

## ORIGINAL ARTICLE



# Validation of the Patient Health Questionnaire-4 for longitudinal mental health evaluation in elite Para athletes

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## Abstract

**Background:** Despite the increasing amount of research regarding mental health in elite athletes in recent years, athletes with impairments are hardly represented. Due to this lack of data and the significant need of athlete-specific mental health screening tools, a continuous mental health monitoring program for elite Para athletes was implemented.

**Objective:** Validation of the Patient Health Questionnaire-4 (PHQ-4) as a suitable tool for continuous mental health evaluation in elite Para athletes.

**Design:** A 43-week prospective observational cohort study.

**Setting:** Online questionnaire, provided weekly via web browser and mobile app.

**Participants:** Seventy-eight Para athletes preparing for Paralympic Summer and Winter Games.

**Interventions:** Not applicable.

**Main Outcome Measures:** Weekly PHQ-4 scores, stress level, and mood.

**Results:** With a mean weekly response rate of 82.7% (SD = 8.0), 2149 PHQ-4, 2159 stress level and 2153 mood assessments were completed. Mean PHQ-4 score among all participating athletes was 1.2 (SD = 1.8; 95% confidence interval [CI], [1.1–1.3]). Individual weekly scores ranged from 0 to 12 and showed significant floor effects, with 54% of the scores being zero. PHQ-4 scores were significantly higher among female athletes and team sport members ( $p < .001$ ). Internal consistency of the PHQ-4 was satisfying, Cronbach's  $\alpha$  being 0.839. There were significant cross-sectional as well as longitudinal correlations of PHQ-4 and stress level as well as mood values ( $p < .001$ ). 39.7% of all athletes ( $n = 31$ ) had at least one positive screen for mental health symptoms.

**Conclusions:** The PHQ-4 was shown to be a valid tool for mental health surveillance in elite Para athletes. Significant correlations of the PHQ-4 and stress level as well as mood were shown. High weekly response rates among participating athletes indicated good acceptance of the program. The weekly monitoring allowed for the identification of individual fluctuations and could identify potential athletes at risk for mental health problems when combined with clinical follow-up.

## INTRODUCTION

Mental health disorders are frequent diseases, affecting 38% of the population in the European Union (EU) each year.<sup>1</sup> Measured with disability-adjusted life

years, depression is thought to cause the greatest burden of all diseases in the EU.<sup>1</sup> In Germany, the prevalence for mental health disorders is 28% per year, with the two most common diagnoses being anxiety (15%) and mood disorders (9%).<sup>2</sup> At

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44%, the prevalence of mental health disorders is even higher among younger people (18–34 years),<sup>2</sup> the age group to which most elite athletes belong.

There has been an increasing amount of research regarding the prevalence of mental health symptoms in elite athletes in recent years.<sup>3</sup> The prevalence of depression and anxiety disorders appears to be similar to that in the general population.<sup>3</sup> Despite the increase of publications on this topic, elite Para athletes are hardly represented, although a focus on mental health problems seems to be particularly relevant in this population.<sup>4</sup> In addition to sport-specific stressors, athletes with various impairments are exposed to disability-specific stressors.<sup>3,4</sup> These include complex medical situations, chronic pain, logistic difficulties in organizing training and competition, expensive sport specific equipment, and lower financial support due to a lack of professional status despite a fast development of professionalism in Paralympic sports.<sup>3,4</sup> In 2020, Nabhan et al. showed a significantly higher percentage of positive screenings for depression and anxiety among Paralympic athletes compared to the Olympic group.<sup>5</sup> In a descriptive cross-sectional survey, 25% of 124 South African Para athletes scored high on anxiety.<sup>6</sup> Depending on the cutoff score, 12%–76% showed symptoms of distress.<sup>6</sup>

In addition to insufficient knowledge about the prevalence of mental health disorders in elite Para athletes, there is a lack of reliable and valid methods to detect and prevent them.<sup>3</sup> The 2019 consensus statement of the International Olympic Committee required future research to focus on athlete-specific mental health screening tools.<sup>3</sup> Gouttebarger et al. developed a complex algorithm for licensed health professionals to identify Olympic and Paralympic Athletes with mental health disorders or symptoms.<sup>7</sup> Their three-step algorithm includes triage, screening, and clinical interviewing.<sup>7</sup> Also, Hofmann et al. suggest a psychiatric basic assessment within the preparticipation examination to detect symptoms of mental health disorders.<sup>8</sup>

Although various longitudinal injury and illness surveillance programs have been implemented in elite Para athletes,<sup>9–12</sup> mental health evaluation has seldom been included. The aim of this study was to validate the Patient Health Questionnaire-4 (PHQ-4) as a suitable, time-efficient, and easy-to-use tool to monitor mental health symptoms in this population.

## METHODS

### Study design and participants

In November 2018, all German candidate athletes preparing for the 2020 Tokyo Paralympic Summer and the 2022 Beijing Paralympic Winter Games were identified and contacted with the support of the

National Paralympic Committee. The recruitment process for the national health surveillance program and inclusion and exclusion criteria have been described in detail elsewhere.<sup>11,13–16</sup> In this prospectively designed observational study over 43 weeks (starting in May 2019), a cohort of 78 athletes completed a weekly mental health assessment, including the PHQ-4, subjective stress levels, and mood, in addition to their routine injury and illness surveillance.<sup>11</sup> The survey was conducted via AthleteMonitoring, an online system for athlete health monitoring available via web browser or mobile app. Data collection via AthleteMonitoring was tested for its functionality in a 10-week pilot study.<sup>14</sup>

The study was carried out according to the STROBE (Strengthening the Reporting of Observational studies in Epidemiology) guidelines and has been conducted after obtaining approval from the Freiburg University's Ethics Committee (approval 254/18) and Heidelberg University's Ethics Committee (approval S-365/2019) according to the Declaration of Helsinki.

### Data collection

Informed consent and demographic information such as age, gender, type of impairment, and mobility in daily life and sports were collected from all athletes.

To screen for symptoms of depression and anxiety, the PHQ-4, an ultra-brief self-report screening scale used worldwide, was utilized.<sup>17</sup> This questionnaire assesses the frequency of mental health-related symptoms in the last 2 weeks on a 4-point Likert scale ranging from 0 (not at all) to 3 (nearly every day) in four items and a PHQ-4 sum score can be calculated, ranging from 0 to 12.<sup>18</sup> It is composed of two subscales, the Patient Health Questionnaire-2 (PHQ-2) for depressive symptoms and the Generalized Anxiety Disorder scale-2 (GAD-2) for symptoms of anxiety.<sup>18</sup> To ensure a continuous monitoring, the PHQ-4 was provided on a weekly basis. Due to clinical recommendations to regard PHQ-4 scores of 6 or greater as a yellow flag for depression or anxiety<sup>17</sup> and the preventive approach of the program, we considered PHQ-4 scores > 4 as a positive screen on mental health symptoms. When athletes showed positive screenings in 2 consecutive weeks, they were contacted by a clinically experienced sports psychiatrist.<sup>19</sup> The follow-up contact included an assessment of athletes' mental health status, such as symptoms, potential stressors, already diagnosed mental illness, and need for professional psychological/psychiatric care.

To test for correlation between the PHQ-4 score and other mental health symptoms, subjective stress levels were collected on a 11-point Likert-scale<sup>20</sup> ranging from 0 (no stress) to 10 (maximum stress) and a subjective mood scale ranging from 1 (I felt great—I was completely relaxed) to 7 (I felt extremely stressed). An

overview of the weekly mental health assessment is given in Table 1.

## Statistical analysis

Weekly responses were extracted from AthleteMonitoring into an Excel database (Microsoft Excel 2021). Statistical analyses were conducted with SPSS (SPSS Statistics 28). Missing data were not imputed.

The study population's demographic characteristics are presented descriptively.

We calculated response rates based on the number of completed questionnaires divided by the number of participants.

To analyze PHQ-4 results, means (M) and SD of the PHQ-4 sum scores, subscales (PHQ-2 and GAD-2), and each item were calculated for both the entire study population as well as for each individual athlete. Further, we analyzed absolute frequencies and cumulative percentages of all PHQ-4 sum scores.

For reliability, internal consistency with Cronbach's  $\alpha$  was assessed for the PHQ-2, GAD-2, and PHQ-4, and Spearman-Rho correlation was calculated between PHQ-2 and GAD-2.

To show construct validity, Spearman-Rho correlation was also performed between mean PHQ-4 sum scores and mean scores of stress levels and mood. Additionally, we assessed the correlation of mean PHQ-4 scores and mean age. For longitudinal validation, we checked also for weekly correlations between PHQ-4 scores, stress levels, and mood intraindividually for each participant and calculated a mean weighted correlation using Fisher's Z-transformation.

Mann–Whitney-*U*-test and Wilcoxon-W-test were performed to compare the PHQ-4 sum scores between

different subgroups gender (male/female), type of sport (team/individual, with contact/without contact), and mobility in sports performance (wheelchair/ambulatory).

Information drawn from follow-up contacts with athletes are presented descriptively.

## RESULTS

### Sample characteristics

Of 252 invited athletes, a total of 80 (31.8%) agreed to participate. Two athletes withdrew their consent during the study period and were considered as dropouts. Finally, data of 78 athletes were included into the statistical analysis; 37.2% of the participants ( $n = 29$ ) were female. Mean age was 29.7 years (SD 10.7), ranging from 16 to 61 years. Fifteen different sports were represented in the cohort: wheelchair basketball (women  $n = 14$  [18%], men  $n = 11$  [14.1%]), paracycling ( $n = 13$  [16.7%]), table tennis ( $n = 7$  [9%]), wheelchair rugby ( $n = 7$  [9%]), goalball ( $n = 6$  [7.7%]), athletics ( $n = 4$  [5.1%]), shooting ( $n = 3$  [3.9%]), Nordic skiing ( $n = 3$  [3.9%]), rowing ( $n = 2$  [2.6%]), judo ( $n = 2$  [2.6%]), equestrian ( $n = 2$  [2.6%]), alpine skiing ( $n = 1$  [1.3%]), wheelchair tennis ( $n = 1$  [1.3%]), wheelchair fencing ( $n = 1$  [1.3%]), and swimming ( $n = 1$  [1.3%]). A total of 40 (51.3%) athletes were active in individual sports, 38 (48.7%) athletes in team sports. The breakdown into contact and noncontact sports was 41 (52.6%) and 37 (47.4%) athletes, respectively. Different types of impairment were represented: visual impairment ( $n = 11$  [14.1%]), spinal cord related disorders ( $n = 29$  [37.2%]), cerebral palsy ( $n = 3$  [3.9%]), other neurological impairments ( $n = 8$  [10.3%]), limb deficiency ( $n = 10$  [12.8%]), other musculoskeletal

**TABLE 1** Sequence of questions in the weekly mental health survey in elite Para athletes, including PHQ-4, stress level, and mood, provided through web browser or mobile app.

| Weekly mental health assessment |   |            |  |                         |                  |
|---------------------------------|---|------------|--|-------------------------|------------------|
| 1. PHQ-4                        | Over the last week, how often have you been bothered by the following problems? |            |  |                         |                  |
| Depression items (PHQ-2)        | Feeling down, depressed, or hopeless  | Not at all | Several days   | More than half the days | Nearly every day |
|                                 | Little interest or pleasure in doing things                                     | 0          | 1  | 2                       | 3                |
| Anxiety items (GAD-2)           | Feeling nervous, anxious or on edge   | 0          | 1  | 2                       | 3                |
|                                 | Not being able to stop or control worrying                                      | 0          | 1  | 2                       | 3                |
| 2. Stress level                 | Indicate your current stress level on the following scale.                      |            | 0 (no stress) to 10 (maximum stress)                                       |                         |                  |
| 3. Mood                         | Indicate your current mood on the following scale.                              |            | 1 (I felt great—I was completely relaxed) to 7 (I felt extremely stressed) |                         |                  |

Abbreviations: GAD-2, Generalized Anxiety Disorder Scale-2; PHQ-2, Patient Health Questionnaire-2; PHQ-4, Patient Health Questionnaire-4 adapted from Kroenke, 2009.<sup>18</sup>

**TABLE 2** Descriptive analysis of the results of the mental health assessment of 78 elite Para athletes over 43 weeks: Means, SDs and Cronbach's  $\alpha$  of the PHQ-4, PHQ-2, GAD-2, and all items.

| Descriptive analysis of the PHQ-4 and its subscales |      |      |                     |
|---|------|------|---------------------|
| Item  | Mean | SD   | Cronbach's $\alpha$ |
| Depression items (PHQ-2), $n = 2149$                |      |      |                     |
| Little interest or pleasure in doing things         | 0.35 | 0.60 |                     |
| Feeling down, depressed or hopeless                 | 0.25 | 0.51 |                     |
| PHQ-2 sum score                                     | 0.60 | 1.00 | 0.75                |
| Anxiety items (GAD-2), $n = 2149$                   |      |      |                     |
| Feeling nervous, anxious or on edge                 | 0.37 | 0.58 |                     |
| Not being able to stop or control worrying          | 0.19 | 0.47 |                     |
| GAD-2 sum score                                     | 0.56 | 0.95 | 0.75                |
| Total scale score (PHQ-4), $n = 2149$               | 1.16 | 1.78 | 0.84                |

Abbreviations: GAD-2, Generalized Anxiety Disorder Scale-2; PHQ-2, Patient Health Questionnaire-2; PHQ-4, Patient Health Questionnaire-4.

impairments ( $n = 15$  [19.2%]), intellectual impairment ( $n = 1$  [1.3%]), and other ( $n = 1$  [1.3%]). Regarding mobility, 44 (56.4%) athletes performed their sports in a wheelchair and 34 (43.6%) as ambulatory.

With a mean response rate of 82.7% ( $SD = 8.0$ ) for the PHQ-4, a total of 2149 valid PHQ-4 measurements were obtained and included. There were 2159 valid measurements of stress level and 2153 of mood.

## PHQ-4

The mean scores of the PHQ-4 and the subscales, PHQ-2 and GAD-2, among all participants over the entire study period were 1.2 ( $SD = 1.8$ ; 95% CI [1.1–1.3]), 0.6 ( $SD = 1.0$ ; 95% CI [0.56–0.64]), and 0.6 ( $SD = 1.0$ ; 95% CI [0.5–0.6]), respectively. All scales were fully utilized as individual total scores range from minimum 0 to maximum 12. The analysis of each item showed mean scores between 0.2 and 0.4. Weekly PHQ-4 mean scores fluctuated between the highest value of 1.5 at week 3 and the lowest value of 0.6 at week 35, with no apparent upward or downward trend.

Internal consistency of the PHQ-4, PHQ-2, and GAD-2 was satisfactory ( $\alpha = 0.839$ ,  $\alpha = 0.753$ , and  $\alpha = 0.754$ , respectively), considering they comprise only four and two items, respectively.<sup>21,22</sup>

An overview of the descriptive analysis of PHQ-4, PHQ-2, GAD-2, and items is provided in Table 2.

There was a linear correlation between the two subscales, PHQ-2 and GAD-2, with Spearman-Rho of 0.601 ( $p \leq .01$ ).

Individual mean PHQ-4 scores of each athlete showed a wide range from zero ( $SD = 0$ ;  $n = 41$ ) to 7.1 ( $SD = 2.9$ ;  $n = 22$ ). Half of all athletes ( $n = 39$ , 50%) had mean PHQ-4 scores  $< 1$ , 19.3% ( $n = 15$ ) never had a PHQ-4 score  $> 1$  during the whole study period, and 9.0% ( $n = 7$ ) had a mean PHQ-4 score above the cutoff value of 4.

The PHQ-4 score frequency distribution showed significant floor effects with 54.2% of the scores being 0. The majority (94.8%) of all scores were below our PHQ-4 cutoff value for positive screening, and 5.2% ( $n = 111$ ) of all PHQ-4 measures were above the cutoff value of 4, being considered as a positive screening on mental health symptoms. In total, 39.7% of all athletes ( $n = 31$ ) had at least one positive screening over the entire study period. An illustration of the score frequency distribution and the cumulative percentages of all PHQ-4 scores can be found in Figure 1.

When looking at the weekly PHQ-4 scores of individual athletes over time, individual fluctuations could be observed. Figure 2 shows an example of the different courses of PHQ-4 scores of four athletes over the entire study period.

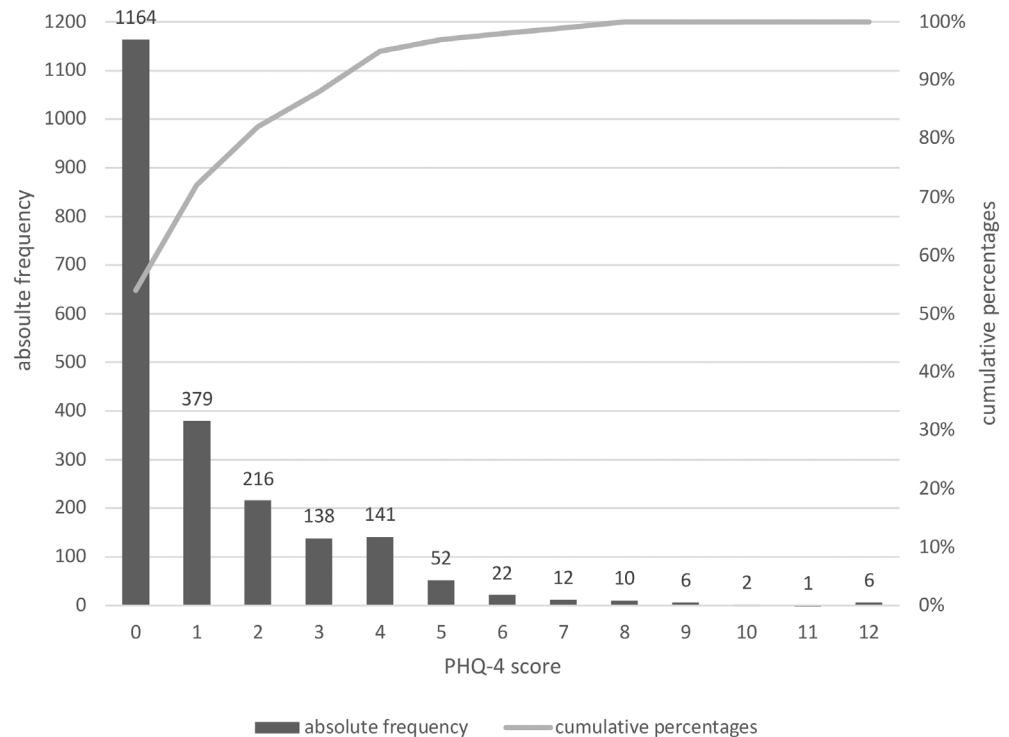
In 14 cases, athletes were contacted for a follow-up due to positive screenings ( $PHQ-4 > 4$ ) in two consecutive weeks. In 71.4% of all follow-up contacts, athletes reported diagnosed mental illness, mental health symptoms, and/or mental burden due to exposures such as current stressful life events.

## Stress level and mood

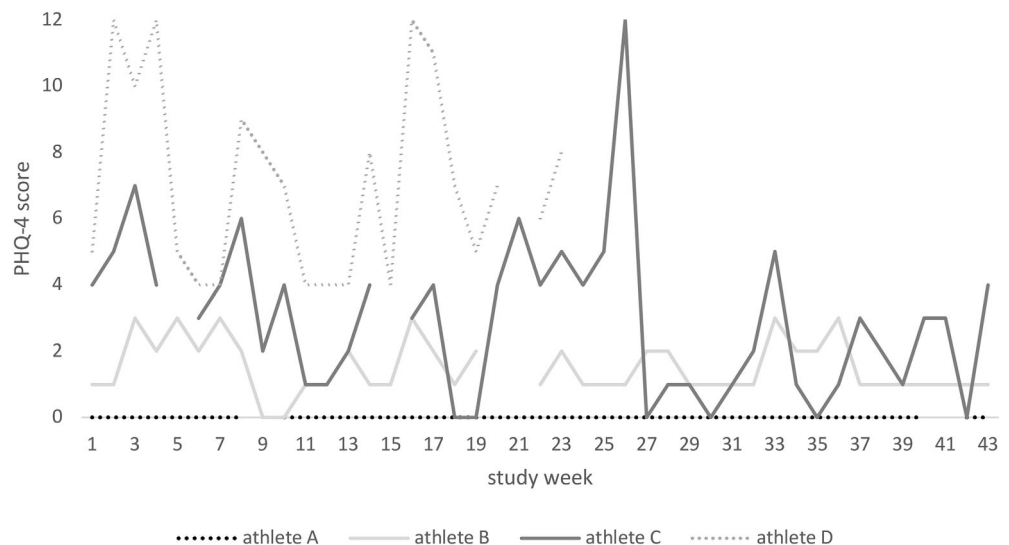
Mean scores of stress level and mood among all participants over the entire study period were 3.5/10 ( $SD = 2.4$ ; 95% CI [3.4–3.6]) and 3.0/7 ( $SD = 1.5$ ; 95% CI [2.9–3.0]), respectively. Both scales were fully utilized as scores on individual measures ranged from 0 to 10 and 1 to 7, respectively. Individual mean stress level ranged from 0.1 ( $SD = 0.4$ ;  $n = 9$ ) to 7.8 ( $SD = 0.9$ ;  $n = 43$ ) and mood values from 1.1 ( $SD = 0.3$ ;  $n = 30$ ) to 5.0 ( $SD = 1.1$ ;  $n = 13$ ).

There were moderate positive linear correlations between mean PHQ-4 scores and mean stress level/mood with  $\rho = 0.537$  and  $\rho = 0.491$ ,

**FIGURE 1** Frequencies of all weekly Patient Health Questionnaire-4 (PHQ-4) scores of 78 elite Para athletes over 43 weeks: bar chart of absolute frequencies and curve chart of cumulative percentages of all PHQ-4 scores ranging from 0 to 12.



**FIGURE 2** Patient Health Questionnaire-4 (PHQ-4) scores over time, exemplified by four different athletes; athlete A: PHQ-4 score of 0 at all measuring points; athlete B: low PHQ-4 scores without any positive screening; athlete C: low and high PHQ-4 scores including positive screenings; athlete D: mainly high PHQ-4 scores including frequent positive screenings.



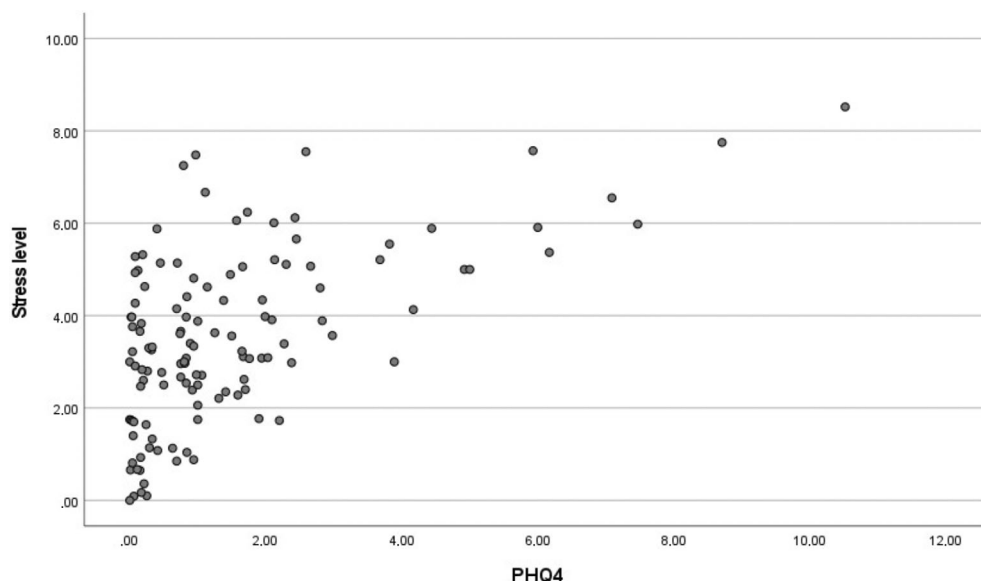
respectively ( $p < .001$ ). Figure 3 illustrates the correlation between PHQ-4 score and stress level. Correlation of stress level and mood was higher ( $\rho = 0.634$ ;  $p < .001$ ). Weekly correlations between PHQ-4 scores, stress level, and mood were also demonstrated intraindividually. The intraindividual correlation coefficients showed variances in the weighted mean correlation with a mean correlation of  $r = 0.528$  (variance of 0.205;  $p < .001$ ) between PHQ-4 and stress and of 0.544 (variance of 0.153;  $p < .001$ ) between PHQ-4 and mood, respectively. For some participants, these correlations were 0.9, whereas for others the correlations were insignificant.

There was no linear correlation between mean PHQ-4 scores and mean age ( $\rho = -0.142$ ).

## Subgroup analysis

Significant differences between subgroups were found. PHQ-4 scores were significantly higher among athletes in team or contact sports than among athletes in individual or noncontact sport ( $Z = 5.73$  and  $Z = 4.67$ , respectively;  $p < .001$ ). Regarding mobility, higher PHQ-4 scores were found among athletes performing in a wheelchair ( $Z = -3.92$ ;  $p < .001$ ) compared to





**FIGURE 3** Linear correlation between Patient Health Questionnaire-4 (PHQ-4) score (0–12) and stress level (0–10) in a weekly mental health assessment in elite Para athletes over 43 weeks.

ambulatory sports. Also, female athletes showed significantly higher scores compared to male ( $Z = -14.03$ ;  $p < .001$ ).

## DISCUSSION

### Using the PHQ-4 for weekly mental health surveillance

Due to the lack of data on mental health in elite para-athletes<sup>4</sup> and the substantial need of athlete-specific mental health screening tools,<sup>3</sup> the aim of the study was to validate the PHQ-4 for weekly mental health assessment within elite Para athletes preparing for the 2020 Tokyo Paralympic Summer Games and the 2022 Beijing Winter Games. Based on a literature review, we decided to use the PHQ-4 as it is considered an ultra-brief measure<sup>18</sup> and thus seemed particularly suitable for a weekly monitoring program. The PHQ-4 captures symptoms of depression and anxiety,<sup>17,18</sup> the two most common mental health disorders.<sup>2</sup> As a worldwide used screening tool<sup>17</sup> the PHQ-4 has been validated for clinical samples<sup>18,23</sup> and for the general population.<sup>17</sup> However, the PHQ-4 has seldom been used for longitudinal assessments before.<sup>24</sup> The main findings of the study indicate that the PHQ-4 is a reliable and valid screening tool for mental health symptoms in elite Para athletes. The weekly PHQ-4 monitoring allows for the identification of individual fluctuations and could potentially be used for identifying athletes at risk.

The dispersion of the weekly mean PHQ-4 scores over time (maximum: 1.5; minimum: 0.6) showed the ability of the questionnaire to capture different expressions of mental health symptoms. Likewise, the fact that the entire 13-point scale was utilized, confirms the PHQ-4 as a suitable instrument. The floor effects in the

frequency distribution of individual PHQ-4 scores (0 in 54.2% of all PHQ-4 sum scores) were as expected, assuming most athletes did not have any current mental health problem.

The two subscales, PHQ-2 and GAD-2, achieved an expected level of intercorrelation, considering the previously demonstrated high comorbidity of depression and anxiety<sup>25</sup> and the correlation between validated psychometric depression and anxiety scales.<sup>26</sup>

To test for correlation with other mental health symptoms we added the query of subjective stress levels and mood, as according to the *Diagnostic and Statistical Manual of Mental Disorders*, depressed mood and significant distress are both criteria for major depressive disorders.<sup>27</sup> Furthermore, two of three most common responses from elite athletes when asked about their first association with mental health symptoms were depression and stress.<sup>7</sup> Meanwhile, mood monitoring has a long history of assessing the mental health of elite athletes.<sup>28</sup> The cross-sectional as well as longitudinal correlations between PHQ-4 scores and stress levels and mood values, respectively, suggest that the PHQ-4 is a suitable instrument for weekly screening mental health symptoms in this population.

The recruitment rate of 31.8% suggests a selection bias with respect to the recruitment process especially regarding the distribution of different sports. In general, high-level athletes are often skeptical about sharing data with study personnel and tend to avoid participation in scientific studies. Additionally, head coaches and team physicians involved in the study showed very different attitudes toward the project, ranging from very enthusiastic to skeptical, and may have influenced their athletes. Therefore, some sports are more highly represented in the population than others. It may also be possible that Para athletes being more concerned about their physical or mental health might have been

more attracted by the study than others or vice versa. Nevertheless, as the whole study population is diverse in terms of age, gender, disabilities, and sports, and athletes with very high PHQ-4 scores as well as athletes with very low values are represented, we believe that the transferability to other Para athlete cohorts can be assumed and the effect of a possible selection bias regarding our findings is limited.

Among the participating athletes the mean weekly response rate of 83% was considered high given the fact that the PHQ-4, stress, and mood questionnaires were provided on a weekly basis over a long period of 43 weeks. The high response rate demonstrated good acceptance of the program and confirmed that adding the PHQ-4, as a psychological questionnaire, to an established and ongoing weekly health evaluation is feasible without significantly altering compliance.<sup>11</sup>

## PHQ-4 scores

The participating para-athletes showed a mean PHQ-4 score of 1.2. Compared to the general population and to the 24–34 year age group in the general population with PHQ-4 mean values of 1.8 and 1.6, respectively, the current measures appeared relatively low.<sup>17</sup> Nevertheless, there were athletes in the study group who showed very high values including the maximum value of the scale. Lower PHQ-4 scores among Paralympic athletes compared to a general population sample have also been shown by Busch et al. during the COVID-19 pandemic.<sup>16</sup> A conceivable reason for this may be a supportive environment and the positive effect of the sport regarding mental health.<sup>29</sup> Furthermore, the network of coaches, trainers, medical staff, and sports psychologists is extensive in the highest-level athletes. However, accurate epidemiological data are lacking on the potential beneficial effects on mental health of participating in professional Paralympic sports.<sup>4</sup> Certainly, a preventive effect of the longitudinal monitoring may have had a positive effect.<sup>16</sup> Considering that 54.2% of all PHQ-4 scores have been 0, the lower PHQ-4 scores could also be due to anchoring effects,<sup>16</sup> assuming that elite Para athletes are generally exposed to a lot of mental health stressors<sup>3</sup> and may have higher resilience than the general population.<sup>16</sup>

The amount of positive screenings for depressive and anxiety symptoms, with 5.2% of all measures, may seem lower than expected, considering a meta-analysis about mental health symptoms and disorders among elite athletes revealing a prevalence of 34% for anxiety and depression.<sup>30</sup> However, this discrepancy may be compensated by the continuity of our monitoring, taking into account that over the entire study period 39.7% of all participating athletes reported at least one positive screen. Diagnosed mental illness, mental health symptoms, and/or mental burden due to exposures such

as current stressful life-events were reported in 71.4% of the follow-up contacts made due to positive screenings in 2 consecutive weeks. Given the preventive approach of the project, this percentage is high, therefore supporting the assertion that the PHQ-4 is a screening tool to identify athletes at risk for mental health symptoms or disorders in a longitudinal monitoring.

However, due to possible anchoring effects of the PHQ-4 scores it is worth considering reducing the cutoff score in future screening projects. Regarding the wide range of individual mean PHQ-4 scores (0–7.1) the question arises whether an individual cutoff score for each athlete depending on the individual mean PHQ-4 score would be more sensitive for identifying mental health problems and athletes at risk.

## PHQ-4 scores among different subgroups

Significant differences in mean PHQ-4 scores were found when comparing the subgroups. Just as women in general are more likely to experience anxiety and depression,<sup>2</sup> female participants in this study also had significantly higher PHQ-4 scores than male. Similarly, Walton et al. showed female elite athletes were more likely to report mental health symptoms and less mental health well-being.<sup>31</sup> Team sport athletes scored significantly higher PHQ-4 scores than individual sport athletes in our program. This contrasts with a study by Pluhar et al. in which team sport athletes reported less anxiety and depression than athletes in individual sports.<sup>32</sup>

## STRENGTHS AND LIMITATIONS

Given the diverse and large study population, the study duration of 43 weeks, and the high response rate among participating athletes, this is a robust study to answer our research question. However, the rather low recruitment rate suggests a selection bias. Furthermore, our results are not fully applicable to all groups of Para athletes because of the large number of different impairment types and sports in general. However, high response rates among the participating athletes demonstrated good acceptance of the weekly surveillance. The prospective study design enables continuous monitoring of mental health symptoms including the identification of individual fluctuations and athletes at risk. Furthermore, it allows for the assignment of a current PHQ-4 score to other possibly collected information such as weekly physical health problems and training load. Certainly, more complex assessment tools will give a more comprehensive impression of athletes' mental health. However, the main concern was to select a screening instrument that is time efficient and easy to use to maintain athlete compliance especially

considering athletes with disabilities such as intellectual and visual impairments. A final conclusion about clinically verified diagnoses and prevalence of mental health disorders among Para athletes with positive PHQ-4 screens is limited due to self-reported symptoms and lacking diagnostic interviews.

## FUTURE DIRECTIONS

As a valid and easy to use tool to monitor mental health symptoms, the PHQ-4 should be included in ongoing health surveillance programs in Para athletes.

The additional survey of stress level and mood is recommended as it allows early detection of mental distress that may develop into mental health symptoms or disorders. To identify potential athletes at risk and obtain more specific information about mental health disorders among Para athletes, future programs should conduct follow-up surveys such as confirmative interviews of athletes with positive screenings. Furthermore, future mental health surveillance programs should provide the opportunity to receive psychological support from a clinical experienced psychiatrist or psychologist if needed. It is worth considering supplementing additional criteria, such as sleep quality, because sleeping problems among athletes are frequent.<sup>5,33</sup> Assessing disordered eating behavior may also be worth the screening, as it is more prevalent in some sports than in the general population.<sup>34</sup>

## CONCLUSION

The PHQ-4 is a valid and reliable screening tool for mental health surveillance in elite Para athletes with satisfying compliance of participants when queried weekly. PHQ-4 scores were higher among female athletes and team sport members. Nearly 40% of all participating athletes had at least one positive screening for symptoms of depression or anxiety. The weekly monitoring allowed the recording of individual fluctuations in the presence of mental health symptoms over time and could potentially be used to identify athletes at risk for mental health problems when combined with clinical follow-up.

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## DISCLOSURES

We have no further disclosure.

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