Physical activity, post-traumatic stress disorder, and exposure to torture among asylum seekers in Sweden: a cross-sectional study

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Research Article

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Abstract

Background: Forced migrant populations have high rates of trauma-related ill health, including post-traumatic stress disorder (PTSD). Physical activity (PA) is well-established as an effective stress reliever, while insufficient PA is associated with adverse effects on both mental and physical health. The aim of this study was to examine the prevalence of different levels of PA and its association with PTSD symptom severity, controlled for exposure to torture, among asylum seekers in Sweden.

Methods: A cross-sectional survey study, with data from 455 asylum seekers, originating from Afghanistan, Eritrea, Iraq, Somalia, and Syria, residing at large housing facilities across Sweden. Level of PA was assessed by the Exercise Vital Sign and categorized as: Inactive, Insufficient PA, and Sufficient PA. Prevalence estimates for proportions of different levels of PA were calculated. Analysis of variance were conducted to determine the association between levels of PA and PTSD symptom severity, measured by the Harvard Trauma Questionnaire. Multivariable logistic regression analysis was performed to determine the contribution of PA on PTSD beyond sex, age, and exposure to torture.

Results: About half of the participants (53.3%, 95% CI: 48.6-58.1) met the recommendations for Sufficient PA. One third of the participants (33.3%, 95% CI: 28.7-37.8) were insufficiently engaged in PA, and 13.4% (95% CI: 10.1-16.7) were inactive. There was a significant difference in PTSD symptom severity between groups of asylum seekers with different levels of PA ($F_{(2,316)} = 23.15, p < .001$). When controlling for sex, age, and exposure to torture, Sufficient PA was found to be associated with less PTSD symptom severity compared to both Insufficient PA ($B = 0.297, SE = 0.086, p < .001$) and Inactive ($B = 0.789, SE = 0.104, p < .001$).

Conclusions: Insufficient PA was common among the asylum seekers and our findings suggest that more PA is highly associated with better mental health in these populations. An increased focus on assessment and promotion of PA is justified during the extended time of asylum-seeking processes. The result support PA as a potentially viable treatment component in PTSD.

Background

As a result of war, conflict, persecution and human rights violations, the numbers of forcibly displaced people have escalated in recent years. Almost 80 million people are currently being forced to flee their homes, whereof 26 million are refugees and 4.2 million are asylum seekers, i.e., seeking international protection but whose claim for refugee status has not yet been determined [1]. Sweden is one of the largest European recipients of refugees and asylum seekers, and has received more than 500,000 applications for asylum over the past decade (2010–2019) [2].

Forced migrant populations are subjected to extreme stress related to both ongoing living difficulties [3–7] and high rates of pre-migratory exposure to trauma [7–9], e.g. war at close quarters, witnessing the death of others, generalized violence, and torture. Experiences of interpersonal trauma, and especially torture, are powerful predictors of mental ill health in general and symptoms of post-traumatic stress disorder (PTSD) in particular [9, 10]. Torture is by definition a grave violation of human rights. It is prohibited in international human rights law, but still practiced in over 140 countries, e.g. Syria, Afghanistan, Somalia, and other countries where many refugees originate [11]. Furthermore, exposure to trauma and extreme stress often continue both during and after the migration. Experiences such as separation from family, dangerous travel methods, continued conflicts in home country, prolonged and uncertain asylum processes, socioeconomic difficulties, and perceived racism may add to previous traumatic experiences and contribute to the development or maintenance of mental illness and symptoms of PTSD [3–6, 10]. Consequently, refugees and asylum seekers have high rates of mental ill health, including trauma-related disorders such as PTSD and comorbidity [4, 7, 9], which constitutes substantial health care challenges [10, 12, 13] and a significant public health problem in receiving countries [12, 14].

PTSD and other stress-related disorders are also associated with poor health behaviors, including low levels of physical activity (PA) [15–18], which may additionally complicate the already burdened health situation among forced migrant populations. The health benefits of PA is well established [19] and regular PA is known as an effective stress reliever and associated with improved psychological wellbeing [20]. Both international [21] and national PA guidelines [22] suggest that at least 150 minutes of moderate-intensity PA per week is needed to obtain important health benefits. Insufficient PA (i.e. < 150 minutes per week) is strongly connected to adverse effects on both mental and physical health, including increased risks of chronic medical conditions such as diabetes, hypertension, and cardiovascular disease [23], which forced migrant populations are already at heightened risk for [24]. Previous research on PA and PTSD has shown that low levels of PA can act as a reciprocal maintaining factor of both PTSD and comorbidity [17, 25, 26]. Interventions including PA and exercise have been shown to alleviate the severity of PTSD symptoms and to have beneficial effects on prevalent comorbidity such as depression, sleep disturbances, and chronic pain [27, 28]. Further, regular PA is associated with
a range of favorable health aspects that may be of particular importance concerning forced migrants’ health, including increased energy and daily life functioning, resilience and self-management of stress, sleep quality, physical health status, self-esteem and self-confidence, cognitive performance, and improved social relations [19, 20, 29]. However, the potential impact of PA has received scarce research attention in the field of PTSD and forced migrants’ health, and particularly among the vulnerable group of asylum seekers.

Despite the complex mental health needs related to stress and trauma exposure among asylum seekers, and the shown impact of PA on health and wellbeing in general, neither the prevalence of PA nor its association to PTSD and exposure to grave trauma, especially torture, has to our knowledge previously been examined. Thereby, the aim of this study was to (i) assess the prevalence of PA among a cohort of asylum seekers in Sweden, in total and stratified by sex and age group, (ii) examine the differences in PTSD symptom severity between asylum seekers with different levels of PA, and (iii) examine the associations between PA and PTSD, controlled for exposure to torture.

Methods

Study design

A cross-sectional survey design was used for the study. The reporting adheres to the STROBE guidelines for reporting observational studies [30].

Participants and setting

The study setting was three large housing facilities for asylum seekers located in Sweden. Inclusion criteria for participation in the study were: having an asylum seeker status, belonging to one of the largest refugee groups at present in Sweden (Afghanistan, Eritrea, Iraq, Somalia, or Syria), and being at least 18 years old. The total number of eligible participants was 1698. Data on PTSD and exposure to torture among the sample has been published previously [6].

Data collection and procedure

Data collection for this study was part of a comprehensive survey to asylum seekers in Sweden and was conducted from May 2016 to March 2018 [6]. A questionnaire including sociodemographic data, trauma history, measures of mental health, and level of PA, was used. Translations of the questionnaire were carried out by certified translators and reviewed by other certified translators or by bilingual staff members of the Swedish Red Cross University College. At each housing facility, volunteers and Red Cross staff members distributed the questionnaires and written information about the study to eligible participants in their native language (Arabic, Dari, or Tigrinya). At each site, professional interpreters were available during data collection. Completing the questionnaire and handing it in was regarded as informed consent. All completed questionnaires were scanned and compiled for analysis.

Measures

Sociodemographic characteristics

Data on sex, age, country of origin, and year of immigration was provided by the Swedish Migration Board. Age of participants was categorized into two groups: 18–30 years and 31–64 years. Additional sociodemographic data, including highest educational level and family situation, were collected by self-report from the participants.

PA

Level of PA was assessed by the Exercise Vital Sign (EVS) [31]. The EVS is a brief PA questionnaire that was designed to identify individuals who are not meeting PA recommendations. It assesses the average time spent in moderate to strenuous activity, displayed in minutes per week, by multiplying the responses on two self-report questions: 1) “On average, how many days per week do you engage in moderate to strenuous exercise (like a brisk walk)?” (response options: 1–7 days) and 2) “On average, how many minutes per day do you engage in exercise at this level?” (response options for minutes per day: 0, 10, 20, 30, 40, 50, 60, 90, 120, and 150 or more). In this study, the EVS score was divided into three PA categories according to established cut-offs in PA guidelines [21]: Inactive (0 min·wk$^{-1}$), Insufficient PA (1–149 min·wk$^{-1}$), and Sufficient PA (≥ 150 min·wk$^{-1}$). The questionnaire has been validated in cross-cultural settings and used in cross-sectional studies to examine the prevalence of PA in culturally diverse populations [32].

PTSD

To assess symptoms of PTSD, the trauma symptom scale (part IV) of the Harvard Trauma Questionnaire (HTQ) [33] was used. The HTQ symptom scale is cross-culturally validated and has been used for both evaluation of treatment outcome [34] and screening [35].
The scale consists of 16 PTSD symptom items, corresponding to the Diagnostic and Statistical Manual of Mental Disorders, 4th edition, (DSM-IV) criteria for PTSD. The PTSD symptoms is assessed by asking respondents to rate how much they have been bothered by each of the 16 symptoms during the past week on a 4-point scale: not at all (1), a little bit (2), quite a bit (3), or extremely (4). PTSD symptom severity is computed by averaging the responses on the list of symptoms, giving a score between 1 and 4. Higher score indicates more symptom severity, and a mean item score of ≥ 2.06 was used to define positive PTSD cases [36]. According to a recent study by Vindbjerg et al [37], the HTQ may also be divided into two subscales: a 9-item arousal/intrusion subscale (AIS) and a 7-item avoidance/numbing subscale (ANS). In the present study, these subscales were used to examine differences between clusters of PTSD symptoms in relation to different levels of PA.

Exposure to torture
Two questions from the Refugee Trauma History Checklist (RTHC) [38] was used to assess whether participants had experienced torture before and/or during their flight. In addition to the question regarding torture exposure, the checklist includes questions targeting other potentially traumatic events, e.g., war at close quarters, violence, and forced separation from family and close friends. All questions are answered on a binary outcome scale (Yes/No). The two questions regarding exposure to torture prior to flight and during the flight were combined to establish exposure, i.e., participants who endorsed either or both of the questions were considered exposed.

Statistical analysis
Descriptive statistics was used to describe participant characteristics. Prevalence estimates and their corresponding 95% confidence intervals (CI) were calculated to outline the proportions for each EVS category both within the total sample and stratified by sex and age group. Although no significant testing of the differences between strata were performed, non-overlapping CI’s were viewed as indicating significant differences in prevalence estimates.

The differences between participants designated to different EVS categories (levels of PA) in regard to HTQ score (PTSD symptom severity) and its subscales, AIS and ANS, were assessed by univariate and multivariate Analysis of Variance (ANOVA and MANOVA). ANOVA for independent group was used to assess the difference in regard to total HTQ score, while MANOVA was used for assessing the overall differences in AIS and ANS due to high intercorrelation between these symptom clusters ($r = 0.83$). Upon establishing an overall significance indicated by Wald and $F$ statistics, follow-up univariate ANOVAs were then used to explore the differences in AIS and ANS separately. Pairwise comparisons between each pair of EVS categories were done by Hochberg’s GT2 test in order to account for different samples sizes in each category, and Dunnett’s T3 test in order to account for possible heterogeneity of variance. In all analyses, the significance level was set to $p \leq .05$.

Assumption about homogeneity of variance for ANOVA for total HTQ score, and MANOVA for ANS and AIS, were tested by Levene’s Test and Box’s Test of Equality of Covariance Matrices. Neither of the tests were significant. Furthermore, normal distribution of residual for both HTQ total score and AIS and ANS were examined and showed neither substantive departure of normality nor presence of outliers. Although the assumptions for ANOVA and MANOVA were confirmed, the analyses were also performed by bootstrapping the CIs as a further mean of guarding against violations of assumptions.

Multiple regression analysis with HTQ score as the dependent variable was performed to assess the overall associations between sex, age, exposure to torture, and level of PA, indicated by EVS categories. Stepwise hierarchical regression in three steps were applied in order to assess the contribution of the EVS categories to PTSD symptom severity, indicated by HTQ score, by controlling for sex, age, and exposure to torture. Subsequently, the variables sex and age group were entered in the first step of the model, exposure to torture was added in the second step, and lastly, the variable EVS categories were added in the final step of the model. Analyses were performed by bootstrapping in order to provide robust bootstrap adjusted standard errors of the estimates and to guard against the violation of assumptions of normality. All statistical analysis were conducted using the IBM SPSS Statistics for Windows, version 24.0.

Results
Characteristics of participants
In total, 455 asylum seekers were included in the study by responding to the questionnaire (26.8% of the eligible residents). Characteristics of the participants are presented in Table 1. In brief, the majority of participants were men, between 18–30 years of age, not living with a partner, and had 9 years or less of education. About one third originated from Afghanistan, one third were from Syria, and the remaining from Somalia, Eritrea, and Iraq. Among the participants, 56% had been exposed to torture. Among the participants
who responded to the HTQ (n = 319), 61% reported PTSD symptom severity above or equivalent to the recommended cut-off (≥ 2.06) to define a checklist-positive diagnosis. The mean PTSD symptom severity score was 2.28 (SD = 0.771).
Table 1
Sociodemographic characteristics, including exposure to torture and PTSD, among the participants (N = 455).

| Sample characteristics            | n    | %    |
|-----------------------------------|------|------|
| **Sex**                           |      |      |
| Men                               | 333  | 73.2 |
| Women                             | 122  | 26.8 |
| **Age groups**                    |      |      |
| 18–30 years                       | 269  | 59.1 |
| 31–64 years                       | 186  | 40.9 |
| **Educational level**             |      |      |
| ≤ 9 years                         | 261  | 57.4 |
| 9–12 years                        | 101  | 22.2 |
| > 12 years                        | 74   | 16.3 |
| **Missing**                       | 19   | 4.2  |
| **Family situation**              |      |      |
| Living with a partner             | 119  | 26.2 |
| Not living with a partner         | 261  | 57.4 |
| Divorced/widow                    | 37   | 8.1  |
| **Missing**                       | 38   | 8.4  |
| **Year of immigration**           |      |      |
| Prior to 2014                     | 20   | 4.4  |
| 2014                              | 33   | 7.3  |
| 2015                              | 362  | 79.6 |
| 2016                              | 15   | 3.3  |
| 2017                              | 20   | 4.4  |
| 2018                              | 4    | 0.9  |
| **Missing**                       | 1    | 0.2  |
| **Country of origin**             |      |      |
| Afghanistan                       | 154  | 33.8 |
| Eritrea                           | 45   | 9.9  |
| Iraq                              | 38   | 8.4  |
| Somalia                           | 64   | 14.1 |
| Syria                             | 145  | 31.9 |
| Stateless                         | 9    | 2.0  |
| **Torture**                       |      |      |
| Exposure to torture before and/or during migration | 254 | 55.8 |

*a* Percentage of positive PTSD cases are based on those responding to the HTQ, n = 319.

PTSD, post-traumatic stress disorder; N, population size; n, sample size; HTQ, Harvard Trauma Questionnaire.
Sample characteristics

|                        | n   | %    |
|------------------------|-----|------|
| Missing                | 25  | 5.4  |
| PTSD a                 |     |      |
| PTSD according to HTQ cut-off ≥ 2.06 | 194 | 60.8 |
| Missing                | 136 | 29.9 |

a Percentage of positive PTSD cases are based on those responding to the HTQ, n = 319.

PTSD, post-traumatic stress disorder; N, population size; n, sample size; HTQ, Harvard Trauma Questionnaire.

Prevalence of PA

The level of PA, in total as well as stratified by sex and age group, is presented in Table 2. About half of the participants (53.3%, 95% CI: 48.6–58.1) met the recommendations for a sufficient level of PA. One third of the participants (33.3%, 95% CI: 28.7–37.8) were insufficiently engaged in PA, and additionally 13.4% (95% CI: 10.1–16.7) were inactive.

Table 2
Prevalence of PA categorized as Inactive, Insufficient PA, and Sufficient PA.

|                              | Inactive % (95% CI) | Insufficient PA % (95% CI) | Sufficient PA % (95% CI) |
|------------------------------|---------------------|----------------------------|--------------------------|
| Total sample (n = 418)       | 13.4 (10.1–16.7)    | 33.3 (28.7–37.8)           | 53.3 (48.6–58.1)         |
| 18–30 years (n = 244)        | 13.5 (9.2–17.8)     | 31.6 (25.7–37.4)           | 54.9 (48.7–61.2)         |
| 31–64 years (n = 174)        | 13.2 (8.2–18.3)     | 35.6 (28.5–42.7)           | 51.1 (43.7–58.6)         |
| Women (total, n = 115)       | 19.1 (11.9–26.3)    | 35.7 (26.9–44.4)           | 45.2 (36.1–54.3)         |
| 18–30 years (n = 59)         | 23.7 (12.9–34.6)    | 30.5 (18.8–42.3)           | 45.8 (33.1–58.5)         |
| 31–64 years (n = 56)         | 14.3 (5.1–23.5)     | 41.1 (28.2–54.0)           | 44.6 (31.6–57.7)         |
| Men (total, n = 303)         | 11.2 (7.7–14.8)     | 32.3 (27.1–37.6)           | 56.4 (50.9–62.0)         |
| 18–30 years (n = 185)        | 10.3 (5.9–14.6)     | 31.9 (25.2–38.6)           | 57.8 (50.7–65.0)         |
| 31–64 years (n = 118)        | 12.7 (6.7–18.7)     | 33.1 (24.6–41.5)           | 54.2 (45.2–63.2)         |

Levels of PA are based on the Exercise Vital Sign (EVS) total score of minutes per week in moderate to strenuous exercise; Inactive (0 min·wk$^{-1}$), Insufficient PA (1–149 min·wk$^{-1}$), and Sufficient PA (≥ 150 min·wk$^{-1}$).

The analyses indicated lower level of PA among women than men, although CIs were more or less overlapping. A possible difference between women and men was found among those inactive and of younger age (18–30 years), for whom the estimates were 23.7% for women and 10.3% for men, but also here the CIs were overlapping. No differences in prevalence of PA were detected between age groups for the total population.

Differences in PTSD symptom severity between groups of asylum seekers with different levels of PA

Table 3 shows that there was a significant difference in PTSD symptom severity between groups of asylum seekers with different levels of PA ($F_{(2,316)} = 23.15, p < .001$). Pairwise post-hoc tests showed a clear pattern of dose-response, i.e., the Sufficient PA group had less PTSD symptom severity compared to both the Insufficient PA group ($p = .004$) and the Inactive group ($p < .001$), and the Insufficient PA group had less PTSD symptom severity compared to the Inactive group ($p < .001$).
Table 3
Differences in PTSD symptom severity between groups of asylum seekers with different levels of PA.

|                  | Inactive (n = 42) | Insufficient PA (n = 108) | Sufficient PA (n = 169) | F(2, 316) | p   |
|------------------|-------------------|---------------------------|-------------------------|-----------|-----|
| HTQ total (PTSD symptom severity) | 2.89 (0.598) | 2.37 (0.756) | 2.07 (0.727) | 23.15     | < .001 |
| AIS subscale     | 2.95 (0.626) | 2.39 (0.801) | 2.11 (0.803) | 20.06     | < .001 |
| ANS subscale     | 2.81 (0.659) | 2.33 (0.766) | 2.00 (0.731) | 22.07     | < .001 |

Levels of PA are based on the Exercise Vital Sign (EVS) total score of minutes per week in moderate to strenuous exercise; Inactive (0 min·wk⁻¹), Insufficient activity (1–149 min·wk⁻¹), and Sufficient activity (≥ 150 min·wk⁻¹).

PTSD symptom severity are based on the HTQ total score and divided into the AIS and ANS subscales.

PTSD, post-traumatic stress disorder; PA, physical activity; HTQ, Harvard Trauma Questionnaire; AIS, arousal and intrusion symptom subscale; ANS, avoidance and numbing symptom subscale; n, sample size; M, mean; SD, standard deviation; F, Fishers test; p, probability value.

In regard to symptom clusters of PTSD, as indicated by the AIS and ANS, MANOVA revealed overall significant differences in symptom severity between groups with different levels of PA (Wilks’s Λ = 0.868, F(4, 630) = 11.58, p < .001). Follow-up univariate ANOVA established differences in regard to both the AIS (F(2, 316) = 20.06, p < .001) and the ANS (F(2, 316) = 22.07, p < .001). Pairwise post-hoc tests showed a similar dose-response pattern for the AIS and ANS as with the HTQ in total, i.e., the Sufficient PA group had less symptom severity compared to both other PA groups, and the Insufficient PA group had less symptom severity compared to the Inactive group (all significance tests between p < .001 and p = .016).

Associations between PA, exposure to torture, and severity of PTSD symptoms

As shown in Table 4, the first model in the regression analysis revealed that being a woman was associated with less PTSD symptom severity in comparison with being a man (B = -0.207, SE = 0.001, p < .038). No significant association was found between age groups and symptom severity. This model accounted for 2% of the total variance in PTSD symptom severity.
Table 4

Associations between PTSD symptom severity and sex, age group, exposure to torture, and level of PA.

| Covariates                  | Model 1<sup>a</sup> | Model 2<sup>b</sup> | Model 3<sup>c</sup> |
|-----------------------------|----------------------|----------------------|----------------------|
|                             | B        | SE  B     | 95% CI     | p       | B        | SE  B     | 95% CI     | p       | B        | SE  B     | 95% CI     | p       |
| Sex                         |          |          |            |         |          |          |            |         |          |          |            |         |
| Woman                       | -0.207   | 0.100    | -0.416     | .038   | -0.259   | 0.096    | -0.468     | .010   | -0.321   | 0.087    | -0.501     | .002   |
| Man                         | Ref.     |          | Ref.       |         | Ref.     |          | Ref.       |         |          |          |            |         |
| Age group                   |          |          |            |         |          |          |            |         |          |          |            |         |
| 18–30                       | Ref.     |          | Ref.       |         | Ref.     |          | Ref.       |         |          |          |            |         |
| 31–64                       | -0.047   | 0.088    | -0.213     | .607   | -0.015   | 0.085    | -0.167     | .869   | -0.009   | 0.079    | -0.155     | .905   |
|                             |          |          |            |         |          |          |            |         |          |          |            |         |
| Exposure to torture         |          |          |            |         |          |          |            |         |          |          |            |         |
| Yes                         |          |          |            |         |          |          |            |         |          |          |            |         |
|                             | 0.526    | 0.085    | 0.358      | <.001  | 0.469    | 0.083    | 0.308–0.631 | <.001 | 0.700    |          |            |         |
| No                          | Ref.     |          | Ref.       |         | Ref.     |          | Ref.       |         |          |          |            |         |
| Level of PA                 |          |          |            |         |          |          |            |         |          |          |            |         |
| Inactive                    |          |          |            |         |          |          |            |         |          |          |            |         |
|                             | 0.789    | 0.104    | 0.591–1.005 | <.001 |          |          |            |         |          |          |            |         |
| Insufficient PA             |          |          |            |         |          |          |            |         |          |          |            |         |
|                             | 0.297    | 0.086    | 0.133–0.465 | <.001 |          |          |            |         |          |          |            |         |
| Sufficient PA               | Ref.     |          | Ref.       |         | Ref.     |          | Ref.       |         |          |          |            |         |
| R²                          | 0.02     | 0.13     | 0.25       |         |          |          |            |         |          |          |            |         |

a Model 1 includes the variables sex and age.
b Model 2 includes the variables sex, age, and exposure to torture.
c Model 3 includes the variables sex, age, exposure to torture, and PA level.

SE, p, and CI are based on 1000 bootstrap samples.

PTSD symptom severity are based on HTQ score.

Level of PA are based on EVS total score of minutes per week in moderate to strenuous exercise.

PTSD, post-traumatic stress disorder; PA, physical activity; HTQ, Harvard Trauma Questionnaire; PA; EVS, Exercise Vital Sign; B, unstandardized beta; SE, standard error; CI, confidence interval; p, probability value; R², coefficient of determination.

In the second model, which in addition to sex and age group also included exposure to torture, associations were found between PTSD symptom severity and sex and exposure to torture respectively. Being exposed to torture was associated with significantly higher PTSD
symptom severity compared to not being exposed to torture ($B = 0.526$, $SE = 0.085$, $p < .001$). The addition of exposure to torture in this model accounted for an additional 11% of the total variance in PTSD symptom severity and the change in $R^2$ was significant ($F_{(1, 309)} = 40.51$, $p < .001$).

In the final model, all the above-mentioned variables were included with the addition of level of PA. All the above associations persisted, and Sufficient PA was found to be negatively associated with PTSD symptom severity. Both Insufficient PA ($B = 0.297$, $SE = 0.086$, $p < .001$) and Inactive ($B = 0.789$, $SE = 0.104$, $p < .001$) was significantly associated with more symptom severity. This model accounted for 25% of the total variance in PTSD symptom severity, i.e., the addition of the variable PA uniquely explained an additional 12% of the total variance in PTSD symptom severity. This change in $R^2$ was also significant ($F_{(2, 307)} = 23.39$, $p < .001$).

Discussion

Despite the well-known impact of PA on mental health and wellbeing [19, 20], little is currently known about PA among asylum seekers, a population which is known to display high prevalence of trauma-exposure and mental ill health including PTSD [3, 4, 8]. The results of this study revealed several noteworthy findings. First, almost 50% of the study population did not meet the international recommendations for a sufficient level of health-promoting PA, and were classified as either inactive or insufficiently engaged in PA. Second, both inactive and insufficient PA were found to be significantly associated with more PTSD symptom severity compared to those who met the recommendations for a sufficient level of PA. Finally, this association persisted and additionally accounted for a marked proportion of the variance in PTSD symptom severity even when analyses were controlled for sex, age, and exposure to torture.

A proportion corresponding to almost half of the cohort of this study not meeting the recommendations of sufficient PA appears as noticeably high compared to both international and national estimates of insufficient PA (also including those being completely inactive). According to the WHO Global Health Observatory data of 2016 [39], the worldwide estimates of insufficient PA were in average 27.5%, whereas the same estimate for the general population in Sweden was 23.1%. In general, the estimates of insufficient PA is higher in high-income countries than in low-income countries, with in average 36.8% of the populations in high-income countries being insufficiently active compared to 16.2% in low-income countries [40]. Most asylum seekers originate from low- or middle-income countries [1], indicating that the high prevalence of insufficient PA in our study may possibly be viewed as attributed to overall conditions associated with the process of forced migration, trauma exposure, and being an asylum seeker. More specifically, previous research has established that people with severe mental ill health are less likely to engage in PA and are more sedentary in comparison to the general population [41, 42]. Given the high rates of trauma-related ill health [3, 4], disrupted daily life and work routines from home country [4, 6], as well as other barriers to engage in PA that are likely to be faced by forced migrant populations, such as economic strain, access to facilities, and lack of motivation when living under extreme stress and uncertainty about the future [25, 43, 44], it may be concluded that asylum seekers are more readily susceptible to insufficient PA. An increased focus on assessment and promotion of PA is thereby justified. Moreover, recent research [45] has demonstrated important health benefits even at much lower doses than advocated by generic PA guidelines, especially when moving from completely inactive to some activity [46], suggesting that the promotion of any level of PA may be advisable among those currently inactive or at the lower end of the insufficient PA spectrum.

Our findings of a dose-response pattern of differences in PTSD symptom severity relating to level of PA, support that there is an association between mental ill health and insufficient PA. Previous research has found substantial reductions in PA and active leisure time habits after the onset of PTSD [18], which may indicate a direction of mental illness as a contributing factor or an antecedent to insufficient PA. However, research has also shown that low levels of PA can act as a major risk factor for the development and maintenance of mental ill health, including PTSD and comorbidity [26, 42, 47, 48]. For example, LeardMann et al [26] found that higher levels of pre-trauma PA, among U.S service members, was associated with decreased odds of developing PTSD symptoms. It is thus possible that a similar pattern is reflected in the findings of the present study. In that case, low levels of PA may adversely influence mental health and PTSD symptom severity among asylum seekers who have been exposed to severe traumatic experiences. Taken together, the associations indicated by the differences in regard to insufficient PA and PTSD symptom severity may as well be bidirectional in the same line as delineated by the Mutual Maintenance Model [49]. This model proposes that PTSD symptoms and chronic pain are mutually maintaining conditions, and that there may be several pathways by which both conditions can lead to an escalation of symptoms and distress following trauma. Concerning PA, this would imply that PTSD symptom severity may partially influence level of PA while also simultaneously be adversely influenced by insufficient PA. Promotion of PA may, in this case, be seen as both a preventive measure and an attempt to alleviate current symptom severity. Further, our findings of differences in PTSD symptom severity compared to not being exposed to torture ($B = 0.526$, $SE = 0.085$, $p < .001$). The addition of exposure to torture in this model accounted for an additional 11% of the total variance in PTSD symptom severity and the change in $R^2$ was significant ($F_{(1, 309)} = 40.51$, $p < .001$).
severity also between those being completely inactive compared to those with insufficient PA, might indicate that even a low dose of PA can yield important health benefits [45, 46].

The possibility that levels of PA may, to some extent, influence PTSD symptom severity, was furthermore supported by the results of the analyses in which exposure to torture, as a main predictor of PTSD [9, 10], was controlled for.

While exposure to torture displayed an expected high explanatory function for PTSD symptom severity, insufficient PA provided additional high explanation for the variation in PTSD symptom severity beyond exposure to torture. Although those not exposed to torture may still have experienced other severe trauma, the overall pattern indicates that insufficient PA may be a risk factor, mediator, or aggravator of PTSD symptom severity for those inflicted by severe trauma. However, these results need to be replicated by means of longitudinal studies in order to clarify causality and to assess each factor's contribution to symptom severity. In addition, there may be other symptoms or conditions, such as chronic pain [50], poor social support [51], and low self-efficacy [52], that may influence both PTSD symptoms and level of PA, which are warranted further investigation in future studies.

Our results regarding different clusters of PTSD symptoms, i.e., arousal/intrusion and avoidance/numbing, showed similar patterns of differences and associations with insufficient PA as that of the overall PTSD symptom severity. These results deviate to some extent from the inferences of a systematic review by Vancampfort et al [25], suggesting that the only correlate consistently associated with low PA in people with PTSD is symptoms of hyperarousal. Our findings, however, could also be viewed in light of other studies that have suggested that physical and social inactivity may also comprise a part of avoidance symptoms and negative cognitions and mood, e.g., avoidance of trauma-related stimuli, feeling isolated, and decreased interest in activities [18, 28, 47, 53]. Moreover, these symptom clusters may as well be closely interrelated in regard to their influence on PA, such as avoiding activities or exercise due to lack of energy or motivation, fear of bodily arousal (e.g., muscle tension, increased heart rate, shortness of breath), or fear of intrusive memories that may be triggered by physical strain. In addition, the role of social, cultural, environmental, and policy factors on PA participation among people with PTSD in general [25], and for forced migrant populations in particular [44, 54], is unknown and need to be addressed by future research.

**Strengths and limitations**

To our knowledge, this is the first assessment of prevalence of PA and its association to PTSD in a cohort of asylum seekers in a high-income country setting. The use of a cross-culturally validated measure for PTSD and well-established measures of PA, availability of information on the sample population, and an adequate sample size that provided necessary statistical power for assessment of associations and the possibility to establish the actual response rates compared to the total eligible study population, are the strengths of the study. It is, however, a limitation to the study that the proportion of those choosing to participate was just slightly more than one fourth of the total population. Still, such response rate is common in surveys conducted among hard-to-reach populations in general, and in forced migrant populations in particular. Thus, obtaining data on PA and severity of PTSD symptoms among 26.8% of all eligible individuals could be considered acceptable in this context. However, the generalizability of the estimates of prevalence of PA to other settings and other forced migrant groups may be limited.

Further, it has been reported that mental health problems may be more common among non-respondents [55, 56], which may also bias the results concerning the PA prevalence estimates. However, since the estimates of associations, compared to that of population characteristics, are less prone to bias caused by non-response [56, 57], the results concerning associations of PA with PTSD symptom severity may be viewed as less influenced by this condition.

Moreover, given the cross-sectional design and the observational data in the study, causal directions in links between PTSD symptomatology and PA cannot be established by means of the obtained empirical data. Bearing this in mind, our ambition has not been to assess the casualty of these associations and we have opted to discuss the possible directions of these associations against the background of the existing literature. Nevertheless, the results provide some evidence for the potential importance of PA in regard to PTSD symptomatology and mental health of asylum seekers. Our results also encourage more in-depth examination of PA and mental health among forced migrants and provide an interesting starting point for future studies using prospective and longitudinal designs.

**Conclusions**

Insufficient PA appears to be more prevalent among asylum seekers than the reported prevalence in general populations. Our findings suggest that more PA is highly associated with better mental health among the trauma-exposure prone populations of asylum seekers.
An increased focus on assessment and promotion of PA is justified during the currently much extended time of asylum-seeking processes. The results of this study support PA as a potentially viable treatment complement in PTSD.

**Abbreviations**

AIS: arousal and intrusion subscale; ANS: avoidance and numbing subscale; DSM-IV: Diagnostic and Statistical Manual of Mental Disorders, 4th edition; EVS: Exercise Vital Sign; HTQ: Harvard Trauma Questionnaire; PA: physical activity; PTSD: post-traumatic stress disorder; RTHC: The Refugee Trauma History Checklist.

**Declarations**

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**Authors' contributions**

HN and FS conceptualized and designed the study. HN and FS analyzed the data and MG and CG reviewed the analyses. HN drafted the initial version of the manuscript with support from FS, MG, and CG. All authors contributed to revising, editing, and finalizing the manuscript. All authors read and approved the final manuscript.

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**Availability of data and materials**

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

**Ethics approval and consent to participate**

The study conforms to recognized ethical standards [58] and was approved by the Regional Ethical Review Board in Stockholm, Sweden (2015/1463-31, 2016/549-32, 2017/1203-32). All methods were carried out in accordance with relevant guidelines and regulations. Informed consent was obtained from all participants. Consent to participate was implied by completing and returning the questionnaire, which was approved by the Ethical Review Board.

**Consent for publication**

Not applicable.

**Competing interests**

The authors declare that they have no competing interests.

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