of SSBs.

The association between exposure to violence and obesity was moderated by health literacy. The chances of obesity were 62% lower among adolescents with high functional health literacy when exposed to domestic and school violence. Moreover, chances of having obesity were 72% lower among adolescents who were not exposed to any form of violence when they had high health literacy in the communication subscale compared with those who had low health literacy. In Sweden, an intervention programme to promote health literacy and human rights in Arabic and Somali migrant mothers from conflict areas empowered and inspired the women to follow a healthier

lifestyle.³⁵ Previous reports have focused on the separate relationship between obesity and health literacy or exposure to violence.^{13 14 36–38} No study has investigated how health literacy moderates the relationship between exposure to violence and obesity.²⁴

Therefore, the results of this study are important and might contribute to filling an existing gap in the literature regarding the importance of health literacy for those exposed to violence. Better health literacy leads to having the necessary skills, competencies, and willingness to use and benefit from health promotion, health education and other preventive services to have better health-related behaviours and outcomes. Health literate adolescents might have the ability to formulate specific health goals (e.g., losing weight) and self-efficacy to achieve these predetermined goals. Students' health literacy skills can be developed through the school system.^{39 40} Integrating health literacy within the school system can influence students' critical thinking and decision-making abilities, self-awareness, health status and well-being.⁴¹ Health literacy can affect the citizenship of adolescents; it prepares them to be socially responsible by being aware of the impact of their actions on the health of others or the environment surrounding them and by being involved in the social and political activities that addressed the root causes of social inequalities in the community.⁴²

In this study, a lack of direct exposure to any form of violence was associated with a higher risk of obesity. Those who were not exposed to any form of violence were twice as likely to be obese as those who had had such exposure. Contradictory to these results, exposure to violence was reported to be associated with obesity in the USA.^{13 14} However, Palestinians remain indirectly (or



collectively) exposed to political violence, even if they do not personally experience it.¹⁸ Witnessing violence alone may explain adolescents' increased risk of obesity.^{13 14}

Moreover, in addition to the possible influence of indirect exposure to violence, the previous results can be further explained by the high consumption rate (79%) of SSBs among adolescents. This high consumption of SSBs can be attributed to violence exposure, as those exposed to violence had 77% higher odds of consuming SSBs than those not exposed to violence. Consequently, higher SSB consumption was associated with higher chances of overweight, given that adolescents who reported consuming SSBs had 61% higher chances of being overweight than those who did not consume SSBs. This might indicate that adolescents engage in obesogenic behaviours to respond to stressors such as being exposed directly or indirectly to violent events. The related stressors in the early stages of life may disrupt children's growth and development.^{13 14} These disruptions may lead to permanent alterations in the autonomic nervous system, metabolic system and hormones responsible for energy metabolism and appetite regulation.¹³ These neurobiological changes might make people susceptible to having strong emotional reactions to the stressors they encounter. It means they might suffer from negative effects such as anxiety, anger, stress, fear, sadness, loneliness, distress or depression.^{13 24} Victims of violent events might engage in emotional, binge, and excessive eating, physical inactivity, and higher intake of unhealthy diet (e.g., SSBs) to cope with, control or eliminate their negative emotions.¹³ This will eventually lead to overweight and obesity.^{24 43}

Comparable to these results, American adolescents engaged in obesogenic behaviours such as consuming unhealthy food on the same days they witnessed violent acts at home, school or anywhere else.¹⁴ In Tunisia, women exposed to community violence during childhood were more likely to be obese or overweight. Obesity and overweight among Tunisian men were also associated with exposure to collective and war violence during childhood.⁴⁴ Stress-driven eating habits can be a way to cope with stressors related to violence exposure.⁴⁵ Therefore, adolescents need to gain healthy coping skills that help them overcome the stressors they face and prevent unwanted health outcomes such as obesity. However, it should be kept in mind that several studies reported that adolescents might not tend to overeat as a response to stress; instead, they might eat less after heavy stressful events,^{46–48} particularly when related to the family,⁴⁸ while other minorities do not change their eating habits.^{46–48}

Finally, a high prevalence of exposure to domestic and school violence was found among Palestinian adolescents. More than half of the adolescents reported being exposed to domestic and school violence. According to the UNICEF, a widespread prevalence of exposure to violent acts performed at home, school and peer violence was observed in Palestine.⁴⁹ In Palestine, the increased rates of domestic violence can be directly linked to living through war and politically violent environments.⁵⁰ This was also the case in

other countries, such as Peru, Sri Lanka, Uganda, Afghanistan and Timor-Leste.^{51–54} Exposure to political violence predicted higher violence rates at other levels (e.g., home and school).⁵⁵ For example, exposure to political violence in Palestine was correlated with adolescents experiencing violence at home and witnessing violence in school.⁵⁰ Exposure to violence in any setting, including home and school, renders adolescents vulnerable to mental health problems such as stress, depression and anxiety,⁵⁶ which are detrimental to health, well-being and quality of life.⁵⁷ Domestic and school violence are relatively and easily modifiable compared with political violence. Therefore, interventions are needed to target parents, people about to become parents, children or professionals working with families at various levels (i.e., population, community and individual levels).⁵⁸ Creating a positive and safe school climate is essential for reducing school violence rates.⁵⁹

Strengths and weaknesses

This study had the following strengths. First, a representative sample of Palestinian adolescents from the Ramallah and Al Bireh district was collected. This sample included all social groups who live in urban and rural areas and refugee camps. Second, the HAS-A-AR was chosen because it measures three important health literacy-related constructs: communication with a healthcare professional, confusion about receiving information, and functional ability to read and understand numbers.²⁵ This scale was initially used in clinical and community settings. It was chosen because it is short, easy to administer and covers various age groups.

However, this study had several limitations. First, it was impossible to include adolescents from other West Bank or Gaza Strip cities because of financial and political considerations. Nevertheless, conducting this study in Palestine's economic centre can help in overcoming the issue of including only the Ramallah and Al Bireh district in this study as people from all other districts choose to live there. Second, the low prevalence of underweight adolescents may lead to sparse data bias. Therefore, 27 underweight adolescents were excluded from the analysis. Moreover, regression analysis and the interaction terms between health literacy and violence exposure reduced sparse data bias. On the contrary, excluding underweight adolescents might be considered a selection bias. Therefore, underweight adolescents should be targeted for future research. Third, socioeconomic status and the frequency and intensity of violence can vary across districts. Only direct exposure to violence was assessed, not indirect exposure to violence. However, this might be a limitation that could have affected the association between exposure to violence and weight status. Future studies should address this issue. Moreover, future research should address other types of violence that were not addressed in this study.

Conclusions

Health literacy moderated the association between direct exposure to violence and adolescents' weight status. When

health literacy levels were higher, lower obesity rates were observed among adolescents who were directly exposed to any form of violence or exposed either to political violence only or to domestic and school violence only. Future research at the national level is required to gain a better understanding of health literacy, particularly its predictors and effects on adolescents' health, including weight status.

This study provides evidence for policy-makers regarding the importance of health literacy for Palestinian adolescents' health. It is recommended that policy-makers integrate health literacy into education and health systems to ensure that adolescents acquire the necessary skills and competencies to become literate in this aspect. It is essential to conduct interventions or programmes (e.g., within school settings) to improve adolescent health literacy. It is also necessary to invest in interventions and training programmes that target parents and doctors. These interventions can improve how they communicate and deliver health information to adolescents and involve adolescents in making decisions related to their health.

Finally, owing to the low likelihood of finding feasible solutions in the near future because of the complicated political situation in Palestine, it is recommended that policy-makers direct more attention to reducing the prevalence of possibly modifiable domestic and school violence. This can be achieved by imposing the necessary laws and legislation and implementing interventions at the population, community and individual levels. Moreover, future research should focus on violence as a whole by assessing not only direct but also indirect exposure.

Contributors Study design: MBAS, RF, RG, AK, JK and MJ. Data collection: MBAS and RG. Data analysis: MBAS, RF and AS. Writing the first and final versions of the manuscript: MBAS. Revision for important intellectual content: MBAS, RF, RG, AS, JK, AK and MJ. Guarantor MJ. All authors have approved the final version of the manuscript for publication.

Funding This work was supported by JSPS KAKENHI, Grant Nos. 16KT0039 and 19K11045.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving research study participants were approved by the Research Ethics Committee of the Graduate School of Medicine, the University of Tokyo (ethical approval Nos. 11545-(1) and 11545-(2)) and the Research Ethics Committee of Birzeit University (ethical approval No. 161013). Adolescents were informed about this study and its objectives, and it was clearly stated that they were not obliged to participate, could refuse to answer any question, and could withdraw at any time. Confidence in the information provided was also ensured. Verbal consent to participate in this study was obtained from the adolescents, and according to the Research Ethics Committee at Birzeit University guidelines, verbal consent for non-invasive procedures is acceptable, and no recordings or signatures are required from the participants. Field workers signed the disclosure form, confirming that they followed the proper procedure to obtain adolescents' verbal consent.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been

peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iDs

Mohammed B A Sarhan <http://orcid.org/0000-0001-5130-4280>

Akira Shibanuma <http://orcid.org/0000-0003-2058-1722>

Akiko Kitamura <http://orcid.org/0000-0003-1954-6954>

Masamine Jimba <http://orcid.org/0000-0001-5659-3237>

REFERENCES

- Ng M, Fleming T, Robinson M, *et al*. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the global burden of disease study 2013. *Lancet* 2014;384:766-81.
- World Health Organization. Obesity and overweight. Available: <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight> [Accessed 4 Nov 2020].
- Al-Lahham S, Jaradat N, Altamimi M, *et al*. Prevalence of underweight, overweight and obesity among Palestinian school-age children and the associated risk factors: a cross sectional study. *BMC Pediatr* 2019;19:483.
- Elessi K, Albaraqouni L. Prevalence of obesity and overweight in Palestine: a systematic review. *Lancet* 2019;393:S20.
- Reilly JJ, Kelly J. Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: systematic review. *Int J Obes* 2011;35:891-8.
- Hruby A, Manson JE, Qi L, *et al*. Determinants and consequences of obesity. *Am J Public Health* 2016;106:1656-62.
- National Heart Lung and Blood Institute. Overweight and obesity. Available: <https://www.nhlbi.nih.gov/health-topics/overweight-and-obesity> [Accessed 6 Nov 2020].
- Michou M, Panagiotakos DB, Costarelli V. Low health literacy and excess body weight: a systematic review. *Cent Eur J Public Health* 2018;26:234-41.
- Fleary SA, Joseph P, Pappagianopoulos JE. Adolescent health literacy and health behaviors: a systematic review. *J Adolesc* 2018;62:116-27.
- Sørensen K, Van den Broucke S, Fullam J, *et al*. Health literacy and public health: a systematic review and integration of definitions and models. *BMC Public Health* 2012;12:80.
- Al Sabbah H, Vereecken C, Abdeen Z, *et al*. Associations of overweight and of weight dissatisfaction among Palestinian adolescents: findings from the national study of Palestinian schoolchildren (HBSC-WBG2004). *J Hum Nutr Diet* 2009;22:40-9.
- Mikki N, Abdul-Rahim HF, Awartani F, *et al*. Prevalence and sociodemographic correlates of stunting, underweight, and overweight among Palestinian school adolescents (13-15 years) in two major governorates in the West Bank. *BMC Public Health* 2009;9:485.
- Gooding HC, Milliren C, Austin SB, *et al*. Exposure to violence in childhood is associated with higher body mass index in adolescence. *Child Abuse Negl* 2015;50:151-8.
- Piontak JR, Russell MA, Danese A, *et al*. Violence exposure and adolescents' same-day obesogenic behaviors: new findings and a replication. *Soc Sci Med* 2017;189:145-51.
- Dubow EF, Boxer P, Huesmann LR, *et al*. Exposure to conflict and violence across contexts: relations to adjustment among Palestinian children. *J Clin Child Adolesc Psychol* 2010;39:103-16.
- McEniry M, Samper-Ternent R, Cano-Gutierrez C. Displacement due to armed conflict and violence in childhood and adulthood and its effects on older adult health: the case of the middle-income country of Colombia. *SSM Popul Health* 2019;7:100369.
- Kadir A, Shenoda S, Goldhagen J. Effects of armed conflict on child health and development: a systematic review. *PLoS One* 2019;14:e0210071.

- 18 Giacaman R, Shannon HS, Saab H, *et al.* Individual and collective exposure to political violence: Palestinian adolescents coping with conflict. *Eur J Public Health* 2007;17:361–8.
- 19 Hammoudeh W, Hogan D, Giacaman R. Quality of life, human insecurity, and distress among Palestinians in the Gaza strip before and after the winter 2008–2009 Israeli war. *Qual Life Res* 2013;22:2371–9.
- 20 McNeely C, Barber BK, Spellings C, *et al.* Human insecurity, chronic economic constraints and health in the occupied Palestinian Territory. *Glob Public Health* 2014;9:495–515.
- 21 Tayem YI, Yaseen NA, Khader WT, *et al.* Prevalence and risk factors of obesity and hypertension among students at a central university in the West bank. *Libyan J Med* 2012;7:19222. doi:10.3402/ljm.v7i0.19222
- 22 Rocha PC, Rocha DC, Lemos SMA. Functional health literacy and quality of life of high-school adolescents in state schools in Belo Horizonte. *Codas* 2017;29:e20160208.
- 23 Im H, Swan LET. Qualitative exploration of critical health literacy among Afghan and Congolese refugees resettled in the USA. *Health Educ J* 2019;78:38–50.
- 24 Midei AJ, Matthews KA. Interpersonal violence in childhood as a risk factor for obesity: a systematic review of the literature and proposed pathways. *Obes Rev* 2011;12:e159–72.
- 25 Sarhan MBA, Shannon HS, Fujiya R, *et al.* Psychometric properties of an Arabic-language health literacy assessment scale for adolescents (HAS-A-AR) in Palestine. *BMJ Open* 2020;10:e034943.
- 26 Kish L. A procedure for objective respondent selection within the household. *J Am Stat Assoc* 1949;44:380–7.
- 27 World Health Organization. *WHO STEPS surveillance manual: the WHO STEPwise approach to chronic disease risk factor surveillance*. World Health Organization, 2005.
- 28 de Onis M, Onyango AW, Borghi E, *et al.* Development of a WHO growth reference for school-aged children and adolescents. *Bull World Health Organ* 2007;85:660–7.
- 29 World Health Organization. Growth reference 5–19 years: BMI-forage (5–19 years). Available: https://www.who.int/growthref/who2007_bmi_for_age/en/ [Accessed 26 Jul 2020].
- 30 World Health Organization. Growth reference 5–19 years application tools: WHO AnthroPlus software. Available: <https://www.who.int/growthref/tools/en/> [Accessed 26 Jul 2020].
- 31 Zimmerman GM, Posick C. Risk factors for and behavioral consequences of direct versus indirect exposure to violence. *Am J Public Health* 2016;106:178–88.
- 32 Manganello JA, DeVellis RF, Davis TC, *et al.* Development of the health literacy assessment scale for adolescents (HAS-A). *J Commun Healthc* 2015;8:172–84.
- 33 Sarhan MBA, Kitamura A, Fujiya R. Perceptions of adolescent health literacy in the Palestinian social context: a qualitative study. *Jpn J Heal Educ Promot* 2019;27:29–42.
- 34 World Health Organization. Wellbeing measures in primary health care/the DEPCARE project: report on a WHO meeting, Stockholm, Sweden 12–13 February 1998 1998.
- 35 Ekblad S. To increase mental health literacy and human rights among new-coming, low-educated mothers with experience of war: a culturally, tailor-made group health promotion intervention with participatory methodology addressing indirectly the children. *Front Psychiatry* 2020;11:611.
- 36 Shih S-F, Liu C-H, Liao L-L, *et al.* Health literacy and the determinants of obesity: a population-based survey of sixth grade school children in Taiwan. *BMC Public Health* 2016;16:280.
- 37 Lam LT, Yang L. Is low health literacy associated with overweight and obesity in adolescents: an epidemiology study in a 12–16 years old population, Nanning, China, 2012. *Arch Public Health* 2014;72:11.
- 38 Chari R, Warsh J, Ketterer T, *et al.* Association between health literacy and child and adolescent obesity. *Patient Educ Couns* 2014;94:61–6.
- 39 Kilgour L, Matthews N, Christian P, *et al.* Health literacy in schools: prioritising health and well-being issues through the curriculum. *Sport Educ Soc* 2015;20:485–500.
- 40 Bruselius-Jensen M, Bonde AH, Christensen JH. Promoting health literacy in the classroom. *Health Educ J* 2017;76:156–68.
- 41 Hagell A, Rigby E, Perrow F. Promoting health literacy in secondary schools: a review. *British Journal of School Nursing* 2015;10:82–7.
- 42 Okan O, Bauer U, Levin-Zamir D, *et al.*, eds. *International Handbook of Health Literacy: research, practice and policy across the lifespan*. Policy Press, 2019.
- 43 Lee EY, Yoon K-H. Epidemic obesity in children and adolescents: risk factors and prevention. *Front Med* 2018;12:658–66.
- 44 El Mhamdi S, Lemieux A, Abroug H, *et al.* Childhood exposure to violence is associated with risk for mental disorders and adult's weight status: a community-based study in Tunisia. *J Public Health* 2019;41:502–10.
- 45 Jääskeläinen A, Nevanperä N, Remes J, *et al.* Stress-related eating, obesity and associated behavioural traits in adolescents: a prospective population-based cohort study. *BMC Public Health* 2014;14:321.
- 46 Oliver G, Wardle J. Perceived effects of stress on food choice. *Physiol Behav* 1999;66:511–5.
- 47 Gibson EL. The psychobiology of comfort eating: implications for neuropharmacological interventions. *Behav Pharmacol* 2012;23:442–60.
- 48 Debeuf T, Verbeken S, Van Beveren M-L, *et al.* Stress and eating behavior: a daily diary study in Youngsters. *Front Psychol* 2018;9:2657.
- 49 UNICEF. *Children: the state of Palestine*, 2018.
- 50 Al-Krenawi A, Graham JR, Sehwal MA. Tomorrow's players under occupation: an analysis of the association of political violent with psychological functioning and domestic violence, among Palestinian youth. *Am J Orthopsychiatry* 2007;77:427–33.
- 51 Gutierrez IA, Gallegos JV. *The effect of civil conflict on domestic violence: the case of Peru*. Santa Monica, CA: Rand Corporation, 2016.
- 52 Catani C, Jacob N, Schauer E, *et al.* Family violence, war, and natural disasters: a study of the effect of extreme stress on children's mental health in Sri Lanka. *BMC Psychiatry* 2008;8:33.
- 53 Rees S, Thorpe R, Tol W, *et al.* Testing a cycle of family violence model in conflict-affected, low-income countries: a qualitative study from Timor-Leste. *Soc Sci Med* 2015;130:284–91.
- 54 Saile R, Ertl V, Neuner F, *et al.* Does war contribute to family violence against children? Findings from a two-generational multi-informant study in Northern Uganda. *Child Abuse Negl* 2014;38:135–46.
- 55 Dubow EF, Huesmann LR, Boxer P, *et al.* Exposure to political conflict and violence and posttraumatic stress in Middle East youth: protective factors. *J Clin Child Adolesc Psychol* 2012;41:402–16.
- 56 Flannery DJ, Wester KL, Singer MI. Impact of exposure to violence in school on child and adolescent mental health and behavior. *J Community Psychol* 2004;32:559–73.
- 57 Harsha N, Ziq L, Ghandour R, *et al.* Well-being and associated factors among adults in the occupied Palestinian territory (oPt). *Health Qual Life Outcomes* 2016;14:122.
- 58 Gershoff ET, Lee SJ, Durrant JE. Promising intervention strategies to reduce parents' use of physical punishment. *Child Abuse Negl* 2017;71:9–23.
- 59 Gilstad-Hayden K, Carroll-Scott A, Rosenthal L, *et al.* Positive school climate is associated with lower body mass index percentile among urban preadolescents. *J Sch Health* 2014;84:502–6.