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ORIGINAL PAPER

ADHD and depressive symptoms in adolescents: the role of community violence exposure

Andrew Stickley[1,2] · Roman Koposov[3] · Ai Koyanagi[4,5] · Yosuke Inoue[6] · Vladislav Ruchkin[7,8]

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Abstract

Purpose Comorbid depression is common in adolescents with attention-deficit/hyperactivity disorder (ADHD). As yet, however, little is known about the factors associated with co-occurring depression in this population. To address this research gap, the current study examined the role of community violence exposure in the association between ADHD symptoms and depression.

Methods Data came from 505 Russian adolescents [mean age 14.37 (SD = 0.96)] who had teacher-reported information on ADHD symptoms that was collected in conjunction with the Social and Health Assessment (SAHA). Adolescent self-reports of witnessing and being a victim of community violence were also obtained while depressive symptoms were self-assessed with an adapted version of the Center for Epidemiologic Studies-Depression Scale (CES-D). Logistic regression analyses were performed to examine associations.

Results In univariable analyses, both witnessing and being a victim of violence were associated with significantly increased odds for depressive symptoms in adolescents with ADHD symptoms compared to non-ADHD adolescents who had not experienced community violence. However, in the multivariable analysis only being a victim of violence continued to be associated with significantly increased odds for depression [odds ratio (OR) 4.67, 95% confidence interval (CI) 1.33–16.35].

Conclusion Exposure to community violence may be associated with depression in adolescents with ADHD symptoms. Clinicians should enquire about exposure to community violence in adolescents with ADHD/ADHD symptoms. Early therapeutic interventions to address the effects of violence exposure in adolescents with ADHD may be beneficial for preventing depression in this group.

Keywords Attention-deficit/hyperactivity disorder · Depressive symptoms · Witness violence · Violent victimization · Adolescent

✉ Andrew Stickley
amstick66@gmail.com

[1] Department of Preventive Intervention for Psychiatric Disorders, National Institute of Mental Health, National Center of Neurology and Psychiatry, 4-1-1 Ogawahigashicho, Kodaira, Tokyo 1878553, Japan

[2] Stockholm Center for Health and Social Change (SCOHOST), Södertörn University, 141 89, Huddinge, Sweden

[3] Regional Center for Child and Youth Mental Health and Child Welfare, UiT The Arctic University of Norway, Tromsö, Norway

[4] Parc Sanitari Sant Joan de Déu, Universitat de Barcelona, Fundació Sant Joan de Déu, Dr Antoni Pujadas, 42, Sant Boi de Llobregat, 08830 Barcelona, Spain

[5] Instituto de Salud Carlos III, Centro de Investigación Biomédica en Red de Salud Mental, CIBERSAM, Monforte de Lemos 3-5 Pabellón 11, 28029 Madrid, Spain

[6] Carolina Population Center, The University of North Carolina at Chapel Hill, 123 West Franklin St, Chapel Hill, NC 27516, USA

[7] Child and Adolescent Psychiatry Unit, Department of Neuroscience, Uppsala University, Uppsala, Sweden

[8] Child Study Centre, Yale University Medical School, New Haven, CT 06520, USA

Introduction

Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder that is common in childhood affecting as many as 7.2% of those aged 18 and under [1]. Its core features of inattention, hyperactivity and impulsivity have been linked to a range of detrimental outcomes across different domains. Specifically, ADHD/ADHD symptoms have been associated with academic underachievement [2], peer problems [3], family dysfunction [4] and disrupted parent–child relations [5]. There is also some evidence that ADHD may be linked to negative health behaviors [6] and worse health outcomes [7] including an increased risk for suicidal behavior [8]. In turn, this might be one consequence of the poorer quality of life that has been reported in children with ADHD [9].

Comorbid disorders may also exacerbate the negative outcomes associated with ADHD [10]. Comorbidity is highly prevalent in children and adolescents with ADHD with an earlier study from the United States reporting that as many as 67% of these children had at least one comorbid disorder [11]. Moreover, research has shown that both internalizing (e.g., mood and anxiety disorders) and externalizing disorders (e.g., conduct disorder, oppositional defiant disorder) are common in this population [11–13] and may increase the risk for a variety of other adverse outcomes including social problems [14], poorer social skills [15], somatic complaints and aggressive behavior [16]. Although it is uncertain what underlies the association between ADHD and comorbid conditions, it is unlikely to be only due to overlapping diagnostic criteria [17]. Rather, it has been hypothesized that various pathways may link ADHD and comorbid disorders that might reflect for example, a mix of genetic and environmental risk factors [18].

Building on earlier research the current study will examine the role of community violence exposure in the association between ADHD symptomatology and depressive symptoms in adolescents. There are several reasons why such research is warranted. First, depression is highly comorbid with ADHD with the results of a meta-analysis indicating that the odds of co-occurring depression are 5.5 times higher in children and adolescents with ADHD [17]. Second, there is some evidence that co-occurring depression may be highly disabling in adolescents with ADHD and has been linked to numerous negative outcomes including an increased risk of suicidality [18, 19]. Determining what factors are associated with comorbid depression might therefore be important for interventions to reduce these detrimental effects. Third, although there have been several studies that have looked at family, environmental and other factors that may be associated with ADHD-depression comorbidity [20–22], to the best of our knowledge, as yet, there has been no specific focus on community violence exposure. This may be an important omission. Recent studies have indicated that the prevalence of neighborhood violence exposure may be significantly higher in children with ADHD [23] and that witnessing and experiencing violence are associated with a higher number of parent-reported ADHD symptoms in children [24], while in an earlier study, a victimization trauma variable that included community violence was associated with a significantly increased risk for lifetime depression in adolescents with ADHD [25]. Importantly, other research among community-based adolescents without ADHD has indicated that both witnessing and being a victim of violence are associated with an increased risk for current and future depression [26–28].

Given this, the aim of this study was to examine community violence exposure and its association with depression in both ADHD and non-ADHD adolescents. In particular, we sought to determine if adolescents with ADHD symptoms who either do or do not experience community violence are at an increased risk for depression compared to non-ADHD adolescents not exposed to community violence. Based on previous research in both ADHD and non-ADHD populations, it was hypothesized that both witnessing and victimization would be linked to depression in adolescents both with and without ADHD symptoms.

Method

Study participants

The data used in this study came from the Social and Health Assessment (SAHA). This study was undertaken in Arkhangelsk, a medium-sized city in the northwest part of European Russia (population, 356,000). Details of the study procedure have been presented in an earlier publication [29]. A representative sample of students aged 12–17 from the 30,000 youths in this age range in the city was selected using a two-stage sampling procedure. In the first stage, 14/71 schools from the city's 4 districts that contained 210 classes in the 6–11 grade range were randomly selected and student reports were obtained. In the second stage, data were collected from teachers in a subsample of 20 randomly selected classes. In the current study, data were used from 505 adolescents [mean age 14.37 (SD = 0.96) 52.3% female] who had complete information in terms of teacher-reported ADHD symptoms and self-reported community violence exposure.

Measures

Depressive symptoms (dependent variable)

Depressive symptoms were assessed using an adapted version of the Center for Epidemiologic Studies-Depression Scale (CES-D) [30]. The final version contained 10 negative statements, e.g., 'I felt like crying', 'I felt really down', 'I have lost my interest in other people or things'. Respondents reported on the presence of depressive symptoms in the past month using a three-point scale: not true (scored 0), somewhat true (1) and certainly true (2). Scores could range between 0 and 20 with higher scores indicating increased depressive symptoms. The internal reliability of the scale was good (Cronbach's alpha = 0.84). In an attempt to capture those with the most severe depressive symptoms, in this study we followed the lead of an earlier study [31], where the depression scale was dichotomized, so that those who were in the top quintile of scores were classified as having depressive symptoms (coded 1).

Independent variables

ADHD symptoms were based on teacher-rated symptoms of inattention, hyperactivity and impulsivity. In the current study, we used teacher reports of inattention and hyperactivity–impulsivity symptoms in the previous 6 months obtained with a shortened version of the ADHD Rating Scale-IV [32] which uses the 12 best teacher-rated predictor items for a clinical diagnosis of ADHD [33]. Items are rated on a 4-point scale from never (scored 0) to almost always (scored 3) to give a total score that can range from 0 to 36 with higher scores indicating increased ADHD symptomatology (Cronbach's alpha = 0.94). Given that some previous research has indicated that ADHD symptoms may be highly prevalent in some child populations [34], in the current study, the ADHD variable was dichotomized with those who were in the top 20% of scores classified as having ADHD symptoms. *Witnessing and being a victim of community violence* was measured using two scales that were derived from items developed by Richters and Martinez [35]. Students were asked about the 'things that may happen to people in some neighborhoods'. Specifically, they were asked about events they had seen or experienced in the past year, e.g., 'I have seen…someone else being chased by gangs or individuals', 'I have been…chased by gangs or individuals.' There was a five-point response scale that ranged from 'none' (scored 0) to 10 + times (scored 4). In this study, those who experienced any form of victimization or who witnessed any community violence were each scored 1, while students not witnessing or experiencing community violence were each scored 0.

Covariates

These included the child's *age* (continuous variable) and *gender. Parental education* was divided into those parents with a college education (1 or both parents) and those parents where neither parent had a college education. Given the large number of children who did not know about their parents' educational level, we also included a missing variable to keep as many children in the analysis as possible. *Family structure* contained four categories: children living with both biological parents, those living in single-parent households, those in extended families (biological parents and biological relatives, e.g., grandparents) or children living in other types of family unit (e.g., residing with stepparents). *Parental warmth* was assessed with 5 items that enquired about students' perceptions of their parents' warmth and support, e.g., 'my parents…show their love for me'. Answer options ranged from never (scored 1) to often (scored 4). The scale score ranged from 5 to 20 with higher scores indicating greater parental warmth (Cronbach's alpha = 0.81). *Teacher support* was assessed with five positively worded statements, e.g., 'teachers are willing to help students'. Answer options ranged from 'Definitely not true' (scored 1) to 'Definitely true' (scored 4). The total scale score could range from 5 to 20 with higher scores indicating greater teacher support (Cronbach's alpha = 0.71). *Conduct problems* were measured with 6 items that assessed past year relatively mild behavior problems, e.g., 'During the past year, how many times have you…shoplifted from a store?' Answer options ranged from never (scored 0) to 5 or more times (scored 4). The total scale score could range from 0 to 24 with higher scores indicating greater conduct problems (Cronbach's alpha = 0.73). *Anxiety scores* were measured with 12 items which enquired about worrisome, preoccupying thoughts or unpleasant thoughts about oneself or external stimuli, e.g., 'I feel nervous when I get called on in class'. Answer options were 'not true' (scored 0), 'somewhat true' (1), and 'certainly true' (2). The total scale score could range from 0 to 24 with higher scores indicating increased anxiety (Cronbach's alpha = 0.86). To capture those with the most severe anxiety symptoms, this variable was dichotomized so that those in the top quintile were classified as having anxiety. Finally, posttraumatic stress symptoms (PTSS) were assessed with the Child Post-Traumatic Stress-Reaction Index (CPTS-RI) [36]. This measure contains 20 items that enquire about feelings and behaviors in the past month, e.g., 'Do you have bad dreams about someone dying or getting hurt or other scary things?', 'Do you sleep OK?' Answers are provided on a 5-point response scale ranging from never (scored 0) to most of the time (scored 4) (Cronbach's alpha = 0.87). In

line with the scoring recommendations, those who scored 25 and above were regarded as suffering from at least moderate PTSS.

Statistical analysis

Correlation coefficients were initially computed to explore the relations between the variables. Logistic regression analysis was then performed to examine the relationship between ADHD symptoms, community violence exposure and depression. Following the lead of an earlier study [37], four groups/variables were created to examine these relations: (1) non-ADHD children (i.e., those below the 80th percentile of ADHD symptom scores) who had not witnessed/been victimized by violence (reference); (2) non-ADHD children who had witnessed/been victimized by violence; (3) children with ADHD symptoms who had not witnessed/been victimized by violence; (4) children with ADHD symptoms who had witnessed/been victimized by violence. Two analyses were performed. A univariable analysis was initially performed where only the relation between ADHD symptoms and community violence exposure was examined. A multivariable analysis was then performed where these associations were examined while controlling for a range of variables. All analyses controlled for the presence of school site. Results are presented as odds ratios (OR) with 95% confidence intervals. A value of $p < .05$ was considered as being statistically significant. All analyses were performed with the Statistical Package for the Social Sciences (SPSS) version 21.

Results

There was no difference in age between those classified as having or not having ADHD symptoms ($p = .960$) although there were significantly more boys in the ADHD group ($74 > 33$, $p < .001$). There was no difference between the groups in terms of the level of parental education ($p = .544$) or family structure ($p = .424$). A series of Mann–Whitney *U* tests showed that children in the ADHD group were significantly more likely to witness ($p = .024$) and to be victimized by violence ($p = .002$) and engage in problematic conduct ($p < .001$), while they also had a lower level of teacher support ($p = .007$) (Table 1). ADHD symptoms were positively correlated with both forms of community violence exposure and conduct problems, and negatively correlated with parental warmth. Both forms of community violence exposure were significantly associated with PTSS and depression.

In the univariable logistic regression analysis, those adolescents with ADHD symptoms who witnessed violence had 3.5 times higher odds for depressive symptoms (OR 3.50, 95% CI 1. 67–7.33) compared to non-ADHD students who

Table 1 Variable scores and correlation coefficients

	1	2	3	4	5	6	7	8	9	10	
1. ADHD symptoms	1										
2. Age	−0.031	1									
3. Witness violence	0.118**	0.132**	1								
4. Violence victimization	0.111*	0.034	0.480**	1							
5, Parental warmth	−0.099*	−0.158**	−0.167**	−0.050	1						
6. Teacher support	−0.049	−0.019	−0.093	−0.150**	0.129**	1					
7. Conduct problems	0.218**	0.143**	0.273**	0.235**	−0.134**	−0.242**	1				
8. PTSS	−0.060	−0.021	0.273**	0.414**	−0.055	−0.163**	0.196**	1			
9. Anxiety	−0.080	0.009	−0.026	0.005	0.057	0.075	−0.025	0.290**	1		
10. Depression	0.043	0.129**	0.154**	0.184**	−0.181**	−0.014	0.226**	0.498**	0.320**	1	
ADHD: M (SD)	19.71 (5.30)	14.36 (1.02)	2.86 (4.09)	0.91 (1.77)	15.54 (3.57)	13.15 (3.26)	5.67 (5.42)	19.76 (13.35)	11.75 (5.75)	5.81 (4.91)	
Non-ADHD: M (SD)	5.28 (4.20)	14.38 (0.95)	1.88 (3.25)	0.49 (1.28)	16.11 (3.37)	14.05 (3.09)	3.59 (4.29)	20.90 (12.60)	12.92 (5.27)	5.53 (4.09)	

PTSS posttraumatic stress symptoms

*Correlation is significant at the 0.05 level (two-tailed)

**Correlation is significant at the 0.01 level (two-tailed)

Table 2 Association between ADHD symptomatology, community violence exposure and depressive symptoms in Russian adolescents

	Witness community violence		Victimization by community violence		
	OR (95% CI)	*p* value		OR (95% CI)	*p* value
Univariable analysis					
Independent variable					
Non-ADHD-not witness	1.00		Non-ADHD-no victimization	1.00	
Non-ADHD-witness	1.49 (0.81–2.75)	0.203	Non-ADHD-victimization	**2.17 (1.13–4.13)**	**0.019**
ADHD-not witness	0.76 (0.21–2.78)	0.681	ADHD-no victimization	1.29 (0.58–2.90)	0.535
ADHD-witness	**3.50 (1.67–7.33)**	**0.001**	ADHD-victimization	**4.09 (1.87–8.95)**	**<0.001**
Multivariable analysis					
Independent variable					
Non-ADHD-not witness	1.00		Non-ADHD-no victimization	1.00	
Non-ADHD-witness	0.77 (0.30–2.02)	0.599	Non-ADHD-victimization	1.12 (0.42–3.01)	0.820
ADHD-not witness	0.98 (0.15–6.57)	0.985	ADHD-no victimization	1.48 (0.38–5.84)	0.576
ADHD-witness	2.66 (0.75–9.42)	0.130	ADHD-victimization	**4.67 (1.33–16.35)**	**0.016**
Covariates					
Age	**1.69 (1.08–2.64)**	**0.021**	Age	**1.64 (1.06–2.53)**	**0.025**
Gender (male)	0.49 (0.21–1.11)	0.086	Gender (male)	0.45 (0.20–1.03)	0.058
Parental education			Parental education		
College educated	1.00		College educated	1.00	
Non-college educated	0.97 (0.36–2.59)	0.948	Non-college educated	1.03 (0.38–2.79)	0.948
Family structure			Family structure		
Both biological parents	1.00		Both biological parents	1.00	
Single parent	0.84 (0.25–2.80)	0.771	Single parent	0.75 (0.21–2.63)	0.649
Extended	0.45 (0.05–4.24)	0.482	Extended	0.39 (0.04–3.97)	0.426
Other	1.75 (0.74–4.18)	0.206	Other	1.70 (0.71–4.06)	0.236
Parental warmth	**0.88 (0.79–0.98)**	**0.023**	Parental warmth	**0.89 (0.80–0.99)**	**0.032**
Teacher support	1.06 (0.94–1.21)	0.330	Teacher support	1.09 (0.96–1.23)	0.208
Conduct problems	1.06 (0.98–1.15)	0.134	Conduct problems	1.05 (0.97–1.14)	0.253
Anxiety	1.59 (0.64–3.92)	0.315	Anxiety	1.94 (0.79–4.75)	0.148
PTSS	**7.92 (3.53–17.78)**	**<0.001**	PTSS	**8.44 (3.73–19.07)**	**<0.001**

Statistically significant results are shown in bold font

PTSS posttraumatic stress symptoms

did not witness violence (Table 2). However, in the fully adjusted multivariable analysis, this association became non-significant (OR 2.66, 95% CI 0.75–9.42). In contrast, adolescents with PTSS had almost 8 times higher odds for experiencing depression (OR 7.92, 95% CI 3.53–17.78). Increasing age was associated with significantly increased odds for depression (OR 1.69, 95% CI 1.08–2.64), while a higher level of parental warmth was protective against depressive symptoms (OR 0.88, 95% CI 0.79–0.98). An additional analysis showed that the PTSS variable mediated the witnessing violence-depressive symptoms association in students with ADHD symptoms when included in the univariable model (OR 2.18, 95% CI 0.90–5.31, $p = .084$) (data not shown). Among those victimized by violence, in the univariable analysis, both non-ADHD and ADHD students victimized by violence had significantly increased odds for depression (non-ADHD OR 2.17, 95% CI 1.13–4.13; ADHD OR 4.09, 95% CI 1.87–8.95). In the multivariable model, only those victims with ADHD symptoms continued to have significantly higher odds for depression (OR 4.67; 95% CI 1.33–16.35). As in the analysis for witnessing community violence, in the fully adjusted multivariable model PTSS, increasing age and parental warmth were, respectively, associated with significantly increased and decreased odds for experiencing depressive symptoms.

Discussion

This study examined the association between ADHD symptomatology, community violence exposure and depression. Adolescents with ADHD symptoms were significantly more likely to both witness and be victims of community violence. In univariable logistic regression analyses, having ADHD

symptoms alone was not associated with higher odds for depression. Rather, adolescents with ADHD symptoms who had both witnessed and been victimized by community violence had significantly higher odds for depressive symptoms compared to those without ADHD symptoms and not exposed to community violence. However, in the multivariable analyses, only those adolescents with ADHD symptoms who were directly victimized by violence continued to be at an increased risk for depression.

Although the average community violence exposure scores were low, the finding that adolescents with ADHD symptoms were significantly more likely to both witness and be victims of community violence accords with earlier research that has linked ADHD with greater neighborhood violence exposure [23] and with a recent study from Spain which has indicated that experiencing victimization may be common in adolescents with ADHD [38]. This suggests that those with ADHD symptoms may be more likely to live in communities with higher levels of violence although a recent study reported that ADHD prevalence and severity in children were not associated with neighborhood disorder [39]. Alternatively, it is possible that those with ADHD symptoms had higher community violence exposure because they themselves engage in more delinquent/violent behavior. Previous research has indicated that children with ADHD may have an increased likelihood of engaging in high levels of aggressive behavior [40] and that ADHD symptoms are linked to violent delinquency in youth, even though there is some evidence that this relation may be primarily mediated by other factors such as conduct disorder [41], which was also linked to ADHD symptoms in this study.

In univariable logistic regression analyses, both witnessing and being a victim of community violence were associated with significantly increased odds for depression in adolescents with ADHD symptoms compared to a reference group without ADHD symptoms or violence exposure. This finding accords with the results of a meta-analysis that showed that both forms of community violence exposure were associated with internalizing symptoms in non-ADHD children and adolescents [42], while another study found that children aged 7 to 12 with clinically significant depressive symptoms were more likely to have both witnessed and been victims of community violence [43]. However, in the multivariable analyses, witnessing violence was no longer significantly associated with depression. This also corresponds with the results from other studies which found that witnessing violence was not positively linked to depression in children and adolescents [44] and that the association with distress/depression may depend on who the actual victim of the violence is [28, 45]. In the current study, however, an additional analysis showed that the association was mediated by PTSS. This is an important finding given that it has not only been suggested that in terms of mental health, community violence exposure is most strongly associated with posttraumatic stress disorder (PTSD) [42] but because previous research has shown that PTSS/PTSD symptomatology may mediate the association between violence exposure and depression in adolescents [46, 47]. This highlights that timely therapeutic interventions with victims of violence exposure to reduce the trauma and stress associated with these experiences may be important for preventing the development of subsequent psychopathology [47].

In the multivariable analysis being a victim of community violence continued to be associated with significantly higher odds for depression in adolescents with ADHD symptoms even after controlling for PTSS and other covariates. This supports the results from earlier studies showing a stronger association between victimization and internalizing symptoms/depression than for witnessing violence [42, 48]. An extended discussion of how being a victim of community violence may lead to depression in adolescents with ADHD symptoms is beyond the scope of this study although several mechanisms that have been hypothesized as linking violence/trauma and psychopathology in community-based adolescents more generally might be involved. For example, victimization may impact on the adolescent's belief that their environment is safe, controllable and predictable [49] and result in increased fear, a feeling of chronic threat and changes in behavior [50]—which together might negatively impact on mental health. A recent study has also suggested that trauma exposure may result in enhanced threat processing as seen in social information processing biases, altered emotional learning, heightened emotional reactivity and emotional regulation difficulties that might increase the risk for internalizing outcomes [51]. Other changes resulting from violence might also be important in this context. Earlier research linked community violence exposure to sleep disturbance in adolescents [52], while a recent study found that sleeping problems are associated with depression in children and adolescents with ADHD [53].

Several study limitations must be discussed. The specific study design meant that we were not able to examine sex differences in the observed associations. Additional analyses were conducted but models did not converge due to the low number of females in the ADHD symptoms group. This is an important limitation given that gender differences may exist in both exposure to community violence [48] and depression [54]. An urgent task for future research will be to thus examine these associations in boys and girls with ADHD. We also used a common dichotomization standard for possible ADHD regardless of age. However, by not using the percentile of the RS table by age group, it is possible that this may have resulted in the misclassification of some children. We relied on adolescents' own reports of exposure to community violence without being able to verify the accuracy of this information. This may have resulted in reporting bias as an earlier study found that

socially desirable responding was linked to reports of lower community violence exposure in children [55]. There is also some evidence that children who are exposed to community violence might also be at greater risk for experiencing family violence [35, 56] which might also be important for mental health but we had no information on this issue. In addition, we also had no access to clinical data on such things as whether any of the children had an ADHD diagnosis, other psychiatric comorbidities or physical illnesses which might have been relevant for the observed associations. Important details on the specific nature of the violent events such as who was involved, where the events took place, and on their immediate effect that would have helped us to better understand these events' impact were also not available [57]. Finally, as this study was cross-sectional, it was not possible to establish causal relations.

This study showed that (higher) ADHD symptoms alone were not associated with higher odds for depression. Rather, it provides preliminary evidence that community violence exposure may be an important environmental risk factor for depression in children with ADHD symptoms. Given that there is evidence that the effects of violence exposure on mental health can be long lasting in adolescents [58], this highlights the importance of further research to gain a better understanding of community violence exposure in adolescents with ADHD/ADHD symptoms because as yet, comparatively little is known about this phenomenon. The results of this study also suggest that it might be beneficial for both teachers and clinicians to enquire about experiences of community violence among children with ADHD/ADHD symptoms so these experiences and their effects can be detected and addressed as early as possible.

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Compliance with ethical standards

Conflict of interest The authors declare they have no conflict of interest.

Ethical standards Prior to being included in the study informed consent was obtained from all participants. The study was approved by the institutional review committee at the Northern State Medical University, Arkhangelsk, Russia. The study was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

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