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RESEARCH ARTICLE

Investigation of the relationship between occupational stress and audiovestibular symptoms among glass factory workers

Cam fabrikası işçilerinde iş stresi ve odyovestibüler semptomlar arasındaki ilişkinin incelenmesi

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Abstract

Aim: The aim of this study is to investigate the relationship between occupational stress and audiovestibular symptoms among glass factory workers.

Methods: The study included 40 workers employed at a glass factory. Occupational stress of the glass factory workers was assessed using the Swedish Demand-Control-Support Questionnaire (DCSQ), auditory symptoms using the Turkish version of the Amsterdam Inventory For Auditory Disability And Handicap (T-AIADH), and vestibular symptoms using the Vertigo Dizziness Imbalance Questionnaire (VDI). The Tinnitus Disability Questionnaire was administered to workers with tinnitus.

Results: A weak, significant negative correlation was found between the total score of the Amsterdam Inventory for Auditory Disability and Handicap and the score on the social support subscale of the DCSQ (p=0.048; r=-0.315). No significant relationship was found between the subscale scores of the DCSQ and the subscale scores of the T-AIADH, as well as the VDI symptom, quality of life, and total raw scores (p>0.05).

Conclusion: Our study found that an increase in social support among workers at a glass factory was associated with a decrease in the level of auditory disability. It was determined that vestibular symptoms and the associated quality of life were not associated with occupational stress. Our findings highlight the importance of social support for workers in glass factories and underscore the need for further studies that comprehensively assess risk factors related to occupational stress and audiovestibular symptoms. Our study findings highlight the need to assess auditory symptoms among glass factory workers and to alleviate their perception of these symptoms by providing them with social support. Providing social support to workers can help increase productivity.

Keywords: Occupational stress, glass factory workers, audiovestibular symptoms.

Özet

Amaç: Bu çalışmanın amacı cam fabrikası işçilerinde iş stresi ile odyovestibüler semptomlar arasındaki ilişkinin araştırılmasıdır.

Yöntemler: Çalışmaya cam fabrikasında çalışan 40 işçi dahil edildi. Cam fabrikası işçilerinin iş stresleri İsveç İş Yükü-İş Kontrolü-Sosyal Destek Anketi ile (İş Stresi Ölçeği), işitsel semptomları Amsterdam İşitsel Yetersizlik ve Engellilik Anketinin Türkçe versiyonu (T-AIADH) ile, vestibüler semptomları Vertigo, Dizziness, Dengesizlik Anketi (VDI) ile değerlendirildi. Tinnitusu olan işçilere Tinnitus Engellilik Anketi uygulandı.

Bulgular: Amsterdam İşitsel Yetersizlik ve Engellilik Anketi toplam skoru ve İş Stresi Ölçeği sosyal destek alt kategorisi skoru arasında anlamlı negatif yönde zayıf ilişki saptandı (p=0,048; r=-0,315). İş Stresi Ölçeği alt parametre skorları ile T-AIADH alt parametre skorları ve VDI semptom, yaşam kalitesi ve toplam ham puanları arasında anlamlı ilişki saptanmadı (p>0,05).

Sonuç: Çalışmamızda cam fabrikasında çalışan işçilerde iş stresi açısından sosyal destek artışının işitsel yetersizlik düzeyinde azalma ile ilişkili olduğu saptandı. Vestibüler semptomların ve buna bağlı yaşam kalitesinin iş stresi ile ilişkili olmadığı belirlendi. Bulgularımız cam fabrikasında çalışan işçilerin sosyal açıdan desteklenmesinin önemini ve iş stresi ve odyovestibüler semptomlar açısından risk faktörlerinin de kapsamlı bir şekilde değerlendirileceği ilave çalışmaların gerekliliğini göstermiştir. Çalışma bulgularımız; cam fabrikası işçilerinde işitsel semptomların değerlendirilmesinin ve işçilerin sosyal açıdan desteklenerek işitsel semptom algılarının hafifletilmesinin gerekliliğini ortaya koymuştur. İşçilere sosyal destek sağlanması, iş veriminin artırılmasını sağlayabilir.

Anahtar Kelimeler: İş stresi, cam fabrikası işçileri, odyovestibüler semptomlar.

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INTRODUCTION

Industrial audiology is a subfield of audiology that focuses on industrial noise, vibrations, explosions, and noise-induced hearing loss. Factories, plants, and industrial sites are among the primary settings for industrial audiology. Glass factories are another key industrial setting. Various devices, motors, and machines are used in the glass production process at glass factories. Workers who operate these devices or are in close proximity to them may experience certain changes in their vestibular system. Glass factory workers may encounter various environmental, psychosocial, and ergonomic risk factors (1).

One of these risk factors is occupational stress (1). Occupational stress is defined by the European Commission as an emotional, cognitive, behavioral, and psychological response to the negative and distressing aspects of work, the work environment, and work organization (2). Factory workers are one of the occupational groups in society that can cope with occupational stress (3). According to the World Health Organization, examples of the causes of occupational stress include poor work organization, unsatisfactory working conditions, and a lack of adequate support from coworkers and supervisors (4).

Occupational stress has significant effects on factory workers (5). In addition to psychological problems, occupational stress can affect systems such as the cardiovascular, musculoskeletal, and endocrine systems, leading to various health conditions and reducing workers' quality of life (6–9). One type of symptom that workers may experience is audiovestibular symptoms. Dizziness and audiological symptoms are among the vestibular symptoms that can be caused by occupational stress (10). A link has been observed between occupational stress and the prevalence of auditory system disorders such as tinnitus, hearing loss, and hyperacusis (10,11). Self-report questionnaires are validated and standardized surveys that assess patients' perceptions of their own functional status(12). As in other fields, there are various self-report questionnaires in the field of audiology (13). The use of a standardized questionnaire to assess auditory disability among workers in a glass factory in our study may provide a unique contribution to the literature. The fact that our study simultaneously evaluated the relationship between occupational stress and both auditory and vestibular symptoms in glass factory workers also adds to its uniqueness. The aim of this study is to investigate the relationship between occupational stress and audiovestibular symptoms among workers in a glass factory using self-report questionnaires.

METHODS

Ethical approval for the study was obtained from the Ethics Committee of the Faculty of Health Sciences at Ankara Yıldırım Beyazıt University (Decision No. 07/881).

Participants

The study included 40 participants working at glass factories in the province of Samsun. Prior to the study, all participants were provided with informed consent forms detailing the scope and nature of the research and were asked to complete them. The questionnaires and scales were administered to the participants in person at their workplace using paper and pencil. Information regarding age, gender, total work duration, and daily work hours was collected from all participants.

The inclusion criteria for all participants were as follows: being between the ages of 19 and 55, having no uncontrolled systemic diseases, having no neurological or orthopedic conditions, having no history of ear surgery, having no history of hearing loss or vestibular disorders, and volunteering to participate in the study.

The Swedish Demand-Control-Support Questionnaire (DCSQ) was administered to all participants to assess occupational stress. The Turkish version of the Amsterdam Inventory For Auditory Disability And Handicap (T-AIADH) was used to assess auditory disability in all participants, and the Vertigo, Dizziness, Imbalance Questionnaire (VDI) was used to evaluate vestibular symptoms. The Tinnitus Handicap Inventory was administered to workers with tinnitus.

The Swedish Demand-Control-Support Questionnaire (DCSQ)

The Swedish Demand-Control-Support Questionnaire was administered to all participants to assess

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occupational stress. This questionnaire is a self-report scale consisting of 17 items that assesses employees' job demands, decision-making and control, and perceptions of social support (14,15). The questionnaire was adapted into Turkish by Demiral et al. (16).

The questionnaire consists of 5 items assessing workload, 6 items assessing social support at work, and 6 items assessing job control (15). Of the questions assessing job control, 2 evaluate decision-making autonomy, while 4 evaluate skill utilization. The sections assessing skill utilization, workload, and decision-making autonomy are scored using a 4-point Likert scale.

When answering these survey questions, employees use the following responses: "Never (1 point)", "Rarely (2 points)", "Sometimes (3 points)", and "Often (4 points)". Questions in the social support section, however, can be answered as "Strongly disagree (1 point)", "Somewhat disagree (2 points)", "Somewhat agree (3 points)", and "Strongly agree (4 points)". Higher scores on the questionnaire indicate high workload, high job control, and high social support. Occupational stress is assessed as the ratio of workload to job control (16).

Turkish Version of Amsterdam Inventory For Auditory Disability And Handicap (T-AIADH)

The Amsterdam Inventory For Auditory Disability And Handicap is a self-report questionnaire developed by Kramer and colleagues to assess various aspects of auditory disability (17). The questionnaire consists of a total of 30 items; while 28 items relate to five areas of hearing, 2 items focus on music perception. Of the 28 items related to the five areas of hearing, 8 focus on sound discrimination, 5 on sound localization, 5 on speech intelligibility in quiet environments, 5 on speech intelligibility in noisy environments, and 5 on sound perception. The inventory's translation into Turkish, as well as its validity and reliability studies, were conducted by Müjdeci et al (18). For each item, there are four response options: "almost always," "often," "sometimes," and "almost never." These response options are scored as 0, 1, 2, and 3 points, respectively (19). The two items assessing musical perception are scored in the opposite direction from the other questions (18). The lowest possible score on the questionnaire is 0, while the highest is 90. A higher score indicates that the patient experiences greater difficulty hearing(19).

Vertigo Dizziness Imbalance Questionnaire (VDI)

The Vertigo, Dizziness, Balance Questionnaire is a survey developed by Prieto et al. to assess the sense of imbalance, dizziness, and the psychosocial effects these conditions have on individuals (20). The questionnaire consists of two subscales, containing a total of 36 items: 14 items assessing symptoms and 22 items assessing quality of life. A 6-point Likert scale is used for scoring the questionnaire. According to the questionnaire's scoring system, responses are rated as follows: "5: Never, 4: Very rarely, 3: Sometimes, 2: Often, 1: Most of the time, 0: Always"(21,22). High scores on the quality of life subscale indicate a better quality of life, while high scores on the symptom subscale indicate a high presence of symptoms. The validity and reliability study of the questionnaire in Turkish was conducted by Yanık et al (23).

Tinnitus Handicap Inventory (THI)

The Tinnitus Handicap Inventory is a self-report questionnaire developed by Newman et al. to assess the impact of tinnitus on daily life. The questionnaire assesses the impact of tinnitus through three sub-domains. It consists of a total of 25 items, including 11 questions related to the functional domain, 9 questions related to the emotional domain, and 5 questions related to the catastrophic domain (24).

The functional domain concerns problems with mental, social, and physical functioning; the emotional domain concerns the emotional states caused by tinnitus; and the catastrophic domain concerns control abilities and feelings of helplessness (25). Each item in the questionnaire is scored sequentially with 0, 2, and 4 points and can be answered in three ways: "No","Sometimes," and "Yes". The validity and reliability study of the Turkish adaptation of the questionnaire was conducted by Aksoy et al (26). Higher scores indicate a greater impact of tinnitus. The total score is the sum of the scores obtained in each area of the subscales. Based on the total score from the questionnaire, there are five distinct levels of disability. A total score of 0–16 is classified as very mild, 18–36 as mild, 38–56 as moderate, 58–76 as severe, and 78–100 as catastrophic (24,27).

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Statistical Analysis

IBM SPSS Statistics 24.0 was used for the statistical analysis of the data. The normality of the data distribution was assessed using Shapiro-Wilk tests. For the correlation analysis of the survey scores, Pearson correlation was used for normally distributed variables, and Spearman correlation was used for non-normally distributed variables. Differences between variables by gender were evaluated using an independent samples t-test.

Descriptive statistics were presented as the mean ± standard deviation for variables following a normal distribution, and as the median and interquartile range (IQR) for variables not following a normal distribution. In the analyses, results with a p-value below 0.05 were considered statistically significant.

RESULTS

Of the participants in the study, 12.5% (n=5) were women and 87.5% (n=35) were men. The mean age of the women was 36.8±5.40, and the mean age of the men was 33.74±7.85 (Table 1). The mean age of all participants was found to be 34.12±7.60. No significant difference was found between the mean ages of the women and men included in the study (p>0.05). No significant differences were found between the genders in terms of length of employment at the factory or daily working hours (p>0.05).

The educational status of the participants included in the study, according to gender, is given in Table 2, and the educational status of all participants is given in Figure 1. 20% of men are middle school graduates, 60% of men and 5% of women are high school graduates, 2.5% of men and 7.5% of women are associate degree graduates, and 5% of men and 5% of women are bachelor's degree graduates (Table 2).

An analysis of the educational status of all participants revealed that 20% had completed middle school, 62.5% had graduated from high school, 7.5% held an associate's degree, and 10% held a bachelor's degree (Figure 1).

The T-AIADH, DCSQ, and VDI scores for all participants in the study are presented in Table 3. Of the 40 participants in the study, 6 who had tinnitus completed the Tinnitus Handicap Inventory, while all 40 participants completed the other questionnaires. Of the 6 participants who completed the Tinnitus Handicap Inventory, 4 were

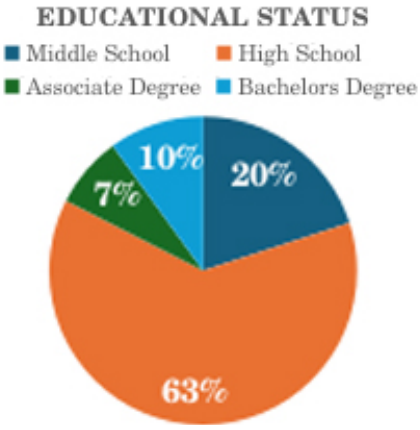

Figure 1. The educational status of all participants included in the study

Table 1. The demographic characteristics, years of experience, and daily working hours of all participants

	Age	Height (cm)	Weight (kg)	Hours Worked at the Factory (Year)	Daily Working Hours (Hour)
Male (n=35)	33.74±7.85	174.28±5.41	81.91±9.88	8.22±5.50	8.17±0.51
Female (n=5)	36.80±5.40	161.20±5.80	77.2±5.97	9.60±4.87	8.40±0.89
Total (n=40)	34.12±7.60	172.65±6.94	81.32±9.56	8.40±5.39	8.20±0.56

Table 2. Educational status of participants by gender

	Middle School	High School	Associate Degree	Bachelor's Degree	Total
Male	8 (%20)	24 (%60)	1 (%2.5)	2 (%5)	35 (%87.5)
Female	-	1 (%2.5)	2 (%5)	2 (%5)	5 (%12.5)
Total	8 (%20)	25 (%62.5)	3 (%7.5)	4 (%10)	40 (%100)

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classified as having "mild" tinnitus, 1 as "moderate," and 1 as "severe". The AIADH, DCSQ, and VDI scores of the participants included in the study are presented in Table 3.

A weak, significant negative correlation was found between the T-AIADH total score and the social support subscale score of DCSQ (p=0.048; r=-0.315). No significant relationship was found between the subscale scores of the DCSQ and the subscale scores of the T-AIADH (p>0.05) (Table 4).

Table 3. T-AIADH, DCSQ and VDI Results

	Median (IQR)
T-AIADH	
Speech intelligibility in a quiet environment	2 (3.00)
Speech intelligibility in a noisy environment	2 (3.50)
Sound discrimination	3 (3.00)
Sound detection	2 (2.00)
Auditory localization	2 (2.75)
Music perception	4 (2.00)
TOTAL SCORE	16 (8.75)
DCSQ	
Social Support	20 (5.75)
Job Control	19 (6.00)
Job Demand	14.5 (4.00)
VDI	
Quality of life (Raw score)	95 (13.75)
Symptom (Raw score)	61 (13.75)
TOTAL RAW SCORE	157 (23.75)

IQR=Interquartile Range
T-AIADH: Turkish version of the Amsterdam Inventory For Auditory Disability And Handicap
VDI: Vertigo Dizziness Imbalance Questionnaire
DCSQ: The Swedish Demand-Control-Support Questionnaire

No significant relationship was found between the sub-scales of the DCSQ and the VDI, either for the sub-scales or for the total raw scores. (p>0.05) (Table 5).

Table 5. Results of the correlation analysis between the DCSQ and VDI scores

DCSQ	VDI					
	Symptom Scale		Quality Of Life Scale		Total	
	p	r_s	p	r_s	p	r_s
Job Demand	0.163	0.225	0.492	0.112	0.296	0.173
Job Control	0.214	0.201	0.652	-0.073	0.807	0.040
Social Support	0.464	0.119	0.136	-0.240	0.499	-0.110

rs = Spearman's rank correlation coefficient
VDI: Vertigo Dizziness Imbalance Questionnaire
DCSQ: The Swedish Demand-Control-Support Questionnaire

DISCUSSION

Occupational stress is defined as the harmful physical and emotional reactions that workers exhibit in response to negative situations encountered in the workplace (28). Examples of situations that can lead to occupational stress include unsatisfactory working conditions, a lack of adequate support from coworkers or employers, and poor job design (29). While occupational stress can affect workers' bodily systems, it can also cause certain changes.

As a result of these occupational stress changes, workers may experience stress-related responses and health issues.(30). The audiovestibular system is defined as an integrated system of hearing and balance. It can be affected by occupational stress. This effect can lead to various symptoms such as dizziness, hearing loss, and

Table 4. Results of the analysis of the correlation between T-AIADH scores and DCSQ scores

DCSQ	T-AIADH													
	Speech intelligibility in a quiet environment		Speech intelligibility in a noisy environment		Sound Discrimination		Sound Detection		Auditory Localization		Music Perception		Total	
	p	r_s	p	r_s	p	r_s	p	r_s	p	r_s	p	r_s	p	r_s
Job Demand	0.470	0.118	0.428	-0.129	0.592	-0.087	0.538	0.100	0.516	-0.106	0.848	0.031	0.576	-0.091
Job Control	0.548	0.098	0.188	-0.213	0.486	-0.114	0.295	-0.170	0.095	-0.268	0.081	-0.279	0.141	-0.237
Social Support	0.205	-0.205	0.108	-0.258	0.057	-0.304	0.171	-0.221	0.147	-0.233	0.306	-0.166	0.048	-0.315

rs = Spearman's rank correlation coefficient
T-AIADH: Turkish version of the Amsterdam Inventory For Auditory Disability And Handicap
DCSQ:The Swedish Demand-Control-Support Questionnaire

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tinnitus. This study investigates the relationship between occupational stress and audiovestibular symptoms in 40 workers at a glass factory who have no history of hearing loss or vestibular disorders.

A study examining the relationship between occupational stress and audiovestibular symptoms (31) have observed varying results depending on participants' work conditions. Rozman et al. found no significant relationship between job satisfaction and physical burnout syndromes, including vestibular symptoms such as vertigo and headache, in their study involving participants from various age groups and occupational backgrounds (32). Beha et al. examined occupational stress among workers with hearing loss and those with normal hearing, and found that workers with hearing loss experienced significantly greater difficulties in the social subdimensions of occupational stress compared to their normal-hearing counterparts.(31). Although there were methodological differences between our study and these previous studies, the participants in our study had low scores on the T-AIADH. While the maximum possible score on the questionnaire was 90, the median total auditory impairment score for participants in our study was 16. The significant negative correlation observed in our study between the total T-AIADH score and the social support score on the DCSQ indicates that an increase in social support reduces the level of auditory disability. This result suggests that auditory disability associated with auditory symptoms experienced by participants working in a glass factory could be reduced if they receive social support. This finding highlights the importance of providing social support to workers in factories, which are environments at risk for the development of auditory symptoms. In our study, no significant relationship was found between occupational stress and the sub-scale scores of the T-AIADH. The reason the relationship between social support score and the total T-AIADH score is at a weak significance level is that there may be other factors, not included in our assessment, that could affect both auditory disability and occupational stress. More comprehensive studies that also evaluate factors affecting hearing impairment and occupational stress could provide useful information on this subject.

Fredriksson et al. found no significant relationship between occupational stress and noise exposure and noise annoyance parameters in their study involving obstetrics personnel (33). They also found that occupational stress has an indirect effect on speech perception difficulties caused by noise, but that this effect is quite weak (β = 0.04; 95% CI: 0.03–0.05). Abbasi et al. in their study examining the relationship between occupational stress and occupational noise exposure in textile workers, found a direct correlation between noise exposure and occupational stress, and an indirect correlation between job satisfaction and noise sensitivity. (34). It has also been observed that failure to use hearing protection and exposure to noise can contribute to occupational stress, and that taking the necessary precautions against these factors can help reduce occupational stress. In the study by Aldila et al. examining the relationship between continuous noise exposure and occupational stress in factory workers, a weak correlation was found between workplace noise exposure levels and occupational stress in factory workers (35). In our study, similar to the findings of Fredriksson et al. (33) no significant association was found between the T-AIADH subscale assessing speech intelligibility in noise and occupational stress. Since we did not assess workplace noise levels in this study, it is not possible to explain the possible reasons for this finding. Studies that include workplace noise levels in their assessments will provide more useful information for determining the relationship between noise or speech intelligibility in noise and occupational stress.

In a study by Frederiksen et al. examining occupational noise exposure, psychosocial working conditions in the workplace, and tinnitus, no significant association was found between the level of occupational noise exposure and tinnitus. No significant association was found between decision-making autonomy or psychological demands in the workplace and tinnitus either (36). In the study by Atitung et al. examining the relationship between tinnitus and occupational stress, tinnitus was detected in 16.9% of the workers, and according to their multiple linear regression analysis, occupational stress and tinnitus were significantly associated (37). In our study, of the 6 (15%) participants who completed the Tinnitus Handicap Inventory Questionnaire, 4 were classified as having "mild" tinnitus, 1 as "moderate," and 1 as "severe." Since there were only 6 (15%) participants with tinnitus, we did not include the results related to tinnitus in the statistical analysis.

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In their study of the general population, Ihler et al. found that risk factors play a significant role in the development of auditory-vestibular symptoms, but that the underlying mechanism is associated with neuronal and cardiovascular disease processes (38).Similarly, Dipboye et al. in their studry on occupational stress found that cardiovascular diseases are one of the main effects of occupational stress (39). In the VDI questionnaire used in our study, while the maximum possible raw score for vestibular symptoms is 70, the median raw score for vestibular symptoms among our participants was 61, indicating that glass workers have a high level of vestibular complaints. In the same questionnaire, while the maximum raw score for quality of life was 110, the median raw score for quality of life among our participants was 95, indicating that their quality of life was very close to the maximum "good" threshold. The fact that we did not identify a relationship between vestibular symptoms and quality of life and occupational stress in our study can be interpreted, similarly to the findings of Ihler and Dipboye, as indicating that vestibular symptoms and occupational stress are not directly related. The underlying mechanisms for both conditions may be very different and complex. As observed in the study by Mendel et al., there may not be a direct correlation between observable vestibular symptoms and the impact of these symptoms on daily life. In Smit et al.'s study, which included a population aged 45–70, participants experiencing dizziness and vertigo reported that the impact of these symptoms on their daily lives and activities was either nonexistent or minimal (40).

In their studies, Mendel et al. noted that this relationship may stem from factors such as personality traits and coping abilities, and emphasized the need to include additional factors in future research (41).

While neuronal and cardiovascular causes may play a role in the development of occupational stress and/or vestibular disorders, it should not be overlooked that occupational stress is directly influenced by workplace conditions. In conclusion, it was found that an increase in social support among glass factory workers is associated with a reduction in auditory disability. Unlike previous studies in the literature, our study examined the relationship between occupational stress and both auditory and vestibular symptoms. We believe that our finding of a significant association between occupational stress and the T-AIADH total score, as well as the social support score, may be significant in highlighting the importance of social support for glass factory workers. We believe that additional studies are necessary to investigate the risk factors and mechanisms of action in greater detail in order to elucidate the relationship between as and audiovestibular symptoms in factory workers.

LIMITATIONS

One of the limitations of our study is that tinnitus findings were not included in the statistical analysis because the number of workers with tinnitus who completed the THI was lower than the total sample size. This prevented us from evaluating the relationship between tinnitıs and occupational stress. Another limitation is that we did not assess environmental factors such as workplace temperature and ambient noise, which could affect the workers. The fact that the majority of the glass factory workers included in our study were male can also be considered a limitation due to the gender imbalance. In future studies, it is recommended to balance the gender distribution and increase the sample size.

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