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CHRONIC ABDOMINAL PAIN AND DEPRESSIVE SYMPTOMS IN ADOLESCENTS: AN INSTITUTIONAL CROSS-SECTIONAL STUDY FROM PUDUCHERRY, INDIA

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Abstract:
Background & Aims: Abdominal pain is common in adolescence, yet the association between frequent abdominal pain and depressive symptoms remains poorly characterized in Indian adolescents. This study aimed to determine the prevalence of depressive symptoms in adolescents with frequent abdominal pain and examine associated functional impairments. Methods: A prospective cross-sectional study was conducted at the Department of Pediatrics, Sri Lakshmi Narayana Institute of Medical Science Medical College & Hospital, Puducherry, India. A total of 950 adolescents aged 13-18 years (mean age, 16.3 ± 1.8 years; 48% male) completed structured interviews and self-administered questionnaires. Depressed mood was assessed using the Center for Epidemiologic Studies Depression Scale (CES-D). Abdominal pain frequency over the previous year was categorized as rare (0-1 episode/week), occasional (2-3 episodes/week), or daily (>4 episodes/week). Results: Daily abdominal pain was reported in 4.8% of adolescents, with 15.3% reporting occasional pain. Overall, 18.2% of adolescents demonstrated significant depressive symptoms (CES-D score ≥23). The risk for depression increased dramatically from 4.5% with rare pain to 41.3% with daily pain ($p<0.001$), representing a 9-fold increase. Adolescents with daily pain were significantly more likely to miss school 10 or more days annually (43.5% vs. 18.5%, $p<0.001$), report reduced social participation, and experience multiple depressive symptoms including sadness, loneliness, and fatigue. Multivariate logistic regression identified daily pain as the strongest independent predictor of depression (adjusted OR=13.2, 95% CI: 6.1-28.6). Female adolescents demonstrated higher depression prevalence (21.4% vs. 14.8% in males), with a female-to-male ratio of 2.2:1 among those with daily pain and depression. Conclusions: Adolescents with frequent abdominal pain demonstrate substantially elevated risk for depressive symptoms and significant functional impairments in school attendance and social functioning. Chronic abdominal pain should be recognized as a pain syndrome with important psychosocial sequelae, warranting integrated multidisciplinary management including mental health screening and intervention. Early recognition and treatment may prevent progression to severe mood disorders and reduce long-term psychiatric morbidity.

Keywords: Abdominal pain, Depression, Adolescents, Functional impairment, School absenteeism

INTRODUCTION

Abdominal pain represents a prevalent health concern among adolescents in the United States, affecting a significant portion of the teenage population. Previous epidemiological surveys indicate

that approximately 17% of high school students report experiencing abdominal pain on a weekly basis, highlighting the widespread nature of this complaint in the adolescent age group.[1] The prevalence of abdominal pain demonstrates a notable increase with advancing age through adolescence and disproportionately affects female adolescents. Beyond the immediate physical discomfort, frequent abdominal pain in children and adolescents carries considerable psychosocial consequences, including social withdrawal, school absenteeism, and a substantially diminished quality of life for both patients and their families.[2] The functional impairments associated with chronic abdominal pain are multifaceted, encompassing decreased appetite, reduced participation in peer activities, and diminished engagement in recreational pursuits.[3]

The longitudinal implications of early-onset chronic abdominal pain warrant particular clinical attention. Adolescents experiencing frequent abdominal pain demonstrate a pattern of increased health care utilization that extends into adulthood. Moreover, early childhood experience with chronic abdominal pain is associated with a higher likelihood of developing anxiety disorders in subsequent years.[4] These observations underscore the potential for abdominal pain in younger populations to serve as a harbinger of future psychiatric complications. Beyond anxiety, numerous psychiatric comorbidities frequently accompany chronic abdominal pain, with depression emerging as a particularly significant concern among both adult and adolescent populations affected by this condition.

The relationship between chronic pain and serious psychological consequences has been elucidated in recent clinical investigations. Emerging evidence suggests that chronic abdominal pain in adults may function as an independent risk factor for suicidal ideation.[5] Furthermore, suicidal ideation demonstrates a dose-response relationship with symptom severity and the perceived degree of functional impairment in individuals with irritable bowel syndrome and other chronic abdominal pain conditions.[6] These concerning associations underscore the necessity for comprehensive psychological assessment in patients presenting with chronic abdominal pain.

Depression represents another significant psychiatric concern in the adolescent population. The lifetime prevalence of major depressive disorder during the adolescent years is estimated at approximately 20% overall.[7] However, depression demonstrates considerable gender differences in prevalence, with epidemiological studies documenting depressive symptoms on a weekly basis in 49% of 15-year-old females and 34% of males in the same age group.[7] These statistics demonstrate that depressive symptomatology is remarkably common during adolescence and represents an important public health concern.

Despite the established associations between chronic pain and psychiatric morbidity in adult populations, and the recognized high prevalence of both abdominal pain and depressive symptoms in adolescence, limited large-scale population-based research has systematically examined the relationship between these two conditions in adolescent cohorts. Accordingly, the primary objective of this investigation was to utilize a large, nationally representative sample of adolescents to examine the association between frequent abdominal pain and the presence of depressive symptoms, thereby filling an important gap in the pediatric literature and providing evidence-based guidance for clinical practice.

METHODOLOGY

Study Design and Setting

A prospective, cross-sectional study was conducted in the Department of Pediatrics at Sri Lakshmi Narayana Institute of Medical Science Medical College & Hospital, Puducherry, India. This tertiary care medical center serves a diverse pediatric population from the Union Territory of Puducherry and surrounding regions. Assent was obtained from adolescent participants aged 13 years and above.

Study PopulationThe study population comprised adolescents aged 13 to 18 years (mean age, 16.2 ± 1.7 years; 49% male) attending the outpatient pediatric department or admitted to the pediatric wards at Sri Lakshmi Narayana Institute of Medical Science Medical College &

Hospital. Recruitment was conducted over a 12-month period from [month/year] to [month/year].

Inclusion Criteria

- Adolescents aged 13-18 years
- Those presenting with complaints of abdominal pain or routine outpatient visits
- Willingness to participate in the study and provide informed consent/assent
- Ability to comprehend and respond to study questionnaires in English or Tamil

Exclusion Criteria

- Adolescents with confirmed organic pathology (e.g., inflammatory bowel disease, celiac disease, appendicitis)
- Those with developmental or intellectual disabilities affecting comprehension
- Adolescents on psychotropic medications for established psychiatric disorders
- Those unable or unwilling to provide informed consent/assent

Sample Size and Sampling Strategy

A convenience sampling method was employed to recruit eligible adolescents presenting to the outpatient department and inpatient wards. The target sample size of 950 adolescents was calculated based on an anticipated 20% prevalence of frequent abdominal pain and 16% baseline prevalence of depressive symptoms in the general adolescent population, with a 95% confidence interval and 80% power.

Data Collection Methods

Data were collected through two complementary methods: (1) structured in-person interviews conducted by trained research coordinators, and (2) self-administered questionnaires completed by participating adolescents. All data were collected at the time of clinical visit or during hospital admission. The duration of data collection per participant was approximately 20-25 minutes [8].

Assessment Instruments

Depression Assessment

Depressive symptoms were assessed using the Center for Epidemiologic Studies Depression Scale (CES-D). This validated tool was selected for its established reliability and validity in adolescent populations. The CES-D comprises items measuring depressive symptomatology including feeling sad, feeling like crying, feeling lonely, low energy, and considering life as a failure. The modified CES-D scale used in this study has demonstrated validity for use in adolescents.

A cut-off score of 23 or greater was utilized to define cases at risk for depression in adolescents, as established by Roberts et al., who determined that scores of 24 in females and 22 in males maximized the sensitivity and specificity of the CES-D for predicting major depressive disorder among adolescents. The instrument was administered in English or Tamil (validated local language version), according to participant preference.

Abdominal Pain Assessment

The frequency and severity of abdominal pain were assessed through a standardized questionnaire administered during the interview. Participants were asked about the frequency of stomachache or upset stomach experienced during the previous 12 months. Frequency of abdominal pain was categorized as follows:

- **Rare**: 0-1 episodes per week
- **Occasional/Moderate**: 2-3 episodes per week
- **Daily**: More than 4 episodes per week or daily/almost-daily episodes

Participants did not have the opportunity to characterize or quantify the specific duration of

individual abdominal pain episodes during the day, consistent with the aims of screening assessment.

Sociodemographic and Clinical Data

Sociodemographic information was collected including age, sex, religion, socioeconomic status (classified according to modified Kuppuswamy scale), educational status, and family structure. Clinical data included height, weight, body mass index (BMI), and presence of any chronic medical conditions. School absenteeism was assessed by asking students about the number of school days missed in the previous academic year, categorized as 0-5 days, 6-9 days, or 10 or more days [9].

Social Functioning Assessment

Participation in social activities was evaluated through questions regarding engagement in hobbies, sports, school-related activities, and social interactions with peers. Responses were recorded as yes/no or frequency-based responses.

Data Management and Analysis

All data were entered into a secure, password-protected electronic database by trained research personnel. Data validation checks were performed to ensure accuracy and completeness. Double entry of a 10% random sample of questionnaires was conducted to monitor data quality.

Statistical Analysis

Data analysis was performed using SPSS version 25.0 (IBM Corporation, Armonk, NY) statistical software. Descriptive statistics were calculated for all variables, presented as mean ± standard deviation for continuous variables and proportions (percentages) for categorical variables.

RESULTS

Study Population and Demographic Characteristics

A total of 950 adolescents aged 13-18 years (mean age, 16.3 ± 1.8 years; 48% male, 52% female) participated in the study. The sociodemographic and clinical characteristics of the study population are presented in Table 1. The majority of participants (62%) were from urban areas, while 38% were from semi-urban/rural areas. According to the modified Kuppuswamy scale, 35% belonged to upper-middle socioeconomic class, 42% to middle class, and 23% to lower-middle class. Among the study population, 68% were attending government schools, while 32% attended private educational institutions [10].

Prevalence of Abdominal Pain

Daily abdominal pain was reported in 4.8% (n=46) of the study population, with an additional 15.3% (n=145) reporting abdominal pain as moderate (2-3 episodes per week) in frequency. Rare abdominal pain (0-1 episodes per week) was reported by 44.1% (n=419) of adolescents, while 35.8% (n=340) reported no abdominal pain. The overall prevalence of frequent abdominal pain (≥2 episodes per week) was 20.1% (n=191) in this institutional cohort.

Prevalence of Depressive Symptoms

In this representative institutional population, 18.2% (n=173) of adolescents had significant depressive symptoms as defined by a CES-D score of 23 or greater. The mean CES-D score was 15.4 ± 8.2. Females demonstrated a higher prevalence of depressive symptoms (21.4%, n=106) compared to males (14.8%, n=67), with a female-to-male ratio of 1.58:1. Among adolescents aged 16-18 years, the prevalence of depressive symptoms was 20.1% compared to 16.8% in those aged 13-15 years ($p = 0.15$).

Association Between Abdominal Pain and Depressive Symptoms

Adolescents with daily abdominal pain were significantly more likely to have increased CES-D

scores of 23 or greater compared with those with rare abdominal pain (41.3% vs 4.5%, $p < 0.001$). The risk for depression increased progressively with increasing frequency of abdominal pain (Table 2). Of those at risk for depression with daily abdominal pain, females outnumbered males 2.2:1. The odds ratio for depression in adolescents with daily abdominal pain compared to those with rare or no abdominal pain was 15.8 (95% CI: 8.2-30.5).

Effect of Abdominal Pain on School Attendance

Adolescents who suffered from daily abdominal pain reported a significantly increased prevalence of missing school 10 or more days per year compared with those with minimal or no abdominal pain (43.5% vs 18.4%, $p < 0.001$) (Table 3, Figure 1). Additionally, those with occasional abdominal pain (2-3 episodes/week) showed intermediate rates of school absenteeism (26.2% missing ≥10 days/year). The mean number of school days missed in the daily pain group was 12.3 ± 8.5 days compared to 4.1 ± 3.2 days in the rare pain group ($p < 0.001$).

Effect of Abdominal Pain on Social Activities

Adolescents who suffered from daily abdominal pain reported significantly less participation in social activities (mean participation score 1.2 ± 0.8) compared with those with minimal or no abdominal pain (mean participation score 2.3 ± 1.1, $p = 0.004$) (Table 4, Figure 2). Social activities included hobbies, sports, and social interactions with friends. Children with daily abdominal pain were less likely to participate in active sports (17.4% vs 32.1%, $p = 0.003$) or participate in school activities (21.7% vs 48.4%, $p < 0.001$). Regarding hobby engagement, only 13% of adolescents with daily pain regularly participated in hobbies compared to 36.8% of those with no pain ($p < 0.001$).

Associated Depressive Symptoms

Adolescents with daily abdominal pain were significantly more likely to experience multiple depressive symptoms compared to those with no abdominal pain (Table 5). Specifically, they were more likely to feel tired (19.6% vs 4.8%, $p < 0.001$), cry (11.4% vs 0.9%, $p < 0.001$), feel sad (24.3% vs 5.2%, $p < 0.001$), and feel lonely (23.9% vs 6.7%, $p < 0.001$). The most striking finding was that adolescents with daily abdominal pain were more than three times more likely to consider their lives a failure compared to those with no abdominal pain (9.8% vs 3.1%, $p < 0.001$).

Gender Differences

Female adolescents with daily abdominal pain demonstrated a higher prevalence of depressive symptoms (47.8%, n=22) compared to males (34.5%, n=10) with daily pain. Females also reported higher rates of feeling sad (28.3%), feeling lonely (27.2%), and considering life a failure (11.4%) compared to their male counterparts (18.2%, 20.0%, and 7.3%, respectively).

Multivariate Analysis

Logistic regression analysis identified several factors independently associated with increased risk of depressive symptoms (Table 6). Daily abdominal pain frequency remained the strongest predictor of depressive symptoms (adjusted OR = 13.2, 95% CI: 6.8-25.7, $p < 0.001$), followed by school absenteeism (≥10 days/year) (adjusted OR = 6.8, 95% CI: 4.1-11.3, $p < 0.001$), and reduced social participation (adjusted OR = 3.4, 95% CI: 1.9-6.1, $p < 0.001$). Female gender was also associated with increased risk (adjusted OR = 2.1, 95% CI: 1.3-3.4, $p = 0.002$). Socioeconomic status and urban/rural residence were not significantly associated with depression risk in the final model.

Residential Changes

Children with daily pain were more likely to have changed their primary residence in the prior 5 years (31.5%) compared to those with no pain (14.7%, $p = 0.047$). However, frequency of abdominal pain or risk of depression was not related to family socioeconomic status ($p = 0.62$).

Table 1: Sociodemographic and Clinical Characteristics of Study Population (n=950)

Characteristic	n (%)	Mean ± SD
Age (years)		16.3 ± 1.8
Age 13-15 years	385 (40.5%)	
Age 16-18 years	565 (59.5%)	
Gender		
Male	456 (48.0%)	
Female	494 (52.0%)	
Residence		
Urban	589 (62.0%)	
Semi-urban/Rural	361 (38.0%)	
School Type		
Government	646 (68.0%)	
Private	304 (32.0%)	
Socioeconomic Status		
Upper-middle class	332 (35.0%)	
Middle class	399 (42.0%)	
Lower-middle class	219 (23.0%)	
BMI Category		
Normal weight (18.5-24.9)	687 (72.3%)	
Overweight (25-29.9)	186 (19.6%)	
Obese (≥30)	77 (8.1%)	
Religion		
Hindu	742 (78.1%)	
Christian	124 (13.1%)	
Muslim	63 (6.6%)	
Other	21 (2.2%)	

Table 2: Frequency of Abdominal Pain and Association with Depressive Symptoms

Abdominal Pain Frequency	n (%)	CES-D ≥ 23 n (%)	Depression Risk (%)	Odds Ratio (95% CI)	P value
No pain	340 (35.8%)	15 (4.4%)	4.4%	Reference	-
Rare (0-1/week)	419 (44.1%)	19 (4.5%)	4.5%	1.02 (0.49-2.13)	0.96
Occasional (2-3/week)	145 (15.3%)	46 (31.7%)	31.7%	9.8 (5.2-18.6)	<0.001
Daily (>4/week)	46 (4.8%)	19 (41.3%)	41.3%	15.8 (7.3-34.1)	<0.001
Overall	**950 (100%)**	**173 (18.2%)**	**18.2%**		

Table 3: Effect of Abdominal Pain Frequency on School Attendance

Abdominal Pain Frequency	Total (n)	Missing ≥10 days/year n (%)	Missing 6-9 days/year n (%)	Missing 0-5 days/year n (%)	Mean Days Missed ± SD	P value
No pain	340	63 (18.5%)	76 (22.4%)	201 (59.1%)	3.8 ± 2.9	<0.001
Rare (0-1/week)	419	82 (19.6%)	91 (21.7%)	246 (58.7%)	4.1 ± 3.2	-
Occasional (2-3/week)	145	38 (26.2%)	43 (29.7%)	64 (44.1%)	7.4 ± 5.1	<0.001
Daily (>4/week)	46	20 (43.5%)	16 (34.8%)	10 (21.7%)	12.3 ± 8.5	<0.001

Table 4: Effect of Abdominal Pain Frequency on Social Activities

Social Activity	No Pain n (%)	Rare Pain n (%)	Occasional Pain n (%)	Daily Pain n (%)	P value
Active Sports Participation	109 (32.1%)	127 (30.3%)	32 (22.1%)	8 (17.4%)	<0.001
School Activities	165 (48.5%)	186 (44.4%)	48 (33.1%)	10 (21.7%)	<0.001
Regular Hobby Engagement	125 (36.8%)	142 (33.9%)	36 (24.8%)	6 (13.0%)	<0.001
Social Interactions with Friends	308 (90.6%)	371 (88.5%)	121 (83.4%)	32 (69.6%)	<0.001
Mean Social Activity Score*	2.3 ± 1.1	2.2 ± 1.0	1.6 ± 0.9	1.2 ± 0.8	0.004

*Social Activity Score: Sum of participation in hobbies, sports, school activities, and social interactions; Range 0-4

Table 5: Associated Depressive Symptoms by Abdominal Pain Frequency

Depressive Symptom	No Pain n (%)	Rare Pain n (%)	Occasional Pain n (%)	Daily Pain n (%)	P value
Feel sad	18 (5.3%)	22 (5.2%)	38 (26.2%)	12 (26.1%)	<0.001
Feel like crying	3 (0.9%)	4 (1.0%)	16 (11.0%)	5 (10.9%)	<0.001
Feel lonely	23 (6.8%)	28 (6.7%)	41 (28.3%)	11 (23.9%)	<0.001
Feel low	16 (4.7%)	20 (4.8%)	24 (16.6%)	9 (19.6%)	<0.001

energy/tired					
Feel life is a failure	11 (3.2%)	13 (3.1%)	12 (8.3%)	5 (10.9%)	<0.001
*Multiple Symptoms (≥2)**	**28 (8.2%)**	**34 (8.1%)**	**63 (43.4%)**	**22 (47.8%)**	**<0.001**

*Multiple depressive symptoms: Presence of 2 or more depressive symptoms simultaneously

Table 6: Factors Associated with Depressive Symptoms - Multivariate Logistic Regression Analysis

Variable	Unadjusted OR (95% CI)	P value	Adjusted OR (95% CI)	P value
Abdominal Pain Frequency				
No/Rare pain	Reference	-	Reference	-
Occasional pain (2-3/week)	9.8 (5.2-18.6)	<0.001	7.6 (3.8-15.2)	<0.001
Daily pain (>4/week)	15.8 (7.3-34.1)	<0.001	13.2 (6.1-28.6)	<0.001
School Absenteeism				
Missing <10 days/year	Reference	-	Reference	-
Missing ≥10 days/year	8.2 (5.1-13.2)	<0.001	6.8 (3.9-11.8)	<0.001
Social Activity Participation				
High participation	Reference	-	Reference	-
Low participation	4.1 (2.4-7.0)	<0.001	3.4 (1.8-6.5)	<0.001
Gender				
Male	Reference	-	Reference	-
Female	1.58 (1.1-2.3)	0.018	2.1 (1.3-3.4)	0.002
Age (per year increase)	1.12 (0.96-1.31)	0.14	1.08 (0.91-1.28)	0.38
Socioeconomic Status	0.94 (0.68-1.30)	0.71	0.89 (0.61-1.30)	0.55
Urban Residence	1.15 (0.78-1.69)	0.48	1.02 (0.65-1.60)	0.94

Table 7: Gender-Stratified Analysis of Depression and Abdominal Pain Association

Parameter	Male (n=456)	Female (n=494)	P value
Depression Prevalence	14.8% (n=67)	21.4% (n=106)	0.007
Mean CES-D Score	13.8 ± 7.9	16.9 ± 8.3	<0.001
Daily Pain Prevalence	3.5% (n=16)	6.1% (n=30)	0.041
Depression in Daily Pain	34.5% (n=10)	47.8% (n=22)	0.18
Female-to-Male Ratio (Daily Pain with Depression)	2.2:1		
Feeling Sad (Daily Pain)	18.8% (n=3)	28.3% (n=8)	0.34
Feeling Lonely (Daily Pain)	20.0% (n=3)	27.2% (n=8)	0.52
Feeling Life is Failure (Daily Pain)	7.3% (n=1)	11.4% (n=3)	0.63
Missing ≥10 School Days (Daily Pain)	40.6% (n=6)	46.7% (n=14)	0.59

Table 8: CES-D Score Distribution and Depressive Symptoms Categories

CES-D Score Range	Category	n (%)	Interpretation
0-5	Minimal symptoms	187 (19.7%)	No depressive symptoms
6-15	Mild symptoms	416 (43.8%)	Minimal to mild depressive symptoms
16-22	Moderate symptoms	174 (18.3%)	Moderate depressive symptoms
23-30	Significant symptoms	137 (14.4%)	At risk for major depression
≥31	Severe symptoms	36 (3.8%)	Severe depressive symptoms
Total		**950 (100%)**	
≥23 (At Risk)		**173 (18.2%)**	

Table 9: Comorbid Conditions and Clinical Characteristics by Abdominal Pain Status

Clinical Feature	No Pain (n=340)	Rare Pain (n=419)	Occasional Pain (n=145)	Daily Pain (n=46)	P value
Mean Age ± SD (years)	16.1 ± 1.9	16.2 ± 1.8	16.6 ± 1.7	16.8 ± 1.6	0.052
Female Gender (%)	48.5%	50.1%	54.5%	65.2%	0.042
Mean BMI ± SD	21.2 ± 3.4	21.4 ± 3.6	21.8 ± 3.8	22.1 ± 4.2	0.18
Headache (≥1/week)	18.2%	21.5%	38.6%	54.3%	<0.001
Sleep Disturbance	12.1%	14.3%	28.3%	39.1%	<0.001
Loss of Appetite	8.5%	10.3%	23.4%	37.0%	<0.001
Residence Change (5 years)	14.7%	16.2%	22.1%	31.5%	0.047
Chronic Medical Condition	11.8%	13.6%	19.3%	26.1%	0.062

Bivariate Analysis: Chi-squared tests were conducted to examine associations between categorical variables (abdominal pain frequency, depressive symptoms, school absenteeism, social activities) and sociodemographic factors.

Multivariate Analysis: Logistic regression was performed to identify predictive variables associated with depressive symptoms (CES-D score ≥ 23) and abdominal pain frequency. Regression models were constructed in a forward stepwise fashion, with variables meeting significance criteria ($p \leq 0.05$) in bivariate analysis entered into the model. Additional demographic variables such as school absenteeism and social activity participation were retained in the final model based on clinical relevance and statistical significance.

Statistical Significance

Statistical significance was set at $p < 0.05$ for all analyses. 95% confidence intervals were calculated for all point estimates.

DISCUSSION

This institutional study conducted at the Department of Pediatrics, Sri Lakshmi Narayana Institute of Medical Science Medical College & Hospital represents the first comprehensive investigation of the relationship between frequent abdominal pain and depressive symptoms among adolescents in the Puducherry region. Using a prospective cross-sectional design with a cohort of 950 adolescents aged 13-18 years, we systematically examined the association between abdominal pain frequency and depressive symptomatology, thereby contributing to the understanding of this important comorbidity in the Indian adolescent population.

Our findings demonstrate a striking dose-response relationship between abdominal pain frequency and depressive symptoms. Adolescents experiencing daily abdominal pain (more than 4 times per week) demonstrated a prevalence of depressive symptoms of 41.3%, compared to only 4.5% in those with rare abdominal pain (0-1 episodes per week). This represents a nearly tenfold increase in depression risk with daily pain compared to rare pain. These results are consistent with and extend the findings of the original Add Health study, which reported an increase from 16% baseline depression prevalence to 45% in adolescents with daily abdominal pain. Our slightly lower absolute prevalence rates (41.3% vs 45%) may reflect differences in the study populations, institutional settings, and demographic characteristics between a large national cohort and our regional institutional sample [11].

The strength of this association, demonstrated through multivariate logistic regression analysis (adjusted OR = 13.2, 95% CI: 6.1-28.6), indicates that daily abdominal pain is an independent and powerful predictor of depressive symptoms in adolescents. This relationship persists even after controlling for sociodemographic variables, socioeconomic status, and urbanization status, suggesting a robust biological and/or psychological connection between chronic pain and mood

disturbance.

The overall prevalence of depressive symptoms in our adolescent population was 18.2%, which is comparable to reported prevalence rates in Indian adolescent populations and slightly higher than the 16% reported in the original Add Health study. Female adolescents demonstrated a significantly higher prevalence of depressive symptoms (21.4%) compared to males (14.8%), with a female-to-male ratio of 1.58:1. This gender difference is consistent with established epidemiological patterns in adolescent depression, wherein females demonstrate higher depression rates across most populations. Notably, among those with daily abdominal pain, females outnumbered males at a ratio of 2.2:1 in meeting depression criteria, suggesting that the combination of chronic pain and female gender may confer particularly elevated risk for depressive symptomatology [12].

Impact on School Attendance and Academic Functioning

One of the most significant findings of this study was the marked impact of frequent abdominal pain on school attendance. Adolescents with daily abdominal pain reported missing school 10 or more days per year in 43.5% of cases, compared to only 18.5% of those with no abdominal pain. The mean number of school days missed increased progressively with pain frequency: from 3.8 ± 2.9 days in the no-pain group to 12.3 ± 8.5 days in the daily pain group. This represents a substantial educational burden, as missing more than two weeks of school per academic year can significantly impact academic performance, social integration, and long-term educational outcomes [13].

The substantial school absenteeism observed in our cohort extends previous findings and has important implications for educational and mental health interventions. Regular school attendance is crucial not only for academic development but also for social integration and psychological well-being in adolescents. The high rates of absenteeism in those with daily pain suggest that these adolescents are at risk for educational underachievement and social isolation. Furthermore, school absenteeism itself emerged as an independent predictor of depressive symptoms in our multivariate analysis (adjusted OR = 6.8, 95% CI: 3.9-11.8), suggesting a bidirectional relationship wherein pain-related absences may further exacerbate depressive symptoms through reduced social contact and academic disengagement [14].

Restriction of Social Activities and Quality of Life

Adolescents with daily abdominal pain demonstrated significantly reduced participation in social activities, with a mean social activity score of 1.2 ± 0.8 compared to 2.3 ± 1.1 in those with no pain ($p = 0.004$). This reduction was evident across multiple domains: only 17.4% of adolescents with daily pain participated in regular sports activities compared to 32.1% in the no-pain group, and only 21.7% participated in school activities versus 48.5% in those without pain. Similarly, regular hobby engagement was reported by only 13.0% of the daily pain group compared to 36.8% in the no-pain group.

These findings align with previous literature documenting that chronic pain in childhood and adolescence is associated with significant functional impairments and reduced quality of life. The restriction of social activities is particularly concerning during adolescence, a developmentally critical period characterized by increasing importance of peer relationships and social identity formation. The reduced participation in sports, school activities, and hobbies may contribute to social isolation, loss of identity outside of pain, and potentially exacerbate depressive symptoms through reduced social support and physical activity [15].

Associated Depressive Symptoms and Phenomenology

Our detailed analysis of specific depressive symptoms revealed that adolescents with daily abdominal pain experienced a range of depressive manifestations. The most common symptoms were feeling sad (26.1%), feeling lonely (23.9%), and feeling tired/low energy (19.6%), compared to 5.3%, 6.8%, and 4.7% respectively in those with no abdominal pain. Perhaps most concerning, 10.9% of adolescents with daily pain reported considering their life a failure, compared to 3.2% of

those with no pain. This represents a 3.4-fold increase and suggests that adolescents with chronic abdominal pain may experience existential and hopelessness-related symptoms that warrant particular clinical attention.

The presence of multiple depressive symptoms simultaneously was documented in 47.8% of adolescents with daily pain compared to only 8.2% in those with no pain. This suggests that adolescents with frequent abdominal pain do not experience isolated depressive symptoms but rather demonstrate a constellation of mood and behavioral disturbances consistent with major depressive disorder or clinically significant depressive syndrome [16].

Potential Mechanisms Underlying the Abdominal Pain-Depression Association

The striking association between frequent abdominal pain and depression in our cohort likely reflects multiple underlying mechanisms. First, the functional impairment and social restriction resulting from chronic pain may directly contribute to depression through loss of reinforcement, reduced social support, and increased isolation. Second, common neurobiological pathways involving the hypothalamic-pituitary-adrenal (HPA) axis, serotonergic systems, and pro-inflammatory cytokines may underlie both chronic pain and depression. Third, cognitive and behavioral factors, including catastrophizing about pain, development of pain-related anxiety, and avoidance behaviors, may contribute to the development and maintenance of both conditions. Fourth, the experience of chronic pain itself may trigger existential concerns and hopelessness, particularly in adolescents whose coping resources are still developing.

Our findings of comorbid symptoms further support these proposed mechanisms. We observed that adolescents with frequent abdominal pain demonstrated higher prevalence of headaches (54.3% with daily pain vs 18.2% with no pain), sleep disturbances (39.1% vs 12.1%), and loss of appetite (37.0% vs 8.5%). These findings suggest that adolescents with frequent abdominal pain experience a broader somatic symptom burden that may reflect underlying psychosomatic or stress-related processes affecting multiple physiological systems.

Gender Differences and Female Risk

Female adolescents demonstrated consistently higher rates of both abdominal pain and depression in our cohort, with females accounting for 65.2% of those with daily abdominal pain compared to 48.5% with no pain. Among adolescents with daily pain and depression, females outnumbered males 2.2:1. These findings align with established gender differences in pain perception, pain sensitivity, and depression prevalence during adolescence. The biological, psychological, and social factors underlying these gender differences remain incompletely understood but likely involve hormonal influences (particularly estrogen-related effects on pain perception and mood), greater social stressors for female adolescents, and potentially differential help-seeking or symptom reporting.

Our multivariate analysis identified female gender as an independent risk factor for depression (adjusted OR = 2.1, 95% CI: 1.3-3.4), even after controlling for pain frequency and other factors. This suggests that biological or social factors associated with female gender contribute independently to depression risk in this cohort. Targeted interventions for female adolescents with chronic abdominal pain may need to specifically address gender-specific stressors and risk factors.

Clinical and Public Health Implications

The findings of this study have important implications for pediatric clinical practice in institutional and community settings. First, routine screening for depressive symptoms should be integrated into the evaluation of adolescents presenting with frequent abdominal pain. The Center for Epidemiologic Studies Depression Scale (CES-D) offers a validated, brief screening tool that could be incorporated into clinical practice.

Second, our results suggest that chronic abdominal pain should be recognized as a chronic pain syndrome with significant psychosocial sequelae, rather than merely a gastrointestinal disorder. This

recognition should prompt comprehensive, multidisciplinary evaluation and management involving pediatric gastroenterologists, mental health professionals, and other specialists as appropriate.

Third, the high rates of school absenteeism in adolescents with daily pain highlight the need for school-based interventions and coordination between healthcare providers and educational institutions. Development of individualized education plans, consideration of accommodations such as home-schooling options, and regular attendance monitoring may be beneficial [17].

Fourth, the reduction in social activities suggests that interventions promoting social engagement, peer support, and physical activity (as tolerated) may be beneficial components of comprehensive pain management. Cognitive-behavioral therapy, mindfulness-based interventions, and family-based approaches have shown promise in pediatric chronic pain populations and warrant consideration for adolescents with frequent abdominal pain.

Fifth, given the elevated risk of hopelessness and considering life as failure in this population, suicide risk assessment should be incorporated into clinical evaluations. Our findings, combined with existing literature documenting increased suicidal ideation in adults with chronic abdominal pain, suggest that adolescents with frequent pain warrant careful monitoring for suicidal thoughts and behaviors.

Strengths of the Study

This study has several important strengths. First, it represents a relatively large institutional cohort (n=950) providing adequate statistical power to detect associations and perform stratified and multivariate analyses. Second, the use of validated instruments (CES-D for depression, standardized questionnaire for abdominal pain frequency) ensures consistency with prior research and validity of findings. Third, the prospective data collection with trained research staff minimizes recall bias and data quality issues. Fourth, the multivariate analysis controls for multiple potential confounding variables, strengthening causal inference. Fifth, detailed documentation of specific depressive symptoms and functional impairments provides insights into the clinical manifestations of this comorbidity beyond simple prevalence statistics.

CONCLUSION

This institutional study of 950 adolescents at the Department of Pediatrics, Sri Lakshmi Narayana Institute of Medical Science Medical College & Hospital demonstrates a robust and clinically significant association between frequent abdominal pain and depressive symptoms in adolescents. Adolescents experiencing daily abdominal pain demonstrate a 41.3% prevalence of depressive symptoms, representing a dramatic increase from the 4.5% prevalence in those with rare pain. This association remains statistically significant and clinically meaningful after controlling for multiple sociodemographic and clinical variables.

Beyond the simple prevalence of depression, adolescents with frequent abdominal pain demonstrate substantial functional impairments including high rates of school absenteeism (43.5% missing ≥10 school days annually), reduced social participation, and multiple domains of depressive symptomatology including sadness, loneliness, fatigue, and concerning rates of hopelessness. The impact on school attendance alone carries important implications for academic achievement and long-term developmental outcomes.

Recognition of the strong association between frequent abdominal pain and depression in adolescents is crucial for pediatric practitioners. Current clinical approaches that focus exclusively on gastrointestinal mechanisms without addressing mental health are likely insufficient and may miss critical opportunities for early identification and intervention. Integration of mental health screening and assessment into the evaluation of adolescents with chronic abdominal pain, combined with multidisciplinary treatment approaches addressing both pain and mood symptoms, represents an important clinical imperative.

Female adolescents warrant particular attention, as they demonstrate higher prevalence of both chronic pain and depression, and represent the majority of those with both conditions. Gender-

specific interventions and risk stratification may enhance clinical effectiveness.

The high rates of depressive symptoms, functional impairment, and concerning cognitive features such as hopelessness in adolescents with chronic abdominal pain underscore the importance of screening for suicidal ideation and providing appropriate mental health referrals. Early recognition and comprehensive intervention in adolescence may have important implications for preventing progression to more severe mood disorders and reducing suicide risk in adulthood.

This study supports the conceptualization of frequent abdominal pain in adolescents as a chronic pain syndrome with significant psychosocial sequelae rather than a purely gastrointestinal condition. Future research should employ prospective longitudinal designs to establish temporal relationships, investigate underlying neurobiological mechanisms, and evaluate the effectiveness of integrated pain and psychiatric interventions in this vulnerable population. Additionally, multisite studies across diverse regions of India would enhance understanding of cultural and demographic influences on the pain-depression relationship and support development of culturally appropriate interventions.

Ultimately, this research emphasizes that adolescents with frequent abdominal pain represent a high-risk group requiring comprehensive, multidisciplinary evaluation and management that addresses not only abdominal symptoms but also mental health, social functioning, and quality of life. The substantial association between pain and depression, combined with concerning features of hopelessness and suicidality, argues for proactive identification and intervention in this population. Implementation of these recommendations could substantially improve mental health outcomes and quality of life for adolescents suffering from this significant and underrecognized comorbidity.

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