


# Aerophagia in adolescents is associated with exposure to adverse life events and psychological maladjustment

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## Abstract

**Background:** Aerophagia is a common childhood functional gastrointestinal disorder. We studied the association between adverse life events (ALEs), psychological maladjustment, somatization, and aerophagia (AP) in adolescents. We also assessed the impact of AP on their health-related quality of life (HRQoL).

**Methods:** A cross-sectional survey was conducted on 2500 subjects of 13-18 years in 8 randomly selected schools in Sri Lanka. Translated, validated, and self-administered questionnaires were used to collect data. Aerophagia was diagnosed using Rome III criteria.

**Key Results:** A total of 2453 questionnaires were analyzed (males 1200 [48.9%], mean age 14.8 years, SD 1.6 years). Of them, 371 adolescents had AP (15.1%). Aerophagia was associated with exposure to physical abuse (20.4% vs. 12.7% in controls,  $P < .0001$ ), emotional abuse (20.3% vs. 8.2% in controls,  $P < .0001$ ), and other ALEs (22% vs. 10.2% in controls,  $P < .001$ ). One hundred and ninety (51.2%) adolescents with AP and 775 (37.2%) controls had a personality score above the international cut-off value of 105, indicating psychological maladjustment (odds ratio 1.77, 95% confidence interval 1.42-2.21,  $P < .0001$ ). Those with AP had higher somatization (16.4 vs. 8.9) and lower overall HRQoL scores (77.0 vs. 85.1,  $P < .0001$ ). HRQoL scores of adolescents with AP were lower in all domains, namely, physical (80.6 vs. 86.9), emotional (69.1 vs. 80.3), social (83.8 vs. 90.5), and school (72.6 vs. 82.5) functioning ( $P < .0001$ ).

**Conclusions and Inferences:** Aerophagia was associated with exposure to ALEs and psychological maladjustment. Affected teenagers suffer from more somatic symptoms and has a poor HRQoL.

## KEYWORDS

air swallowing, child maltreatment, personality traits, quality of life

## 1 | INTRODUCTION

Aerophagia (AP) is a functional gastrointestinal disorder characterized by increased intraluminal air in the gastrointestinal tract due to repetitive and excessive swallowing of air. Several epidemiological surveys have proved that it is a common disorder among children. In a previous survey conducted in Sri Lanka,

7.5% of school children had AP.<sup>1</sup> More recent studies from South America noted that the prevalence ranges from 0.5% in El Salvador to 2.6% in Ecuador.<sup>2,3</sup> In another study from Greece, 0.8% of children had AP.<sup>4</sup> Although air swallowing and abdominal distension appear to be benign, in severe cases it is known to lead to grave complications such as volvulus of the colon and even intestinal perforation.<sup>5,6</sup>

Etiology of this disorder remains obscure. Initial studies have suggested that AP is common among neurologically handicapped children and those with learning difficulties.<sup>7,8</sup> We have previously reported that children faced with stressful life events have a higher tendency to develop AP.<sup>1</sup> Hulb et al, using multichannel intra-esophageal impedance studies, have shown that children with AP have increased air swallowing and *supra*-gastric belching.<sup>9</sup> However, we believe that in otherwise healthy children, AP could mainly be due to psychological disturbances and like many other functional gastrointestinal disorders, also leads to significant suffering.

In this study, we aimed to study the association between adverse life events, psychological maladjustment and somatic symptoms of children with AP and its effects on health-related quality of life (HRQoL).

## 2 | METHODS

### 2.1 | Selection of the sample and initial preparation

We conducted a school-based cross-sectional survey involving 4 randomly selected districts of Sri Lanka to study possible associations between functional gastrointestinal disorders, psychological maladjustment, adverse life events, HRQoL, and somatic symptoms. The study was started in 2014 and completed in 2015. From each district, we selected 2 schools from the list of schools available from the zonal education offices. All adolescents aged between 13 and 18 years in the selected schools were included in the sample frame. A sample of 470 adolescents was required to obtain a 95% confidence interval of  $\pm 2\%$  around a prevalence estimate of 5%.

At the planning stage, research assistants visited all selected schools. The questionnaires used in the study were discussed with the school authorities and approval was obtained. Teachers were in agreement that the questionnaires were appropriate for use in adolescents.

### 2.2 | Data collection

We visited each selected school 2 days prior to the data collection date and handed over the information sheet and consent forms to be taken home. Parents were requested to read the information sheet and provide the consent to include their children in the study. Upon return, all consent forms were checked, and those who received written informed consent from parents or the guardian to participate were included into the study. In addition, assent was obtained from all participants of the study before filling the questionnaire.

Questionnaires were answered by the students in their classrooms. All students filled their questionnaire seated in an examination setting. Tables were placed significantly apart to avoid cross-talks and possible copying of the answers. Therefore, students could not see the questionnaires of each other. Class teachers were only present at the beginning of the distribution of questionnaires to introduce the purpose of the study and to introduce the research assistants. They moved out of the classroom before students started filling the questionnaire. Distribution of questionnaires and collection of them at the

#### Key Points

- Aerophagia is a common functional gastrointestinal disorder and its etiological associations and impact are not well known.
- Adolescents with aerophagia have been exposed to physical and emotional maltreatment and adverse life events. They also have abnormal personality traits leading to psychological maladjustment and are suffering from a large number of somatic symptoms. Aerophagia is associated with a significant reduction in health-related quality of life.
- Our findings justify assessment of psychological status of children with aerophagia and screening them for potential child maltreatment and somatic symptoms. In addition, novel therapeutic options need to be explored to minimize their suffering.

end were undertaken by the research assistants. They supervised students during data collection, and clarified any doubts.

The following questionnaires were used for collection of data. All data collection tools have been previously used in studies in Sri Lankan children/adolescents.

#### 2.2.1 | Questionnaire on childhood functional gastrointestinal diseases

This questionnaire was based on the Rome III diagnostic questionnaire for pediatric functional gastrointestinal diseases.<sup>10</sup> This questionnaire has been previously translated into native languages and has undergone validation.

#### 2.2.2 | Child adverse life event inventory

The questionnaire on child adverse life events (ALE) contained a set of questions to identify adverse life events faced by children, which included child maltreatment. It had questions to identify all 3 forms of child abuse, namely physical, sexual and emotional abuse. All the examples of a particular type of abuse and frequency of abuse were included in the questionnaire in an itemized manner.

#### 2.2.3 | Childhood personality assessment questionnaire (Child PAQ)

The PAQ is a self-administered instrument to assess psychological maladjustment. It assesses an individual's perception of him/herself with respect to 7 behavioral dispositions (hostility and aggression, dependency, negative self-esteem, negative self-adequacy, emotional unresponsiveness, emotional instability, and negative world view).<sup>11</sup>

The Child PAQ has 6 items for each of the 7 behavioral dispositions. All 42 items are arranged in a cyclical order. The Child PAQ asks respondents to reflect on their true, rather than their ideal or wished

feelings about themselves. The response options available are: (1) almost always true of me; (2) sometimes true of me; (3) rarely true of me; and (4) almost never true of me. The child was asked to indicate how he/she really feels in response to each of the items and to tick the appropriate response option. By summing up the scores of each of the 7 scales, an overall assessment of the level of personality development of the respondent was made. Higher total scores reflect poorer personality development. In compliance with the world literature, scores at or above 105 were delineated to indicate problems in personality development.<sup>11</sup> A meta-analysis of the instrument involving 9 studies had revealed a full-scale mean alpha of 0.83, allowing for the full-scale's confident use in research, clinical, and applied settings.<sup>12</sup>

The Sinhala version was developed using the internationally accepted translation and back translation method. The content validity and consensual-related validity were in the acceptable ranges. The kappa value of the agreement between the clinician's rating and PAQ was 0.37 ( $P < .001$ ), which shows that there was significant agreement between the two.<sup>12</sup>

### 2.2.4 | Pediatric health-related quality of life inventory (PedsQL)

PedsQL is a tool used to assess HRQoL in children. We used the Quality of Life Inventory for teenagers of the age 13-18 years.<sup>13</sup> It is a self-reported questionnaire and has been validated for the relevant age group. We obtained the translated and validated version of the Sinhala questionnaire from the MAPI institute with permission to use it for this particular research venture. The inventory has 23 items and encompasses physical (8 items), emotional (5 items), social (5 items), and school functioning (5 items). A 5-point response scale is used (0 = never a problem; 4 = almost always a problem). Items were reverse scored and linearly transformed to a 0-100 scale (0 = 100, 1 = 75, 2 = 50, 3 = 25, 4 = 0) with higher scores indicating better health-related quality of life. Final HRQoL scores were computed out of 100.

### 2.2.5 | Somatization inventory

Child Somatization Inventory (CSI) is designed to assess somatic symptoms and their severity. There were 24 somatic symptoms on a scale ranging from 0 (not at all) to 4 (a whole lot). The number of somatic symptoms and the total scores (calculated by summing up of the scores given by the study participant for all 24 symptoms) were taken into account when the final score was calculated.<sup>14</sup>

## 2.3 | Diagnostic criteria

Adolescents who had 2 of the following 3 criteria were diagnosed as having AP according to the Rome III criteria.<sup>15</sup>

1. Air swallowing
2. Abdominal distension because of intraluminal air
3. Repetitive belching and/or increased flatus.

Two out of above 3 criteria need to be fulfilled at least once a week for minimum of 2 months.

Each form of child abuse was defined using the definition provided by the World Health Organization.<sup>16</sup> Children were considered as abused if they had been exposed to physical and emotional abuse even occasionally, and at least once for any form of sexual abuse.

## 2.4 | Statistical analysis

Data from all 8 schools were pooled for the initial analysis. PSPP version 0.8.3-g5f9212 statistic software (Free Software Foundation, Inc., Boston, USA, <http://fsf.org/>) was used in data analysis. Chi-squared test was used to analyze the association between AP and ALE using this software. Multiple logistic regression analysis was performed on variables which had significant association in univariate analysis. Means and standard deviations were calculated for data obtained for HRQoL, PAQ, and somatization index and were compared using unpaired t test.  $P$  values were two-sided and the statistical significant level was defined as  $P < .05$ .

## 2.5 | Ethical approval

Ethics Review Committee of the Faculty of Medicine, University of Kelaniya, Sri Lanka approved the study protocol.

# 3 | RESULTS

## 3.1 | Characteristics of the sample

A total of 2500 questionnaires were distributed and 2453 properly filled questionnaires were included in the final analysis (males 1200 [48.9%], mean age 14.8 years, SD 1.6 years). Of them, 371 (15.1%) adolescents (194 boys 52.2%) had AP. The mean age of adolescents with AP was 15.1 years (SD 1.9 years). They were compared with 2082 of adolescents without AP who served as controls.

## 3.2 | Exposure to child abuse and other ALEs

Table 1 shows data on the association between AP and exposure to all 3 forms of child abuse and other ALEs. Physical abuse (42% in AP vs. 29.2 in controls  $P < .0001$ ) and emotional abuse (78.8% vs. 53.7,  $P < .0001$ ) had statistically significant association with aerophagia. In addition, exposure ALEs were also significantly more common in children with AP.

After multivariate analysis, adolescents who faced physical abuse (adjusted odds ratio [OR] 1.38, [95% confidence interval (CI) 1.08-1.74],  $P = .008$ ) and emotional abuse (adjusted OR 2.66, [95% CI 2.04-3.46],  $P < .0001$ ) were significantly associated with AP. In addition, other adverse life events, namely adolescents staying in a hostel (adjusted OR 1.94, [95% CI 1.14-3.29],  $P = .01$ ), father's alcoholism (adjusted OR 1.73, [95% CI 1.29-2.32],  $P < .0001$ ), and violent confrontations with neighbors (adjusted OR 2.07, [95% CI 1.53-2.81],  $P < .0001$ ) were significantly associated with AP.

**TABLE 1** Adverse life events in children with aerophagia

Adverse life event	Aerophagia number (%)	Controls number (%)	P value <sup>a</sup>
Physical abuse	156 (42)	609 (29.2)	<.0001
Emotional abuse	285 (78.8)	1118 (53.7)	<.0001
Sexual abuse	5 (1.3)	38 (1.8)	.52
Parents living away from home	56 (15.1)	216 (10.4)	.0008
Child staying in a hostel	22 (5.9)	59 (2.8)	.002
Child living in another house	57 (15.3)	238 (11.4)	.032
Father abusing alcohol	93 (25.1)	289 (13.9)	.007
Father abusing substance other than alcohol	42 (11.3)	151 (7.2)	<.0001
Family violence with neighbors	77 (20.8)	201 (9.6)	<.0001
Child earning for the family	25 (6.7)	144 (6.9)	.9
Exposure to at least one adverse life events	226 (60.9)	803 (36.8)	<.0001

<sup>a</sup>Chi-squared test.

### 3.3 | Psychological maladjustment

One hundred and ninety (51.2%) adolescents with AP and 775 (37.2%) controls had a total personality score above the international cutoff value of 105. This indicated psychological maladjustment (odds ratio 1.77, 95% confidence interval 1.42-2.21,  $P < .0001$ , chi-squared test). Table 2 shows the scores obtained for all 7 individual personality traits. The data showed that adolescents with AP had significantly higher scores for each personality type compared to controls.

### 3.4 | Somatization

In Table 3, we have included the symptoms of the somatization inventory. When compared to the control group adolescents suffering from AP were noted to suffer from a large number of somatic symptoms. The total somatization score of adolescents with AP is also significantly higher than the controls (16.5 in AP and 11.5 in controls,  $P < .0001$ ).

### 3.5 | HRQoL

Figure 1 depicts all four domains of HRQoL and the total HRQoL score for adolescents with AP and controls. Adolescents with AP had lower scores for all 4 domains and the total score compared to the controls.

**TABLE 2** Scores obtained for different personality types that indicate psychological maladjustment in children with aerophagia

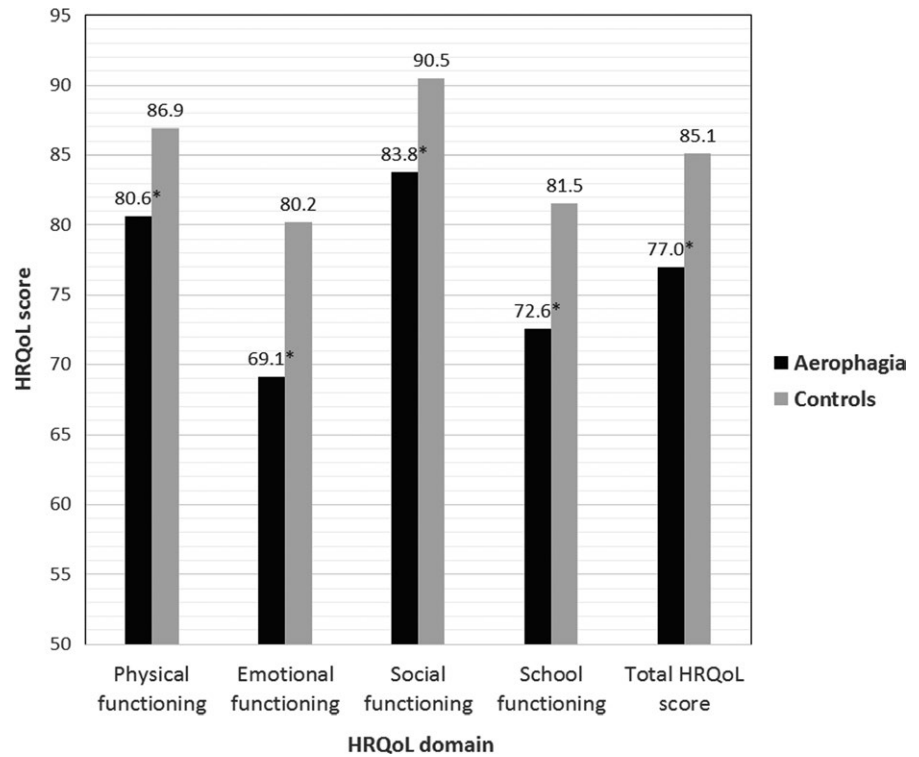
	Aerophagia Mean (SD)	Controls Mean (SD)
Hostility and aggression	14.8 (4.0)**	13.9 (4.7)
Dependency	15.2 (7.0)*	14.1 (6.6)
Negative self-esteem	14.7 (2.5)*	14.3 (2.5)
Negative self-adequacy	14.8 (2.8)**	14.0 (3.1)
Emotional unresponsiveness	14.8 (3.5)**	13.9 (3.6)
Emotional instability	14.9 (3.7)**	13.9 (3.9)
Negative world view	14.8 (2.8)**	13.9 (3.2)
Total personality score	103.9 (18.3)**	98.2 (18.9)

\* $P < .05$ , \*\* $P < .001$ , Unpaired t test.

**TABLE 3** Somatization scores for children with aerophagia and controls

Somatic symptom	Aerophagia Mean (SD)	Controls Mean (SD)	P values <sup>a</sup>
Headache	1.78 (0.99)	1.33 (0.98)	<.0001
Faintishness or dizziness	0.66 (0.88)	0.43 (0.71)	<.0001
Pain—heart of chest	0.94 (1.03)	0.51 (0.81)	<.0001
Low energy, slowed down	0.91 (0.98)	0.60 (0.81)	<.0001
Pain—lower back	0.95 (1.13)	0.54 (0.88)	<.0001
Sore muscles	1.04 (1.04)	0.60 (0.69)	<.0001
Trouble getting breath	0.62 (0.91)	0.30 (1.2)	<.0001
Hot or cold spells	0.89 (0.99)	0.55 (0.82)	<.0001
Numbness or tingling	0.91 (0.94)	0.54 (0.77)	<.0001
Weakness	1.01 (1.01)	0.54 (0.79)	<.0001
Heavy feeling in arms, legs	0.42 (0.82)	0.17 (0.52)	<.0001
Nausea, upset stomach	0.68 (0.91)	0.29 (0.64)	<.0001
Difficulty in defecation	0.44 (0.81)	0.16 (0.46)	<.0001
Loose bowel movements, diarrhea	0.33 (0.75)	0.10 (0.39)	<.0001
Pain—stomach	0.94 (1.16)	0.62 (0.99)	<.0001
Heart beating too fast	0.56 (0.90)	0.7 (1.00)	<.0001
Difficulty in swallowing	0.50 (0.86)	0.28 (0.63)	<.0001
Losing voice	0.37 (0.75)	0.15 (0.49)	<.0001
Blurred vision	0.67 (1.01)	0.35 (0.75)	<.0001
Vomiting, throwing up	0.24 (0.59)	0.12 (0.39)	<.0001
Feeling bloated, gassy	0.66 (0.93)	0.22 (0.55)	<.0001
Food makes you sick	0.13 (0.45)	0.06 (0.30)	<.0001
Pain—Knees, elbows, joints	0.60 (0.89)	0.31 (0.68)	<.0001
Pain—arms, legs	1.17 (1.11)	0.65 (0.89)	<.0001
Total somatization score	16.45	8.9 (8.46)	<.0001

<sup>a</sup>Unpaired t test.



**FIGURE 1** Health-related quality of life in children with aerophagia

#### 4 | DISCUSSION

This is the first report in the literature of an analysis of the association between AP and a number of ALEs, psychological maladjustment, somatization, and HRQoL in a large cohort of adolescents. We found that adolescents with AP have faced significant number of ALEs including physical and psychological abuse. In addition, these adolescents also have a number of abnormal personality traits leading to psychological maladjustment. Aside from symptoms of AP, they are also suffering from a large number of somatic symptoms. Although outwardly it appeared to be benign, AP significantly affects the HRQoL of adolescents.

Prevalence of AP in this study is 15.5%, which is higher than what we found in one of our own previous studies, on young children (7.5%).<sup>1</sup> In that study, we included children aged 10-16 years. The highest prevalence of AP was found in 15-year olds. Prevalence of AP in South America ranges from 0.5% to 2.6% and in Greece, it is 0.8%.<sup>2-4</sup> These studies have recruited younger children when compared to the current study and our previous study. This may possibly play a role in differences in the prevalence. In addition, younger children may have had difficulties in understanding the questions related to a diagnosis of AP possibly due to cultural and language differences. The possibility of increasing prevalence seen with age further strengthen by the finding from Drossman et al. They conducted a household survey of functional gastrointestinal symptoms and noted 24% of adults had symptoms of air swallowing.<sup>17</sup>

We found adolescents faced with ALEs have a higher tendency to develop AP. Exposure to physical and emotional abuse is clearly associated with AP. In previous studies, we have shown that abuse in any form predisposes children to develop functional constipation and

abdominal pain predominant functional gastrointestinal disorders.<sup>18,19</sup> However, in this study we did not find an association between AP and sexual abuse as in previous studies. The number of adolescents exposed to sexual abuse in this study is very low. That may have probably contributed to the lack of an association between sexual abuse and AP. In addition to the 3 major forms of abuse, other ALEs such as child living in a hostel, alcohol abuse by the father, and violent confrontation with neighbors are also independently associated with AP.

In this study, we noted that children with AP have abnormal personality traits leading to psychological maladjustment. They were more aggressive and hostile than controls. These adolescents had a negative view about themselves as indicated by poor self-esteem and negative self-adequacy. They were also emotionally disturbed as they were shown to be emotionally unresponsive and unstable. Furthermore, the adolescents with AP also have a negative world view and they also showed significant dependency. All these abnormal personality traits have led them to be psychologically maladjusted than the controls. It was noted that 51.2% of teenagers with AP were having psychological maladjustment according to the international cutoff value used in the analysis.

Abnormal personality traits and psychological maladjustment are known to occur in children with significant medical conditions. Previous studies have shown children who have undergone surgical procedures for severe congenital heart diseases had psychological maladjustment.<sup>20</sup> In addition, Boekaerts and Roder had also shown that children suffering from chronic severe asthma having psychological maladjustment.<sup>21</sup> Several studies have also noted that children traumatized by victimization and abuse are also psychologically maladjusted.<sup>22,23</sup> However, these studies were mainly conducted using the Child Behavior Checklist. Therefore, we cannot make a straight comparison. In a previous study, using the PAQ, in a different sample

of school children, we demonstrated that children with constipation had a higher degree of psychological maladjustment with similar personality traits.<sup>24</sup>

Somatic symptoms are an integral part of functional gastrointestinal disorders. In previous studies, we have shown that children with constipation and fecal incontinence do have a higher number of somatic symptoms and higher total somatization scores.<sup>25,26</sup> Similar to these findings, adolescents with AP also were suffering from a large number of somatic symptoms. In addition, the total somatization score of these adolescents with AP was significantly higher than the controls. This finding reiterates that somatic symptoms are an inseparable occurrence in functional gastrointestinal disorders, further aggravating their suffering.

Computation of HRQoL is a reliable way to assess the impact of a disease on individuals, especially, when there is no biomarker for the disease. As in the majority, AP is a self-limiting disease, we expect no major reduction of HRQoL in children with AP. Contrary to that hypothesis, children with AP had significantly lower scores for physical, emotional, social, and school domains. Furthermore, the total HRQoL score was also significantly low among them. Multiple factors including AP itself, facing adverse life events and abuse, multiple somatic symptoms and psychological maladjustment would have contributed to this. In previous studies, we have shown that children with several FGIDs (constipation, fecal incontinence, and abdominal pain predominant functional gastrointestinal disorders) have lower HRQoL.<sup>25-27</sup> In these studies, we noted that the total HRQoL of children with constipation, abdominal pain predominant functional gastrointestinal disorders, and fecal incontinence are 79.6, 83.8, and 74.6, respectively. The total HRQoL score for children with AP is 77.0 in the current study. These findings indicate that whether simple or complex, functional gastrointestinal disorders as a group leads to lowering of HRQoL in affected children and AP (particularly when associated with child maltreatment, adverse life events, somatization, and psychological maladjustment) has more devastating effects on HRQoL than some of the major functional gastrointestinal disorders such as functional constipation. Therefore, rather than reassuring that the symptoms will get better with time, these adolescents need realistic interventions to relieve their symptoms and improve their HRQoL.

Findings of this study have several implications. We noted that AP is significantly associated with psychological maladjustment and have serious repercussions on HRQoL of the affected individuals. AP is considered to be a benign and insignificant disease entity in children with no substantial consequences. However, our findings indicate otherwise. Both psychological maladjustment and lower HRQoL could lead to poor social relationships and poor school performance. This in turn affects the developmental and educational capabilities of these adolescents. This could possibly lead to poor earning capacity as adults. Therefore, it is imperative that clinicians caring children with AP pay undivided attention to these findings and optimize care for AP to minimize far reaching consequences of a disease which is generally thought to be harmless. Currently, the therapeutic options for AP is very limited and restricted to behavioral and psychotherapeutic measures and a number of instructions

that can minimize air swallowing.<sup>28</sup> Researchers also need to look for novel therapeutic modalities to eliminate the suffering and psychological consequences of AP.

There are several strengths of this study. We included a large sample in this study and data collection was done in an examination setting to ensure confidentiality and privacy. In addition, we used validated tools for data collection. However, in this questionnaire-based study, we did not conduct a physical examination or investigated children for potential co-existence of organic disorders. In addition, we did not assess other FGIDs in both control group and children with AP. Both groups are likely to have other FGIDs. However, we believe that the effects of other FGIDs could be similar in both groups and it would not have a major impact on our findings.

We would like to conclude by stating that AP is a malady which, although appearing on the surface to be a disease with no significant implications, is associated with psychological maladjustment and reduction of HRQoL. In addition, adolescents with AP have faced a number of ALEs including physical and emotional abuse. Their suffering, indicated by lower HRQoL, is potentially magnified by a large number of somatic symptoms and higher somatization scores, facing child maltreatment, and psychological maladjustment. These findings justify assessment of psychological status of children with AP and screening them for potential child maltreatment and somatic symptoms and actively looking for AP in children who may otherwise appear healthy as the detection of AP may unravel underlying psychological maladjustment and exposure to adverse life events. In addition, novel therapeutic options need to be explored to minimize their suffering.

#### CONFLICT OF INTEREST

No competing interests declared.

#### AUTHOR CONTRIBUTIONS

SR developed the concept, designed the study, contributed in data collection and drafted the first manuscript and approved the final script; SH contributed to design the study, and data entry, and approved the final script; IG contributed to design the study, and data entry, and approved the final script; NJ contributed to design the study, planning the data collection, data collection and approved the final script; SCS contributed to design the study, and data entry, and approved the final script; HKS contributed to design the study, and data entry, and approved the final script; RLS contributed to design the study, and data entry, and approved the final script; SA reviewed the manuscript and approved the final manuscript; NMD contributed to develop the concept, design the study, data collection, and data analysis and interpretation and review the manuscript with a significant intellectual input and approved the final script.

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