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Impact of Relaxation and Music Intervention on Psychological and Gastrointestinal Health in Military Recruits: A Prospective Study

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Background and aims: Gastrointestinal symptoms are closely associated with psychological problems, such as anxiety and depression. This prospective before-after study aimed to explore whether progressive muscular relaxation training combined with music intervention, which is potentially beneficial for psychological conditions, can improve gastrointestinal symptoms.

Methods: A total of 623 recruits' effective questionnaires before and after intervention were collected. They underwent progressive muscular relaxation training combined with music intervention for 4 weeks. They also completed the Self-Rating Depression Scale (SDS) and the Patient Health Questionnaire (PHQ-9) for assessment of depression, the Self-Rating Anxiety Scale (SAS) and the Generalized Anxiety Disorder-7 (GAD-7) for assessment of anxiety, the Gastrointestinal Symptom Rating Scale (GSRS) for assessment of gastrointestinal symptoms, and the Bristol Stool Form Scale (BSFS) for assessment of stool before and after interventions. Changes of psychological conditions and gastrointestinal symptoms were evaluated.

Results: The SDS (P<0.001), PHQ-9 (P<0.001), SAS (P<0.001), GAD-7 (P<0.001), and GSRS (P<0.001) scores were significantly decreased after intervention. The proportions of regurgitation (P<0.001), abdominal pain (P<0.001), dyspepsia (P<0.001), and constipation (P<0.001) evaluated by the GSRS were significantly decreased after intervention, but not diarrhea (P=0.601). The proportions of severe (P<0.001) and mild (P<0.001) constipation evaluated by the BSFS decreased after intervention, but those of severe (P=0.632) and mild (P<0.001) diarrhea evaluated by the BSFS increased.

Conclusion: Short-term progressive muscular relaxation training in combination with music intervention is potentially effective for most gastrointestinal symptoms, but not for diarrhea, in recruits.

Keywords: gastrointestinal symptom, psychology, anxiety, depression, music intervention, progressive muscular relaxation training, intervention

Introduction

Gastrointestinal symptoms, primarily abdominal pain, regurgitation, dyspepsia, diarrhea, and constipation,[1,2] are common, with a prevalence of 61% (45,498/71,812) in the US general population.[3] They negatively influence the quality of life and productivity and indicate the probability of functional or organic gastrointestinal diseases.[4,5] It has been shown that gastrointestinal symptoms are closely associated with psychological problems, such as anxiety and depression.[6–8] This association can be explained by the action of the brain-gut axis that an individual's feelings can influence his or her gastrointestinal function, and vice versa. In

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addition, the gut microbiota, called the human second brain, plays a critical role in the regulation of the central nervous system.[9,10] Thus, the correction of psychological problems should be clinically effective in improving gastrointestinal symptoms.

Military personnel is a special population that needs to complete high-intensity training every day and takes responsibility for war preparedness.[11] Owing to high-stress conditions, they are more likely to develop various psychological and physical diseases.[12,13] Recently, our group has demonstrated a significantly higher prevalence of Helicobacter pylori infection, which is closely associated with functional (ie, irritable bowel syndrome)[14] and organic gastrointestinal diseases (ie, peptic ulcer and gastric cancer),[15] in the military population aged 17–25 years than in the civilian population of the same age (35.6% versus 25.9%, P=0.001).[16] We also found a higher score on the Symptom Checklist 90, a traditional tool for the evaluation of psychological conditions, in recruits with gastrointestinal symptoms than those without.[6] Therefore, it is reasonable to infer that psychological interventions may be beneficial for the prevention of gastrointestinal symptoms. Notably, considering the peculiarity of recruits in terms of their living environment and work burden, it is necessary to develop easy-to-use approaches to adjust their psychological conditions in recruits and further improve their gastrointestinal symptoms. Apart from their advantages in reducing anxiety and stress and promoting quality of life,[17–22] progressive muscular relaxation training and music therapy are very convenient to implement in real-world scenarios, because only a broadcast is required without any psychiatrist. However, until now, it remains unclear about whether progressive muscular relaxation training and music therapy can be employed for preventing from gastrointestinal symptoms in military recruits. Thus, this prospective study was conducted to address this issue.

Methods

Study Design

The protocol for this prospective before-after study was approved by the Medical Ethics Committee of the General Hospital of the Northern Theater Command. The ethical approval number is Y (2022) 162. All subjects signed their written informed consents before starting the study. This study was conducted in accordance with the principles of the Declaration of Helsinki.

We screened all new recruits who joined a troop in September 2022 for eligibility. The exclusion criteria were as follows: 1) definite diagnosis of organic disorders in the gastrointestinal system; 2) missing variables in the questionnaires; 3) suspected accuracy of questionnaires; and 4) refusal of written informed consent.

Data Collection

We collected data including age, sex, history of alcohol consumption, smoking, non-steroidal anti-inflammatory drugs, Helicobacter pylori infection, family history of gastrointestinal diseases, and questionnaires related to gastrointestinal symptoms and psychological status.

Questionnaires

We employed two scales, the Self-Rating Depression Scale (SDS)[23] and the Patient Health Questionnaire (PHQ-9),[24] to measure the presence and grade of depression. The SDS includes 20 items, each of which is evaluated using the Likert 4-piont scale approach, including 1 point as symptoms never or rarely develop and 4 points as symptoms always or persistently develop. The total crude score was calculated as the sum of the scores for the 20 items. The standard total score was equal to the crude total score multiplied by 1.25. A standard total score of 53–62 points is defined as mild depression, 63–72 points as moderate depression, and ≥73 points as severe depression. The PHQ-9 includes 9 items, each of which is also evaluated using the Likert 4-piont scale approach, including 0 point as symptoms never or rarely develop and 3 points as symptoms develop almost every day. The total score was calculated as the sum of the scores for the 9 items. A total score of 0–4 points is defined as no depression, 5–9 points as mild depression, 10–14 points as moderate depression, 15–19 points as severe depression, and 20–27 points as very severe depression.

We employed two scales, the Self-Rating Anxiety Scale (SAS)[25] and the Generalized Anxiety Disorder-7 (GAD-7),[26] to measure the presence and grade of anxiety. The SAS includes 20 items, each of which is assessed using the Likert

4-piont scale approach, including 1 point as symptoms never or rarely develop, and 4 points as symptoms always or persistently develop. The total crude score was calculated as the sum of the scores for the 20 items. The standard total score was equal to the crude total score multiplied by 1.25. A standard total score of 50–59 points is defined as mild anxiety, 60–69 points as moderate anxiety, and ≥70 points as severe anxiety. The GAD-7 includes 7 items, each of which is also assessed using the Likert 4-piont scale approach, including 0 point as symptoms never or rarely develop and 3 points as symptoms develop almost every day. The total score was calculated as the sum of the scores for the 7 items. A total score of 0–4 points is defined as no anxiety, 5–9 points as mild anxiety, 10–14 points as moderate anxiety, and 15–21 points as severe anxiety.

We used the Gastrointestinal Symptom Rating Scale (GSRS) to assess 5 types of gastrointestinal symptoms and their severity.[27] The GSRS includes 3 items related to abdominal pain, 2 items related to regurgitation, 4 items related to dyspepsia, 3 items related to diarrhea, and 3 items related to constipation. The severity of each gastrointestinal symptom was evaluated using the Likert 4-piont scale approach, with 0 point as asymptomatic and 3 points as the most severe. We also employed the Bristol Stool Form Scale (BSFS) to visualize 7 types of stools by illustrating schematic graphs and descriptions of the stool.[28] Specifically, types 1 and 2 refer to constipation, types 3 and 4 refer to normal stools, and types 5–7 refer to diarrhea.

Five researchers (Jun Liu, Haoxu Lu, Shanshan Ma, Fudan Song, and Nanhai Qiao) have worked in the same troop for a long time and fruitful experiences in training new recruits. In the current study, they were responsible for distributing and retrieving Chinese version questionnaires to the participants. Additionally, if a participant did not understand the contents of questionnaires, they would make detailed explanations to maximize the accuracy of responses to each questionnaire. Before intervention, these questionnaires were answered on October 14, 2022. After intervention, they were answered again on November 20, 2022.

Psychological Interventions

We conducted two types of psychological intervention, progressive muscular relaxation training and music intervention, every day. It lasted for 4 weeks from October 15, 2022 to November 11, 2002.

Progressive muscle relaxation training is a type of behavioral therapy[29] in which muscles of the whole body are gradually tightened and relaxed to reduce stress and physical symptoms. It is performed before sleep at night every day and lasts for 15 minutes each time. During the period of progressive muscle relaxation training, all recruits were placed in a flat-lying position and trained in accordance with the instructions of the broadcasts.

Music therapy is a type of psychotherapy[30] in which meditation music is played often. It is performed before lunch breaks every day and lasts for 15 minutes each time. When music at 30–45 decibels is played, all recruits should be placed in a flat-lying position and asked to adjust the frequency of breathing and keep them relaxed. Light music, such as Annie's Wonderland by Bandari, was utilized in this study.

Before the study, our researchers taught all enrolled participants about how to conduct the two psychological interventions. They were also responsible for monitoring whether the two psychological interventions had been conducted. However, it should be acknowledged that no board-certified music therapist had participated in the music intervention.

Sample Size Calculation

We had not estimated the sample size before initiating this study yet. This is primarily because it is a single-arm study without any control group. Additionally, all participants were from the same troop, and thus the number of participants was fixed.

Statistical Analyses

The SPSS statistical package software was used to perform all statistical analyses. Descriptive data are expressed as mean ± standard deviation and median (range) or frequency (percentage). Paired t-tests and chi-square tests were used to compare continuous and categorical variables before and after the psychological interventions. Differences were considered statistically significant at a two-sided P-value of <0.05.

Results

Participants

In total, 623 participants' questionnaires were included in the final analysis (Table 1). Only 15 participants had a definite history of digestive diseases.

Depression by SDS

The SDS scores decreased significantly after the intervention (Table 2). The proportions of mild, moderate, and severe depression evaluated by the SDS also decreased after the intervention, but the differences in the proportions of mild and moderate depression evaluated by the SDS before and after the intervention were not statistically significant.

In 12.23% (57/466) of the participants without depression evaluated by the SDS before the intervention, depression developed after the intervention, which was mild (n=42), moderate (n=14), and severe (n=1) (Table 3). In 56.05% (88/157) of the participants with depression evaluated using the SDS before the intervention, depression disappeared after the intervention. In 58.25% (60/103) of the participants with mild depression evaluated using the SDS before the intervention, depression disappeared after the intervention. In 80% (36/45) of the participants with moderate depression evaluated by SDS before the intervention, depression improved (n=11) or disappeared (n=25) after the intervention. In all of the 9 participants with severe depression evaluated by SDS before the intervention, depression improved (n=6) or disappeared (n=3) after the intervention.

Depression by PHQ-9

The PHQ-9 score significantly decreased after the intervention (3.24±3.69 versus 1.25±2.36, P<0.001) (Table 2). The proportion of mild, moderate, and severe depression, evaluated using the PHQ-9 scale, also decreased after the intervention.

Table 1 Characteristics of Participants

Variables	No. pts	Mean ± Standard Deviation Median (range) or Frequency (percentage)
Age (years)	623	21 21.36 ± 1.43
Male (%)	623	612 (98.23%)
History of smoking (%)	623	253 (39.35%)
History of drinking (%)	623	316 (49.14%)
History of analgesic (%)	623	11 (1.71%)
Definite history of Helicobacter pylori infection (%)	623	3 (0.47%)
Family history of digestive diseases (%)	623	2 (0.31%)
Definite history of digestive diseases (%)	623	15 (2.33%)

Table 2 Differences in Outcomes of Interests Evaluated Before and After Intervention

Outcomes of Interests Evaluated	No. pts	Before Intervention	After Intervention	P value
SDS score	623	44.20±11.66	41.03±10.91	<0.001
Severity of depression according to the SDS				
Mild	623	103 (16.53%)	91 (14.61%)	0.348
Moderate	623	45 (7.22%)	34 (5.46%)	0.201
Severe	623	9 (1.44%)	1 (0.16%)	0.011

(*Continued*)

Table 2 (Continued).

Outcomes of Interests Evaluated	No. pts	Before Intervention	After Intervention	P value
PHQ-9 score	623	3.24±3.69	1.25±2.36	<0.001
Severity of depression according to the PHQ-9				
Mild	623	121 (19.42%)	38 (6.10%)	<0.001
Moderate	623	36 (5.78%)	5 (0.80%)	<0.001
Severe	623	9 (1.44%)	2 (0.32%)	0.034
SAS score	623	38.01±9.05	34.79±7.66	<0.001
Severity of anxiety according to the SAS				
Mild	623	45 (7.22%)	19 (3.05%)	<0.001
Moderate	623	13 (2.09%)	3 (0.48%)	0.012
Severe	623	3 (0.48%)	1 (0.16%)	0.624
GAD score	623	2.24±3.25	0.75±1.93	<0.001
Severity of anxiety according to the GAD				
Mild	623	88 (14.13%)	21 (3.37%)	<0.001
Moderate	623	23 (3.69%)	3 (0.48%)	<0.001
Severe	623	7 (1.12%)	1 (0.16%)	0.033
GSRS score	623	22.64±7.35	19.08±5.13	<0.001
Type of gastrointestinal symptoms according to the GSRS				
Regurgitation	623	130 (20.87%)	63 (10.11%)	<0.001
Abdominal pain	623	235 (37.72%)	110 (17.66%)	<0.001
Dyspepsia	623	462 (74.16%)	350 (56.18%)	<0.001
Diarrhea	623	247 (39.65%)	238 (38.20%)	0.601
Constipation	623	464 (74.48%)	268 (43.02%)	<0.001
Bristol stool score	623	3.58±0.04	4.05±0.04	<0.001
Type of stool according to the Bristol stool scale				
Type 1 Severe constipation	623	23 (3.69%)	4 (0.64%)	<0.001
Type 2 Mild constipation	623	31 (4.98%)	10 (1.61%)	<0.001
Type 3–4 Normal	623	484 (77.69%)	456 (73.19%)	0.065
Type 5 Lacking fiber	623	64 (10.27%)	97 (15.57%)	0.005
Type 6 Mild diarrhea	623	20 (3.21%)	54 (8.67%)	<0.001
Type 7 Severe diarrhea	623	1 (0.16%)	3 (0.48%)	0.632

Abbreviations: SDS, Self-Rating Depression Scale; PHQ-9, Patient Health Questionnaire; SAS, Self-Rating Anxiety Scale; GAD, Generalized Anxiety Disorder-7; GSRS, Gastrointestinal Symptom Rating Scale.

In 138 of the 166 participants with depression evaluated using the PHQ-9 before the intervention, depression disappeared after the intervention (Table 3). In 109 of the 121 participants with mild depression evaluated using the PHQ-9 before the intervention, depression disappeared after the intervention. In 35 of the 36 participants with moderate depression evaluated by the PHQ-9 before the intervention, depression improved (n=9) or disappeared (n=26) after the intervention. In all of the 9 participants with severe depression evaluated by the PHQ-9 before intervention, depression improved (n=6) or disappeared (n=3) after the intervention. In 17 of the 457 participants without depression evaluated by the PHQ-9 before the intervention, depression developed after the intervention, which was mild (n=15) and moderate (n=2).

Anxiety by SAS

The SAS score significantly decreased after the intervention (38.01±9.05 versus 34.79±7.66, P<0.001) (Table 2). The proportions of mild, moderate, and severe anxiety evaluated using the SAS also decreased after the intervention.

In 51 of the 61 participants with anxiety evaluated using the SAS before the intervention, anxiety disappeared after the intervention (Table 4). In 40 of the 45 participants with mild anxiety evaluated using the SAS before the intervention, anxiety disappeared after the intervention. In all of the 13 participants with moderate anxiety evaluated by the SAS

Table 3 Changes in Depression by SDS and PHQ-9

Outcomes of Interests Evaluated	Before Intervention	After Intervention
SDS		
Developed		
From no depression to any depression	466	57
From no depression to mild depression	466	42
From no depression to moderate depression	466	14
From no depression to severe depression	466	1
Disappeared		
From any depression to no depression	157	88
From mild depression to no depression	103	60
From moderate depression to no depression	45	25
From severe depression to no depression	9	3
Improved		
From any depression to a lower grade of depression	157	17
From mild depression to a lower grade of depression	103	Not applicable
From moderate depression to mild depression	45	11
From severe depression to mild/moderate depression	9	6
Unchanged		
No depression remained	466	409
Any depression remained	157	45
Mild depression remained	103	36
Moderate depression remained	45	9
Severe depression remained	9	0
Worsened/deteriorated		
From any depression to a higher grade of depression	157	7
From mild depression to moderate/severe depression	103	7
From moderate depression to severe depression	45	0
From severe depression to a higher grade of depression	9	Not applicable
PHQ-9 score	3.24±3.69	1.25±2.36
Developed		
From no depression to any depression	457	17
From no depression to mild depression	457	15
From no depression to moderate depression	457	2
From no depression to severe depression	457	0
Disappeared		
From any depression to no depression	166	138
From mild depression to no depression	121	109
From moderate depression to no depression	36	26
From severe depression to no depression	9	3
Improved		
From any depression to a lower grade of depression	166	15
From mild depression to a lower grade of depression	121	Not applicable
From moderate depression to mild depression	36	9
From severe depression to mild/moderate depression	9	6
Unchanged		
No depression remained	457	440
Any depression remained	166	10
Mild depression remained	121	9
Moderate depression remained	36	1
Severe depression remained	9	0

(*Continued*)

Table 3 (Continued).

Outcomes of Interests Evaluated	Before Intervention	After Intervention
Worsened/deteriorated		
From any depression to a higher grade of depression	166	3
From mild depression to moderate/severe depression	121	3
From moderate depression to severe depression	36	0
From severe depression to a higher grade of depression	9	Not applicable

Abbreviations: SDS, Self-Rating Depression Scale; PHQ-9, Patient Health Questionnaire.

Table 4 Changes in Anxiety by SAS and GAD

Outcomes of Interests Evaluated	Before Intervention	After Intervention
SAS score		
Developed		
From no anxiety to any anxiety	562	13
From no anxiety to mild anxiety	562	10
From no anxiety to moderate anxiety	562	2
From no anxiety to severe anxiety	562	1
Disappeared		
From any anxiety to no anxiety	61	51
From mild anxiety to no anxiety	45	40
From moderate anxiety to no anxiety	13	9
From severe anxiety to no anxiety	3	2
Improved		
From any anxiety to a lower grade of anxiety	61	5
From mild anxiety to a lower grade of anxiety	45	Not applicable
From moderate anxiety to mild anxiety	13	4
From severe anxiety to mild/moderate anxiety	3	1
Unchanged		
No anxiety remained	562	549
Any anxiety remained	61	4
Mild anxiety remained	45	4
Moderate anxiety remained	13	0
Severe anxiety remained	3	0
Worsened/deteriorated		
From any anxiety to a higher grade of anxiety	61	1
From mild anxiety to moderate/severe anxiety	45	1
From moderate anxiety to severe anxiety	13	0
From severe anxiety to a higher grade of anxiety	3	Not applicable
GAD-7 score		
Developed		
From no anxiety to any anxiety	505	8
From no anxiety to mild anxiety	505	8
From no anxiety to moderate anxiety	505	0
From no anxiety to severe anxiety	505	0
Disappeared		
From any anxiety to no anxiety	118	101
From mild anxiety to no anxiety	88	78
From moderate anxiety to no anxiety	23	20
From severe anxiety to no anxiety	7	3

(*Continued*)

Table 4 (Continued).

Outcomes of Interests Evaluated	Before Intervention	After Intervention
Improved		
From any anxiety to a lower grade of anxiety	118	6
From mild anxiety to a lower grade of anxiety	88	Not applicable
From moderate anxiety to mild anxiety	23	2
From severe anxiety to mild/moderate anxiety	7	4
Unchanged		
No anxiety remained	505	497
Any anxiety remained	118	10
Mild anxiety remained	88	9
Moderate anxiety remained	23	1
Severe anxiety remained	7	0
Worsened/deteriorated		
From any anxiety to a higher grade of anxiety	118	1
From mild anxiety to moderate/severe anxiety	88	1
From moderate anxiety to severe anxiety	23	0
From severe anxiety to a higher grade of anxiety	7	Not applicable

Abbreviations: SAS, Self-Rating Anxiety Scale; GAD, Generalized Anxiety Disorder-7.

before the intervention, anxiety improved (n=4) or disappeared (n=9) after the intervention. In all of the 3 participants with severe anxiety evaluated by the SAS before the intervention, anxiety improved (n=1) or disappeared (n=2) after the intervention. In 13 of the 562 participants without anxiety evaluated by the SAS before the intervention, anxiety developed after the intervention, which was mild (n=10), moderate (n=2), and severe (n=1).

Anxiety by GAD-7

The GAD-7 score was significantly decreased after intervention (2.24±3.25 versus 0.75±1.93, P<0.001) (Table 2). The proportions of mild, moderate, and severe anxiety evaluated using the GAD-7 scale also decreased after the intervention.

In 101 of the 118 participants with anxiety evaluated by the GAD-7 before the intervention, anxiety disappeared after the intervention (Table 4). In 78 of the 88 participants with mild anxiety evaluated by the GAD-7 before the intervention, anxiety disappeared after the intervention. In 22 of the 23 participants with moderate anxiety evaluated by GAD-7 before the intervention, anxiety improved (n=2) or disappeared (n=20) after the intervention. In all of the 7 participants with severe anxiety evaluated by the GAD-7 before the intervention, anxiety improved (n=4) or disappeared (n=3) after the intervention. In 8 of the 505 participants without anxiety evaluated by GAD-7 before the intervention, anxiety developed after the intervention, which was mild (n=8).

Gastrointestinal Symptoms by GSRS

The GSRS score significantly decreased after the intervention (22.64±7.35 versus 19.08±5.13, P<0.001) (Table 2). The proportions of regurgitation (20.87% versus 10.11%, P<0.001), abdominal pain (37.72% versus 17.66%, P<0.001), dyspepsia (74.16% versus 56.18%, P<0.001), and constipation (74.48% versus 43.02%, P<0.001) evaluated by GSRS scale were also significantly decreased after the intervention, but the decrease in the proportion of diarrhea after the intervention (39.65% versus 38.20%, P=0.601) was not statistically significant.

Regurgitation

In 98 of the 130 participants with regurgitation evaluated by GSRS before the intervention, regurgitation disappeared after the intervention (Table 5). In 96 of the 127 participants with mild regurgitation evaluated using GSRS before the intervention, regurgitation disappeared after the intervention. In all of the 3 participants with moderate regurgitation evaluated by GSRS before the intervention, regurgitation improved (n=1) or disappeared (n=2) after the intervention.

Table 5 Changes in Gastrointestinal Symptoms by GSRS

Outcomes of interests evaluated	Before intervention	After intervention
Regurgitation		
Developed		
From no regurgitation to any regurgitation	493	31
From no regurgitation to mild regurgitation	493	31
From no regurgitation to moderate regurgitation	493	0
From no regurgitation to severe regurgitation	493	0
Disappeared		
From any regurgitation to no regurgitation	130	98
From mild regurgitation to no regurgitation	127	96
From moderate regurgitation to no regurgitation	3	2
From severe regurgitation to no regurgitation	0	Not applicable
Improved		
From any regurgitation to a lower grade of regurgitation	130	1
From mild regurgitation to a lower grade of regurgitation	127	Not applicable
From moderate regurgitation to mild regurgitation	3	1
From severe regurgitation to mild/moderate regurgitation	0	Not applicable
Unchanged		
No regurgitation remained	493	462
Any regurgitation remained	130	29
Mild regurgitation remained	127	29
Moderate regurgitation remained	3	0
Severe regurgitation remained	0	Not applicable
Worsened/deteriorated		
From any regurgitation to a higher grade of regurgitation	130	2
From mild regurgitation to moderate/severe regurgitation	127	2
From moderate regurgitation to severe regurgitation	3	0
From severe regurgitation to a higher grade of regurgitation	0	Not applicable
Abdominal pain		
Developed		
From no abdominal pain to any abdominal pain	388	36
From no abdominal pain to mild abdominal pain	388	36
From no abdominal pain to moderate abdominal pain	388	0
From no abdominal pain to severe abdominal pain	388	0
Disappeared		
From any abdominal pain to no abdominal pain	235	161
From mild abdominal pain to no abdominal pain	220	151
From moderate abdominal pain to no abdominal pain	15	10
From severe abdominal pain to no abdominal pain	0	Not applicable
Improved		
From any abdominal pain to a lower grade of abdominal pain	235	5
From mild abdominal pain to a lower grade of abdominal pain	220	Not applicable
From moderate abdominal pain to mild abdominal pain	15	5
From severe abdominal pain to mild/moderate abdominal pain	0	Not applicable
Unchanged		
No abdominal pain remained	388	352
Any abdominal pain remained	235	66
Mild abdominal pain remained	220	66
Moderate abdominal pain remained	15	0
Severe abdominal pain remained	0	Not applicable

(*Continued*)

Table 5 (Continued).

Outcomes of interests evaluated	Before intervention	After intervention
Worsened/deteriorated		
From any abdominal pain to a higher grade of abdominal pain	235	3
From mild abdominal pain to moderate/severe abdominal pain	220	3
From moderate abdominal pain to severe abdominal pain	15	0
From severe abdominal pain to a higher grade of abdominal pain	0	Not applicable
Dyspepsia		
Developed		
From no dyspepsia to any dyspepsia	161	56
From no dyspepsia to mild dyspepsia	161	56
From no dyspepsia to moderate dyspepsia	161	0
From no dyspepsia to severe dyspepsia	161	0
Disappeared		
From any dyspepsia to no dyspepsia	462	168
From mild dyspepsia to no dyspepsia	449	166
From moderate dyspepsia to no dyspepsia	13	2
From severe dyspepsia to no dyspepsia	0	Not applicable
Improved		
From any dyspepsia to a lower grade of dyspepsia	13	9
From mild dyspepsia to a lower grade of dyspepsia	449	Not applicable
From moderate dyspepsia to mild dyspepsia	13	9
From severe dyspepsia to mild/moderate dyspepsia	0	Not applicable
Unchanged		
No dyspepsia remained	161	105
Any dyspepsia remained	462	282
Mild dyspepsia remained	449	280
Moderate dyspepsia remained	13	2
Severe dyspepsia remained	0	Not applicable
Worsened/deteriorated		
From any dyspepsia to a higher grade of dyspepsia	462	3
From mild dyspepsia to moderate/severe dyspepsia	449	3
From moderate dyspepsia to severe dyspepsia	13	0
From severe dyspepsia to a higher grade of dyspepsia	0	Not applicable
Diarrhea		
Developed		
From no diarrhea to any diarrhea	376	111
From no diarrhea to mild diarrhea	376	110
From no diarrhea to moderate diarrhea	376	1
From no diarrhea to severe diarrhea	376	0
Disappeared		
From any diarrhea to no diarrhea	247	120
From mild diarrhea to no diarrhea	241	117
From moderate diarrhea to no diarrhea	6	3
From severe diarrhea to no diarrhea	0	Not applicable
Improved		
From any diarrhea to a lower grade of diarrhea	247	3
From mild diarrhea to a lower grade of diarrhea	241	Not applicable
From moderate diarrhea to mild diarrhea	6	3
From severe diarrhea to mild/moderate diarrhea	0	Not applicable

(*Continued*)

Table 5 (Continued).

Outcomes of interests evaluated	Before intervention	After intervention
Unchanged		
No diarrhea remained	376	265
Any diarrhea remained	247	120
Mild diarrhea remained	241	120
Moderate diarrhea remained	6	0
Severe diarrhea remained	0	Not applicable
Worsened/deteriorated		
From any diarrhea to a higher grade of diarrhea	247	4
From mild diarrhea to moderate/severe diarrhea	241	4
From moderate diarrhea to severe diarrhea	6	0
From severe diarrhea to a higher grade of diarrhea	0	Not applicable
Constipation		
Developed		
From no constipation to any constipation	159	26
From no constipation to mild constipation	159	25
From no constipation to moderate constipation	159	1
From no constipation to severe constipation	159	0
Disappeared		
From any constipation to no constipation	464	222
From mild constipation to no constipation	374	188
From moderate constipation to no constipation	74	26
From severe constipation to no constipation	16	8
Improved		
From any constipation to a lower grade of constipation	464	50
From mild constipation to a lower grade of constipation	374	Not applicable
From moderate constipation to mild constipation	74	42
From severe constipation to mild/moderate constipation	16	8
Unchanged		
No constipation remained	159	133
Any constipation remained	464	187
Mild constipation remained	374	181
Moderate constipation remained	74	6
Severe constipation remained	16	0
Worsened/deteriorated		
From any constipation to a higher grade of constipation	464	5
From mild constipation to moderate/severe constipation	374	5
From moderate constipation to severe constipation	74	0
From severe constipation to a higher grade of constipation	16	Not applicable

Abbreviation: GSRS, Gastrointestinal Symptom Rating Scale.

None of the participants had or developed severe regurgitation before or after intervention, respectively. In 31 of the 493 participants without regurgitation evaluated by GSRS before the intervention, regurgitation developed after the intervention, which was mild (n=31).

Abdominal Pain

In 161 of the 235 participants with abdominal pain evaluated by the GSRS before the intervention, abdominal pain disappeared after the intervention (Table 5). In 151 of the 220 participants with mild abdominal pain evaluated by the GSRS before the intervention, abdominal pain disappeared after the intervention. In all of the 15 participants with moderate abdominal pain evaluated by the GSRS before the intervention, abdominal pain improved (n=5) or disappeared

(n=10) after the intervention. None of the participants had or developed severe abdominal pain before or after the intervention, respectively. In 36 of the 388 participants without abdominal pain evaluated by GSRS before the intervention, abdominal pain developed after the intervention, which was mild (n=36).

Dyspepsia

In 168 of the 462 participants with dyspepsia evaluated by GSRS before the intervention, dyspepsia disappeared after the intervention (Table 5). In 166 of the 449 participants with mild dyspepsia evaluated by GSRS before the intervention, dyspepsia disappeared after the intervention. In 11 of the 13 participants with moderate dyspepsia evaluated by GSRS before the intervention, dyspepsia improved (n=9) or disappeared (n=2) after the intervention. None of the participants had or developed severe dyspepsia before or after intervention, respectively. In 56 of the 161 participants without dyspepsia evaluated by the GSRS before the intervention, dyspepsia developed after the intervention, which was mild (n=56).

Diarrhea

In 120 of the 247 participants with diarrhea evaluated by the GSRS before the intervention, diarrhea disappeared after the intervention (Table 5). In 117 of 241 participants with mild diarrhea evaluated using the GSRS before the intervention, diarrhea disappeared after the intervention. In all of the 6 participants with moderate diarrhea evaluated by the GSRS before the intervention, diarrhea improved (n=3) or disappeared (n=3) after the intervention. None of the participants had or developed severe diarrhea before or after the intervention, respectively. In 111 of the 376 participants without diarrhea evaluated by the GSRS before the intervention, diarrhea developed after the intervention, which was mild (n=110) and moderate (n=1).

Constipation

In 222 of the 464 participants with constipation evaluated by the GSRS before the intervention, constipation disappeared after the intervention (Table 5). In 188 of the 374 participants with mild constipation evaluated using the GSRS before the intervention, constipation disappeared after the intervention. In 68 of the 74 participants with moderate constipation evaluated by the GSRS before the intervention, constipation improved (n=42) or disappeared (n=26) after the intervention. In all of the 16 participants with severe constipation evaluated by the GSRS before the intervention, constipation improved (n=8) or disappeared (n=8) after the intervention. In 26 of the 159 participants without constipation evaluated by the GSRS before the intervention, constipation developed after the intervention, which was mild (n=25) and moderate (n=1).

Stool by Bristol Score

The proportions of severe (3.69% versus 0.64%, P<0.001) and mild (4.98% versus 1.61%, P<0.001) constipation decreased after the intervention, but those with severe (0.16% versus 0.48%, P=0.632) and mild (3.21% versus 8.67%, P<0.001) diarrhea increased after the intervention (Table 2).

In 23 participants with severe constipation evaluated by the Bristol score before the intervention, the type of stool was normalized (n=18) and changed to diarrhea (n=4) after the intervention (Table 6). In 31 participants with mild constipation evaluated by the Bristol score before the intervention, the type of stool was normalized (n=22) and changed to diarrhea (n=6) after the intervention. In one participant with severe diarrhea evaluated using the Bristol score before intervention, the type of stool remained (n=1) after the intervention. In 20 participants with mild diarrhea evaluated by the Bristol score before the intervention, the type of stool was normalized (n=6) and remained (n=14) after the intervention.

Discussion

Our study demonstrated a reduction in depression and anxiety after progressive muscle relaxation training combined with music intervention. Indeed, the benefits of music therapy in various clinical scenarios have been widely recognized.[31–37] Similarly, numerous studies have comprehensively evaluated the effects of progressive muscular relaxation training on anxiety, depression, quality of life, quality of sleep, and other outcomes in diverse populations, including basketball

Table 6 Changes in Type of Stool by Bristol Stool Scale

Outcomes of Interests Evaluated	Before Intervention	After Intervention
Bristol stool score		
Type 1 Severe constipation		
Improved or normalized Type 3–4	23	18
Unchanged or kept constipation Type 1–2	23	1
Changed to diarrhea Type 5–7	23	4
Type 2 Mild constipation		
Improved or normalized Type 3–4	31	22
Unchanged or kept constipation Type 1–2	31	3
Changed to diarrhea Type 5–7	31	6
Type 3–4 Normal		
Unchanged or kept normal Type 3–4	484	374
Changed to constipation Type 1–2	484	9
Changed to diarrhea Type 5–7	484	101
Type 5 Lacking fiber		
Improved or normalized Type 3–4	64	35
Changed to constipation Type 1–2	64	1
Unchanged or kept diarrhea Type 5–7	64	28
Type 6 Mild diarrhea		
Improved or normalized Type 3–4	20	6
Changed to constipation Type 1–2	20	0
Unchanged or kept diarrhea Type 5–7	20	14
Type 7 Severe diarrhea		
Improved or normalized Type 3–4	1	0
Changed to constipation Type 1–2	1	0
Unchanged or kept diarrhea Type 5–7	1	1

athletes,[38] nursing students,[39,40] psychiatric patients,[41,42] COVID-19 patients,[43,44] patients with pulmonary resection,[45] individuals with posttraumatic stress disorder,[46] patients with endometriosis,[18] patients who underwent coronary artery bypass graft surgery,[17] and older people[47] (Supplementary Table 1). However, to the best of our knowledge, the impact of their combination has never been explored in recruits, who are at high risk of developing psychological problems, yet.

Based on the currently available evidence, it seems that progressive muscular relaxation training and music intervention are beneficial for the improvement of anxiety and depression. However, the effects of progressive muscular relaxation on sleep quality remain controversial. Ziv et al compared the effects of progressive muscular relaxation and music therapy on insomnia in 15 older adults, and found that music therapy was superior to progressive muscular relaxation in sleep efficiency.[47] More notably, progressive muscular relaxation may deteriorate sleep quality. Similarly, in another study by Blanaru et al including 13 individuals with posttraumatic stress disorders, music relaxation not only improved objective and subjective sleep efficiency, but also reduced depression; however, muscular relaxation was not beneficial for sleep efficiency.[46] For comparison, our study was designed in which progressive muscular relaxation was performed at night. In this setting, progressive muscular relaxation might compromise the sleep quality of recruits, which is potentially harmful to gastrointestinal symptoms. Therefore, the limitations of our study design should be acknowledged. Future studies should adjust the time at which progressive muscular relaxation is performed to noon.

A major finding of our study was the decrease in the proportion of four gastrointestinal symptoms (regurgitation, abdominal pain, dyspepsia, and constipation), but not diarrhea, after the two psychological interventions. This clinical benefit in terms of gastrointestinal symptoms should be partially attributed to improvements in psychological status. First, studies by our group and others suggest an obvious interaction between psychological problems and gastrointestinal symptoms, primarily due to the brain-gut axis.[6,48] Second, previous studies also indicate that various therapies, including music therapy, can improve the symptoms associated with irritable bowel syndrome, reduce the pain and anxiety, and

increase the satisfaction during colonoscopy,[49,50] and decrease the nausea and vomiting after chemotherapy.[51,52] However, the lack of an effect on diarrhea warrants further investigation. Based on the GSRS results, 120 of the 247 participants with diarrhea before intervention did not have diarrhea after intervention, and 111 of the 238 participants with diarrhea after intervention did not have diarrhea before intervention, suggesting only a limited overlap between the two groups of participants with diarrhea before and after intervention. Similarly, based on the results of the Bristol stool scale, 10 participants with constipation and 101 with normal stool developed diarrhea. Taken together, the two interventions should be efficacious for the improvement of diarrhea to some extent, but cannot prevent its *de novo* occurrence. However, regardless of GSRS or Bristol stool scale, *de novo* diarrhea should be common in our recruits. Further studies are warranted to explore the pathogenesis of this clinical symptom, including psychological, environmental, dietary, and regional factors, and to establish novel approaches for screening, prevention, and treatment.

The absence of a control group without psychological intervention was a major limitation of our study. In the setting of a single-arm design, investigators can only compare anxiety, depression, and gastrointestinal symptoms before and after intervention, but do not adjust the effects of other factors on them. An ongoing randomized controlled trial by our group will address this issue.

Recruit adherence to the two relaxation techniques during the study period was another limitation of our study. We sent out broadcasts on time and reminded all participants to complete the progressive muscular relaxation training and music intervention. Considering that their daily schedules of training and resting were fixed, their objective adherence should be good. However, the possibility of poor subjective adherence cannot be ignored. Owing to the large number of participants included in our study, it was very difficult to monitor the participants' completeness of these interventions in a one-to-one manner.

The third limitation should be that organic gastrointestinal diseases, for which psychological interventions might be hardly effective, were not sufficiently excluded from our study. However, it should be acknowledged that imaging and endoscopy, which are often required for a diagnosis of organic gastrointestinal diseases, are unavailable or neglected in most of cases. Regardless, we recommend that further diagnostic approaches should be performed if participants have persistent gastrointestinal symptoms.

Besides, according to the World Federation of Music Therapy or the American Music Therapy Association, music therapy should be administered by a board-certified or trained music therapist to accomplish individualized goals. However, no credentialed professional researcher has participated in completing music interventions in the current study.

The last limitation is that the participants' responses may be biased. They should have recognized the purpose of our study, and thus may be inclined to answer with an improvement of psychological conditions and gastrointestinal symptoms. Additionally, considering that this study was led by military officers, it is more likely that the recruits gave positive responses after intervention. However, we have acknowledged that the participants' responses should be honest and unbiased. Indeed, based on our daily observations, military recruits hardly denied the presence of their true discomfort.

In conclusion, a combination of progressive muscular relaxation training with music intervention should be considered in recruits to improve anxiety and depression and manage regurgitation, abdominal pain, dyspepsia, and constipation, but not diarrhea. These findings suggest the potential benefits of psychological intervention in the recruits. Thus, they may be incorporated into the routine subjects of recruits' training. Certainly, in the future, these findings should be validated in well-designed, randomized controlled trials where no additional intervention should be designed in a control group. Additionally, the management of diarrhea in this population is an important issue that deserves further exploration.

Data Sharing Statement

Data supporting the findings of this study are available from the corresponding author, XQ, upon reasonable request.

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Disclosure

The authors report no conflicts of interest in this work.

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