To Investigate Musculoskeletal Status and Mental State of Female Recruits During Training

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Research

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To investigate musculoskeletal status and mental state of female recruits during training

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Abstract:

Objective: To investigate the musculoskeletal status and psychological status of female recruits during military boot enlistment training. **Methods:** The musculoskeletal status and psychological status of 110 boot training patients were assessed by scale, the psychological status of the subjects was assessed by Zung Anxiety Self-Rating Scale and Zung Depression Self-Evaluation Scale, the musculoskeletal status was assessed by visual analogue scale, Neck disability index, JOA low back pain evaluation form, Knee injury and Osteoarthritis Outcome Score scale, the medical document data during boot training were collated, and the risk factors affecting physical and mental health were analyzed. Thus, interventions are taken to reduce the injury rate and improve training performance. **Results:** Logistic regression analysis showed that neck dysfunction was a risk factor for depressive state and lumbar dysfunction; lumbar dysfunction was a risk factor for anxiety state, neck dysfunction and pain symptoms around the knee joint; pain around the knee joint was a risk factor for lumbar dysfunction and a protective factor for neck dysfunction; anxiety state was a risk factor for depressive state; depression state was a risk factor for anxiety state and neck dysfunction; and young age was a protective factor for anxiety state.

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Conclusion: In 10 weeks of military training, the site with the highest musculoskeletal injury is around the knee joint, followed by the neck and waist. Knee injury and Osteoarthritis Outcome Score scale scores were significantly associated with mental health status, with neck dysfunction increasing the risk of depression and lumbar dysfunction increasing the risk of anxiety in recruits. Prevention and treatment need to pay attention to these parts, gradually improve the balance, flexibility, strength of the body, while paying close attention to the mental health of recruits, so as to reduce the rate of injury.

Keywords: recruits; military training; female soldiers; anxiety; depression; musculoskeletal injury

1 Introduction

After enlistment, regular training includes team training, military training, political education and mental health education. Basic military training is physically and psychologically demanding, leaving recruits at high risk of injury. Musculoskeletal conditions are the largest contributor to the overall disease burden, accounting for 39.1% of all diagnoses, followed by mental health (10.4%)(1). Musculoskeletal injury (MSI) in military populations is a serious problem. This type of injury is typically characterized by pain, mobility difficulties, dexterity, and functional capacity limitations. Low back pain, in particular, reduces work ability and training efficiency and increases the burden on related health services(2).Studies have shown that recruits are more likely to experience MSI than veterans. This may be caused by the low physical performance of recruits at the beginning of basic training and the excessive and too rapid increase in training load(3, 4). Compared with men, female soldiers are more likely to get injured in their lower limbs(5). It may be that their smaller size puts them at a higher risk of serious personal injury during weight training(6). Due to the shift in social roles and maladjustment to the training life, recruits may

42 produce some psychological changes. Studies have shown that recruits have a high prevalence of
43 depressive symptoms, depression is associated with length of service, smoking, alcohol
44 consumption, family structure, parental relationship, family income, family history of depression,
45 military stress, love relationship, finance, worrying about the future(7), poor coping skills and
46 insufficient social support, special attention should be paid to people from low socioeconomic
47 background, lack of social support, worrying about the future, high education level, and health
48 problems during the training process, psychological strength can provide the greatest protection
49 against depression, and individualized recovery training can help army recruits cope with
50 challenges in life, military training, and combat to avoid depressive symptoms(8, 9).

51 Currently, there are few studies on MSI during training of female soldiers. In this study, we
52 quantified the MSI of female recruits during training and analyzed the relationship between
53 physical parts, causes, and psychological states (i.e., depression, anxiety) that predispose to MSI.
54 Thus, effective injury prevention programs are developed to reduce MSI, improve physical and
55 mental health status, and reduce health care costs while enhancing morale.

56 **2 Methods**

57 **2.1 Study subjects**

58 A total of 110 female recruits in an army unit were followed up for 10 weeks. All subjects
59 were female. All participants lived in the same military base and received three meals a day from
60 the cycling menu, and they all participated in the same military training, combining daily physical
61 training and military skills training.

62 **2.2 Data collection**

63 Participants recorded basic personal information such as name, age, height, and weight in

medical clerical records. Military training injury, basic personal information, and mental health status were investigated, and the mental health status of the subjects was assessed using the Zung Anxiety Self-Rating Scale and Zung Depression Self-Evaluation Scale during the study; the severity of injury was assessed using the Visual Analogue Scale (VAS), Neck disability index (NDI), JOA low back pain evaluation form, Knee injury and Osteoarthritis Outcome Score (KOOS) scale. The evaluation scale and medical document data during training were collated, classified and counted according to the injured site. The common sites and risk factors of boot training injury were statistically analyzed, so as to take intervention measures to reduce the injury rate and improve the training performance.

The study variables included Body mass index (BMI), age, Zung Anxiety Self-Rating Scale, Zung Depression Self-Evaluation Scale, VAS, NDI, JOA low back pain evaluation scale, KOOS scale, etc. All participants were asked to complete an assessment during a 10-week period of military training. Investigators were trained to assess prior to the assessment. The assessment is as follows:

2.2.1. Body mass index Body mass index (BMI)

BMI was calculated by dividing weight (kg) by height (m) squared. According to the Chinese reference standard, BMI < 18.5 kg/m^2 is considered lean, between 18.5 and 23.9 kg/m^2 is normal, BMI ⩾ 24 kg/m^2 is overweight, between 24 and 26.9 kg/m^2 is obese, and between 27 and 29.9 kg/m^2 is obesity.

2.2.2. Psychological status

The psychological symptoms of the subjects were assessed using the Zung Self-Rating Anxiety Scale and the Zung Self-Rating Depression Scale, and the score indicated the severity of

symptoms. Add the scores of 20 questions as the crude score, multiply the crude score by 1.25, round to integer, and obtain the standard score. The cut-off values for anxiety ratings were less than 46 for normal; 46 – 50 for mild anxiety; and greater than 50 for severe anxiety. The cut-off values for depression rating were 25 – 49 points for normal, 50 – 59 points for mild depression, 60 – 69 points for moderate depression; and 70 points and above for severe depression.

2.2.3 Visual Analogue Scale (VAS)

Recruits chose a score based on their self-perception, which was used to indicate the degree of pain, with a higher score indicating more severe pain. 0 points: no pain; 1-3 points: Mild pain, tolerable; 4-6 points: Moderate pain, sleep disturbance, tolerable; 7-10 points: Severe pain, unbearable, affecting appetite and sleep.

2.2.4. Neck disability index (NDI)

Scores from the Neck Dysfunction Assessment program were added to the final score. Each item has a minimum score of 0 and a maximum score of 5. The higher the score is, the more serious the dysfunction is. The degree of cervical function impairment of the subjects was calculated according to the following formula: cervical function impairment index (%) = (sum of the scores of each item/number of items completed by the subjects × 5) × 100%. Judgment of NDI results: 0-20% indicates mild dysfunction; 20-40% indicates moderate dysfunction; 40-60% indicates severe dysfunction; 60-80% indicates very severe dysfunction; 80-100% indicates complete dysfunction or subjects should be examined in detail for exaggerated symptoms.

2.2.5. JOA Low Back Pain Evaluation Form

The full score of this scale is 29 points; 16-24 points are good; 25-29 points are excellent; 10-15 points are moderate; and less than 10 points are poor; it is clinically used to quantitatively

evaluate the severity and improvement of low back pain.

2.2.6. Knee injury and Osteoarthritis Outcome Score (KOOS)

This scale is a subjective instrument to evaluate sports injury. This score mainly includes five aspects: pain (9 items), symptoms (7 items), daily activities (17 items), sports and recreational functions (7 items) and knee-related quality of life (4 items). Each question is divided into five levels: 0-4, and the summary score of each aspect is converted into a standard score (minimum score 0-maximum score 100). The scores of all five parts of the KOOS score were analyzed separately without adding a total score analysis(10).

2.4. Statistical analysis

All data was statistically analyzed using SPSS 20.0 statistical software. Descriptive analysis was performed on the data of basic information age, BMI, Zung Anxiety Self-Rating Scale, Zung Depression Self-Evaluation Scale, NDI, JOA low back pain evaluation form, KOOS, and VAS score of the subjects and Spearman correlation analysis was performed between each variable. Continuous variables were converted into categories, and binary logistic regression analysis was performed to calculate the odds ratio (OR) and 95% confidence interval (95% CI) of the variables and assess the association between the variables and the risk of injury.

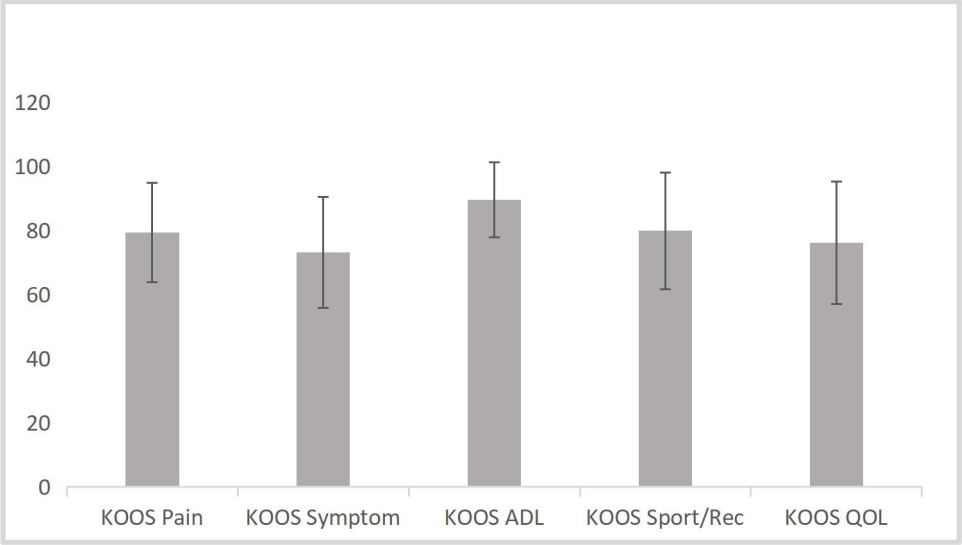
3.Results

3.1 Descriptive analysis

Statistical descriptive analysis of the basic information of the subjects showed that the age of the subjects was 20.37 ± 1.42 years, BMI 21.15 ± 1.47 kg/m^2. There were 24 patients (21.8%) with mild depressive state, 6 patients (5.5%) with moderate depressive state, 6 patients (5.5%) with mild anxiety, 7 patients (6.4%) with severe anxiety, 26 patients (23.4%) with mild dysfunction assessed by neck dysfunction, and 4 patients (3.6%) with moderate dysfunction. A

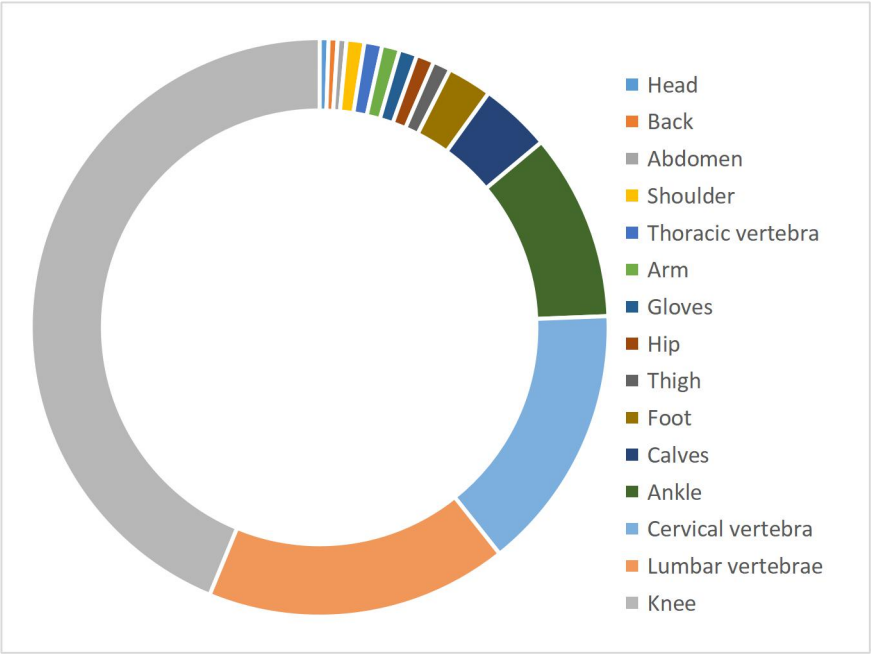
total of 34 patients (30.9%) had varying degrees of lumbar dysfunction, of whom 31 (28.2%) were good and 3 (2.7%) were moderate. Knee injury and Osteoarthritis Outcome Score (KOOS) scale: 79.45 ± 15.565 points, 73.24 ± 17.267 points, 89.66 ± 11.771 points, 79.95 ± 18.28 points and 76.26 ± 19.063 points respectively (See Figure 1). Among the VAS scores, 22 (20%) were painless, 62 (56.4%) had mild pain, 24 (21.9%) had moderate pain, and 2 (1.8%) had severe pain.

Figure 1 Mean of Knee injury and Osteoarthritis Outcome Score (KOOS)



The duration of the military training was 10 weeks, with 110 subjects, corresponding to 7700 days of exposure of recruits. A total of 201 cases were recorded according to the site of injury. Figure 2 shows the number of cases of discomfort per unit body area, with a total of 88 cases of discomfort around the knee, 34 cases of lumbar discomfort, 30 cases of neck discomfort, and 21 cases of discomfort around the ankle. In addition, there were some sudden injuries included: tinnitus after shooting, fainting during physical training, infected cellulitis of the knee, and foot infection after road marching.

Figure 2 The number of cases of discomfort per unit body area



3.2 Correlation analysis

The correlation analysis of each variable showed that the JOA low back pain evaluation form score was significantly negatively correlated with the neck dysfunction assessment score. There was a significant negative correlation between anxiety self-rating scale scores and JOA low back pain evaluation scale scores, and a significant positive correlation between anxiety self-rating scale scores and depression self-evaluation scale scores. The KOOS Pain score was significantly positively correlated with the JOA low back pain evaluation scale score, and significantly negatively correlated with the depression self-evaluation scale and anxiety self-rating scale scores. KOOS Symptom score was significantly negatively correlated with neck dysfunction assessment, depression self-evaluation scale, and anxiety self-rating scale scores, and significantly positively correlated with JOA low back pain evaluation scale total score and KOOS Pain score. There was a significant positive correlation between the KOOS ADL score and the JOA low back pain evaluation form, KOOS Pain, and KOOS Symptom scores. There was

a significant negative correlation with depression self-evaluation scale and anxiety self-rating scale scores. KOOS Sport/Rec scores were significantly positively correlated with JOA low back pain evaluation form, KOOS Pain, KOOS Symptom, and KOOS ADL scores. There was a significant negative correlation with depression self-evaluation scale and anxiety self-rating scale scores. There was a significant positive correlation between the KOOS QOL score and the JOA low back pain evaluation form, KOOS Pain, KOOS Symptom, KOOS ADL, and KOOS Sport/Rec scores. There was a significant negative correlation with depression self-evaluation scale and anxiety self-rating scale scores. VAS scores were significantly positively correlated with depression self-evaluation scale, anxiety self-rating scale, and JOA low back pain assessment scores, and significantly negatively correlated with KOOS Pain, KOOS Symptom, KOOS ADL, KOOS Sport/Rec, and KOOS QOL scores.

3.3 Regression analysis

Converts continuous variables into categories, performs binary logistic regression analysis, calculates the OR and 95%CI of variables, and assesses the association between variables and injury risk.

In the binary logistic regression model of risk factors for depressive state, the risk of developing depression was increased during neck dysfunction (OR = 4.076, 95% CI: 1.23 – 13.50 P < 0.01).Anxiety status increased the risk of developing depression (OR = 14.66, 95% CI: 3.25 – 66.19 P < 0.01).In the binary logistic regression model of risk factors for anxiety state, depressive state increased the risk of developing anxiety (OR = 32.883, 95% CI: 4.88 – 221.579 P < 0.01), lumbar dysfunction increased the risk of developing

anxiety (OR = 8.677, 95% CI: 1.005 – 74.905 P < 0.05), and age decreased the risk of developing anxiety. (OR = 0.428, 95% CI: 0.206 – 0.89 P < 0.05).In a binary logistic regression model of risk factors for lumbar dysfunction, pain around the knee increased the risk of lumbar dysfunction (OR = 15.75895% CI: 1.276 – 194.602 P < 0.05), and neck dysfunction increased the risk of lumbar dysfunction (OR = 8.465 , 95% CI: 2.445 – 29.305 P < 0.01).In a binary logistic regression model of risk factors for neck dysfunction, lumbar dysfunction increased the risk of neck dysfunction (OR = 9.17 , 95% CI: 2.522 – 33.348 P < 0.01), and depressive status increased the risk of neck dysfunction (OR = 5.647, 95% CI: 1.432 – 22.259 P < 0.05), pain around the knee was a protective factor for neck dysfunction (OR = 0.098 , 95% CI: 0.012 – 0.811 P < 0.05).In a binary logistic regression model of risk factors for pain around the knee, lumbar dysfunction increased the risk of pain around the knee (OR = 7.089 95% CI: 1.147 – 20.386 P < 0.05).

During 10 weeks of military training, soldiers with neck dysfunction were more likely to have depressive state, lumbar dysfunction than soldiers without neck dysfunction. Soldiers with lumbar dysfunction were more likely to have anxiety state, neck dysfunction, and pain symptoms around the knee than soldiers without lumbar dysfunction. Soldiers with pain around the knee are more likely to have lumbar dysfunction and less likely to have neck dysfunction than soldiers with pain around the knee. Soldiers with an anxious state were more likely to have a depressive state than soldiers without an anxious state. Soldiers with depressive state were more likely to have anxiety state, neck dysfunction than soldiers without depressive state. Older soldiers were more likely to experience anxiety than younger soldiers.

That means, neck dysfunction is a risk factor for depressive state and lumbar dysfunction; lumbar dysfunction is a risk factor for anxiety state, neck dysfunction and pain symptoms around the knee joint; pain around the knee joint is a risk factor for lumbar dysfunction and a protective factor for neck dysfunction; anxiety state is a risk factor for depressive state; depressive state is a risk factor for anxiety state and neck dysfunction; and young age is a protective factor for anxiety state.

4 Discuss

At the time of enlistment, better physical examination policies should be planned and implemented, with physical performance testing and basic musculoskeletal injury questionnaires as screening tools to reduce MSI rates during training(11).Studies have shown that an increase in training volume of more than 10% per week is associated with an increased risk of injury, while a smaller training volume increases the risk of injury will be greatly reduced, a rapid increase in training workload is the problem, overload can lead to fatigue, fatigue in turn can affect muscle coordination and movement sensation, and labeling the injuries with "overuse" may encourage soldiers to reduce training, so the use of "training load errors" is more appropriate(12).The training protocol was changed to gradually increase the training load of the initial training program and progressively increase the duration, frequency, and intensity(13).In order that their physical capacity is sufficient to overcome intense fatigue and establish resilience to training loads, thereby improving the physical fitness of soldiers(14).It may improve the mental health of soldiers(15).Training programs for recruits' physical abilities should be incorporated into injury prevention strategies, with active cooperation between exercise coaches and

227 training commands, and active participation of trainers, researchers, and health care
228 providers to institutionalize MSI prevention practices(16).

229 Preventive strategies should target the main factors leading to the risk of
230 musculoskeletal injury, such as training duration, frequency, intensity, physical
231 performance level and equipment (such as ankle protection, knee protection, wrist
232 protection, footwear, shock absorbing insoles(14). Health education is appropriate
233 training sessions to reduce injuries. Develop a prevention plan, conduct personalized
234 training according to specific risk factors, and arrange appropriate training intervals and
235 recovery time(17);Running is associated with most physical training impairments during
236 basic training and therefore reduces running mileage in basic training(18), i.e. In physical
237 training, the use of boots with ankle support or increased proprioceptive training of the
238 lower extremities can reduce the number of injuries due to trips or falls(19).Because of
239 the frequent occurrence of lower limb injuries, examination of postural stability is
240 necessary for injury prevention and movement optimization studies. Postural stability
241 training is the core component of physical training, which can not only improve physical
242 performance, but also prevent injuries(20).Both prevention and treatment programs
243 should take into account the importance of functional core stability and psychological
244 factors(21).Proprioception, strength training(15), balance and flexibility(22) training are
245 incorporated into military physical training to improve neuromuscular control, thereby
246 reducing the risk of knee and ankle injuries, ligament injuries, and lower limb injuries.
247 Considering the high prevalence of depressive symptoms in soldiers at combat training
248 grounds, they should be carefully evaluated and recommended to receive appropriate

249 mental health care(9).

250 This study has limitations: a descriptive and cross-sectional study, the causal
251 relationship between exposure and outcome cannot be properly assessed. Bias in data
252 collection, scale assessment, and subjectivity cannot be ruled out, and this nonuniformity
253 may reduce the quality of data and pose difficulties in data collection and analysis. The
254 participants in this study are representative of the population engaged in vigorous
255 physical activity, and most of the subjects are under 25 years of age. Therefore, the
256 clinical significance of these results should be recognized before they can be applied to
257 other populations. Despite these limitations, the main advantage of this study is that the
258 rehabilitation therapist lives with the recruits and can report and describe the mental and
259 physical health of the recruits in detail. There is no drawback of the lack of uniformity
260 between physicians and medical staff in terms of medical records and diagnostic records.
261 Before the scale assessment, rehabilitation therapists and patients were trained to
262 answer and more objectively assess their health status. The physical and psychological
263 factors associated with pain in enlisted soldiers were analyzed. The significant predictors
264 identified in this study can be used to prevent the occurrence of psychological disorders
265 and injuries. This study determined the relationship between mental health status and
266 military training injury.

267 **5 Conclusion**

268 Similar to the results of previous studies, the knee joint is the most common injury
269 site, and anatomical and physiological factors are considered to be the cause of the
270 higher rate of female knee injury(19). Therefore, a prevention plan needs to be developed.

In 10 weeks of military training, the most injured site was around the knee joint, followed by the neck and waist. Knee injury and Osteoarthritis Outcome Score (KOOS) scores were significantly associated with mental health status, with neck dysfunction increasing the risk of depression and lumbar dysfunction increasing the risk of anxiety in recruits. Prevention and treatment require attention to these sites to progressively improve the balance, flexibility, strength of the body, while paying close attention to psychological factors, thereby improving the effectiveness of physical therapy.

Abbreviations

MSI: Musculoskeletal injury; BMI: Body mass index; VAS: Visual Analogue Scale; KOOS: Knee injury and Osteoarthritis Outcome Score; OR: Odds Ratio; 95% CI: 95% confidence interval.

Supplementary Information

Additional file 1. Figure 1：Mean of Knee injury and Osteoarthritis Outcome Score (KOOS).

Figure 2：The number of cases of discomfort per unit body area.

Declarations

Ethics approval and consent to participate

The study was approved by the Ethics Committee of the Affiliated Hospital of Shandong Academy of Medical Sciences (FY2021034). All individuals provided their informed consent for inclusion before they participated in the study.

Consent for publication

Not applicable.

Availability of data and materials

293 The datasets supporting the conclusions of this article are included within the article and

294 its additional files.

295 **Competing interests**

296 The authors declare that they have no competing interests.

297 **Funding**

298 Not applicable.

299 **Authors' contributions**

300 GDS, QBW, ZWS, ZHL, SL, ZZ and QJD designed the study. QBW, ZHL, SL, ZZ and GDS

301 collected the data. QBW and GDS were responsible for statistical analysis. GDS and

302 QBW wrote the draft. ZWS, ZHL, SL, ZZ and QJD revised the draft; QBW and GDS

303 finalized the manuscript. All authors read and approved the final manuscript.

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