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Research Article

Oxytocin is an important determinant of psychosocial behavior: a study conducted in three secondary schools in rural Bangladesh

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Abstract

Background and objectives: Increasing psychosocial dysfunction (PD) is a major mental health issue globally. Deviation from normal mental health in early childhood leads to severe sequelae in adulthood, jeopardizing not only the individual affected but also his family, community and the entire society as a whole. Social crimes indicate mental health disorders of society. Early detection and intervention of behavioral disorders are expected to prevent such an increasing trend. The study aims to measure the prevalence of psychosocial dysfunction in secondary school- going children and to determine its biological risk variables.

Materials and methods: Three secondary high schools in rural communities were purposively selected. Students aged 11 – 18 years from classes six to ten were selected randomly. Having purposively selected 3 schools, the student participants were randomly selected based on class roll numbers 5, 15, 25, 35, 45, 55, 65 - --- 95; ten from each class for the girls (10 X 5 = 50). Likewise, for the boys, 20 from each class according to Class Roll No: 5, 10, 15, 20, 25 ---- 100. PSC35 was used for scoring psychosocial behavior. The class teachers filled out the questionnaire in consultation with parents or caretakers. Investigations included: a) anthropometry (height, weight, waist- and hip-girth), blood pressure; b) biochemistry profile (blood glucose, dopamine, serotonin, cortisol and oxytocin). PSC35 ≥23 was taken as the cut-off for PD.

Results: A total of 250 students (boys / girls = 165/85) participated. The prevalence of PD was found to be 36.4% (boys / girls = 25.6 / 10.8%; p=0.332). Compared with the girls, the boys had significantly higher central obesity (WHR, p=0.018; WHtR, p<0.001) than girls, whereas the girls had higher FBG (p<0.001), cortisol (p = 0.009) and OT (p<0.001). Comparisons between those with PD (PSC35 ≥23) and without PD (PSC35<23) showed that PD group had significantly lower OT (p=0.015). Pearson's correlation estimated that OT had negative correlations (r = - 0.159, p = 0.016) with PSC35. Multiple comparisons of risk variables based on PSC35-tertiles by ANOVA (Scheffe) showed the higher tertile had significantly lower OT (p = 0.008). Logistic regression (binary) also proved lower OT was significantly associated with PD.

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Conclusions: This cross-sectional study revealed a higher prevalence of PD among the school students. It investigated major biological risk variables (obesity, blood pressure, blood glucose and neurotransmitters), and whether these variables contribute to PD. Of the investigated variables, lower OT level was found to be significantly associated with PD and proved to be an important risk. Further study may be initiated to confirm our study findings.

Acronyms – BMI – body mass index (weight in kg/height in met sq.), DBP – diastolic blood pressure, FBG – fasting blood glucose, MAP –mean arterial pressure [(MAP = DBP + 1/3 (SBP – DBP)], SD- standard deviation, WHR – waist-to-hip ratio, WHtR- waist-to-height ratio, SBP – systolic blood pressure; PSC35 – pediatric symptom checklist 35. PD- Psychological dysfunction: [ADHD – attention deficiency hyperactive disorders, CD – conduct disorders, ODD – oppositional defiant disorders].

Introduction

Bangladesh is the most densely populated country in the world (total 172 million; 1329/sq km). According to the Bangladesh bureau of statistics (BBS), almost half of the population is below age 30y. A total of 33 million students are enrolled in 1.6 million primary educational institutes. Despite all efforts, Bangladesh experiences a sizeable dropout rate of about 18% at the primary level ('Primary enrolment rate 98%', 2020), which increases to 50% at the secondary level (Ministry of Education, 2011; Sarker et al., 2019).

The factors causing such an alarming dropout rate are unknown. May be worthy to note – this population age-group is most important considering young energetic productive force, future development and dynamic strength of the country. It may also be noted that there is an increasing rate of social crimes indicating a deterioration of healthy attitude and behavior, inflicting mental health and crimes. Increasing rate of Juvenile delinquency may contribute to these crimes. According to UNICEF "there are 36 million teenagers in Bangladesh. Since 2012, the police headquarters has had records of juvenile crime. In 2012, 751 children and teenagers were accused in 484 cases. In the first six months of 2020, 1191 were arrested in 821 cases. Sources in the social welfare directorate said that most of these teenagers were arrested under the case of drug, murder, and rape and sent to the correctional centers.

The above-mentioned findings suggest that the young and most potential population is at risk of dropping out of school, thus increasing the rate of juvenile delinquency. From Bangladesh's perspective, it has been reported that poverty, broken families, social and economic inequalities and discrepancies are the causes of such juvenile delinquencies [1].

A very recent study in China on 'Antisocial Behavior and Antisocial Personality Disorder (ASPD) among Youth' showed that ASPD affects all youth irrespective of class and ethnicity [2,3]. An extensive review by Perrotta G et al. on Behavior and Conduct Disorder in Childhood, highlights the main predictive elements in preadolescents and adolescents that can be correlated with the symptoms of distinctive disorders in deviant and criminal conduct. Early detection and intervention in all forms, including therapeutic measures, can encourage behavioral improvement of those who are still not adults [3].

Regarding neurophysiology, some neurotransmitters (chemical messengers) play an important role in the brain by influencing mood and behavior like dopamine, serotonin, oxytocin, cortisol, norepinephrine, and endorphins [2,4]. Abnormalities (quality or quantity) of these chemical messengers may relate to behavioral disorders. Of them, oxytocin (OT) has been studied in relation to social bonding and has been termed as 'love hormone', 'cuddling chemical' and 'hormone of sociostasis' [4-6]. John Tully et al.opined oxytocin as a master regulator of social affiliation, social connection, and adaptive reproductive behaviors [7]. OT plays a very vital role in maintaining 'Love and longevity' [8]. The effect of OT on empathy and socialization was also reported from Argentina [9].

Based on the above findings – a) an alarming number of dropouts from schools, b) increasing involvement of youth in anti-social behavior, c) deteriorating mental and social health, eventually leading to juvenile crimes, this study aims to screen PD among secondary school children aged 11 – 18 years. Additionally, the study addresses some important metabolic (obesity, blood pressure, blood glucose) and neurotransmitters (dopamine, serotonin, oxytocin and cortisol) risks.

Material and methods

The study protocol was duly approved by theIbrahim Medical College Institutional Review Board (IMC IRB). Three secondary schools were selected purposively –two in Kharua, Nandal upazila (one boys' school and one girls') under Mymensingh. The third school having co-education, was selected in Vulbaria, Santhia under Pabna.

For each selected school, local social leaders, parents and schoolteachers including the headmasters, were communicated with. They were informed about the objectives and the procedural details of the study.

The selection of three secondary schools was purposive. Having purposively selected 3 schools the student participants were randomly selected based on class roll no: 5, 15, 25, 35, 45, 55, 65 - --- 95; ten from each class for the girls (10 X 5 = 50). Likewise, for the boys 20 from each class according to class roll no: 5, 10, 15, 20, 25 ---- 100. The eligibility criteria of the participants are based on class roll no. and willingness (assessed by class teacher) to volunteer for the investigation that needs blood sample.

The schoolteachers kindly volunteered to fill out questionnaires on Pediatric Symptom Checklist-35 (PSC35) [10]. The parents / guardians of each student were interviewed by his / her respective class teachers. Having completed the questionnaires (PSC35), the data collected was computerized. The eligibility lists of the participants were prepared and printed. The investigation date and site at school were announced following consultation with teachers. The eligible participants were advised to attend the investigation site in the morning with an overnight fast. The teachers maintained a disciplined queue of the participants during investigations.

At first, a brief clinical history (present illness, medications) was taken from each participant. Anthropometry (height, weight, waist- and hip-girth) and blood pressure were taken. Fasting blood samples were collected, centrifuged and serum samples were refrigerated and transported to Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrinology and Metabolic Disorders (BIRDEM). Cold chain was strictly maintained while transporting. The Lab investigations included fasting blood glucose (mmol/L), neurotransmitters [dopamine (pg/ml), serotonin (ng/ml), cortisol (ng/ml) and oxytocin (pg/ml)]. These were assayed in BIRDEM Endocrine Labusinga commercially competitive ELISA-based kit (DRG, USA).

Diagnostic cut-off: Psychological dysfunctions (PD /behavioral disorders – ADHD, CD, ODD) were diagnosed based on PSC35 ≥23 [10,11].

Statistical analysis: The prevalence of PD was presented in percentages. All quantitative variables were expressed in mean with SD and 95% CI. The biophysical characteristics were compared between boys and girls using an independent t-test and so were the comparisons between students with and without PD. ANOVA compare the quantitative variables among the PSC35-tertiles. SPSS version 20.0 was used for all statistical analyses and $p<0.05$ was accepted as the level of significance. Logistic regression analysis estimated the biophysical variables as the independent and the PD (PSC35 ≥23) as the dependent variable. For the regression analysis, the quantitative variables were dichotomized into qualitative based on median– WHtR2 (<0.42 v ≥0.42), FBG2 (<6.0 v ≥6.0 mmol/l), Dopamine2 (<32.4 v ≥32.4 pg/ml), serotonin2 (<141.2 v ≥141.2ng/ml), cortisol2 (96.14 v ≥ 96.14ng/ml) and oxytocin2 (<109.5 v ≥109.5 pg/ml). For PD tertiles, the values are lower, middle and upper, <22, 22-28 and >28, respectively.

Results

A total of 250 (boys / girls = 165/85) students took part in the study. The prevalence of PD was 36.4% (boys / girls = 25.6 / 10.8%, p=0.332; Table-1).

The mean (SD) values and 95% CI of investigated variables were showing in Table-2. The biophysical variables included anthropometry (BMI, WHR, and WHtR), blood pressure, dopamine, serotonin, cortisol and OT. Comparisons between boys and girls of the variables are shown in Table-3. The boys had significantly higher central obesity (WHR, p=0.018; WHtR, p<0.001) than girls, whereas the girls had higher FBG (p<0.001), cortisol (p = 0.009) and OT (p<0.001).

Correlations among the variables controlling for age and sex were displayed in Table-4. OT had significant positive correlation with dopamine (p=0.001), cortisol (p<0.001), serotonin (p=0.004), but significant negative correlation with PSC35 (p=0.016). No other neurotransmitters showed such association with PSC35.

Table-1: *Prevalence of psychosocial dysfunction by sex (boys / girls = 165 / 85)*

PSC35	<23 N (%)	≥23 N (%)	Total N (%)
Boys	101 (40.4)	64 (25.6)	165 (66.0)
Girls	58 (23.2)	27 (10.8)	85 (34.0)
Total	159 (63.6)	91 (36.4)	250 (100)

Chi sq test: p = 0.332. Both sexes were equally affected.

Table-2: *Biophysical characteristics of the participants (boys and girls: n =250: mean (SD) and 95% CI*

Variables	Mean (SD)	95% CI
Height (cm)	156.5 (10.1)	155.2 – 157.8
Weight (Kg)	43.8 (9.9)	42.5 – 45.0
Waist (cm)	59.4 (18.4)	57.2 – 61.7
Hip (cm)	70.9 (21.4)	68.3 – 73.6
BMI	17.7 (3.20)	17.3 – 18.1
WHR	0.84 (0.07)	0.83 – 0.85
WHTR	0.38 (0.11)	0.36 – 0.39
SBP (mmHg)	109.3 (14.9)	107.4 – 111.2
DBP (mmHg)	66.6 (8.9)	65.4 – 67.7
MAP (mmHg)	80.8 (9.5)	79.6 – 82.02
FBG (mmol/L)	6.4 (0.9)	6.2 – 6.48
Dopamine (pg/ml)	37.4 (23.3)	34.4 – 40.3
Cortisol (ng/ml)	107.7 (54.5)	100.9 – 114.5
Serotonin (ng/ml)	143.7 (52.4)	137.2 – 150.3
Oxytocin (pg/ml)	154.4 (122.8)	139.1 – 169.7
*PSC35	21.7 (7.2)	20.8 – 22.6

BMI – body mass index (weight in kg/height in met sq.), CI – confidence interval, DBP – diastolic blood pressure, FBG – fasting blood glucose, MAP –mean arterial pressure, SD- standard deviation, WHR – waist-to-hip ratio, WHtR- waist-to-height ratio, SBP – systolic blood pressure; PSC35 – pediatric symptom checklist 35.
** PSC35 –Pediatric Symptom Checklist 35; Total: Attention + Internalization + Externalization + Other*
*(Ref: Brown, F.L., Steen, F., Taha, K. et al. Validation of Arabic versions of the child psychosocial distress screener and pediatric symptom checklist for young adolescents living in vulnerable communities in Lebanon. Int J Ment Health Syst **18**, 21 (2024). https://doi.org/10.1186/s13033-024-00640-y)*
Pagano ME, Cassidy LJ, Little M, Murphy JM, Jellinek MS. Identifying psychosocial dysfunction in school-age children: the pediatric symptom checklist as a self-report measure. Psychol Sch. 2000;37(2):91–106. Epub 2000/03/01. pmid:22328794; PubMed Central PMCID: PMC3274771.

Table-3: *Comparison of biophysical characteristics (N= boys /girls = 165/85)*

	Boys		Girls		
	Mean	**SD**	**Mean**	**SD**	**p**
BMI	17.7	3.2	17.8	3.20	0.704
WHR	0.84	0.08	0.82	0.06	0.018
WHtR	0.42	0.06	0.28	0.12	0.000
MAP, mmHg	80.6	9.7	81.2	9.2	0.640
FBG, mmol/L	6.068	0.79	6.97	0.74	0.000
Dopamine, pg/ml	35.4	23.51	41.1	22.7	0.072
Cortisol, ng/ml	101.3	48.04	120.3	63.8	0.009
Serotonin, ng/ml	144.5	49.9	142.1	57.3	0.731
Oxytocin, pg/ml	114.5	82.9	231.8	148.7	0.000
PSC35	22.1	7.7	20.9	5.9	0.204

BMI – body mass index (weight in kg/height in met sq.), CI – confidence interval, FBG – fasting blood glucose, MAP –mean arterial pressure, SD- standard deviation, WHR – waist-to-hip ratio, WHtR- waist-to-height ratio, PSC35 – pediatric symptom checklist 35

Table-4: *Correlations among biophysical variables controlling sex and class/age*

		Dopa	**Cortis**	**Serotn**	**Oxytoc**	**BMI**	**whr**	**whtr**	**MAP**	**FBG**	**PSC 35**
Dopamine	r	1.000	.151	.268	.222	-.012	-.117	.126	.234	.191	-.050
	p	.	.022	.000	.001	.855	.076	.056	.000	.004	.455
	df	0	227	227	227	227	227	227	227	227	227
Cortisol	r		1.000	.017	.350	-.114	-.236	-.045	.024	.209	.007
	p		.	.799	.000	.084	.000	.498	.723	.002	.920
	df		0	227	227	227	227	227	227	227	227
Serotonin	r			1.000	.190	-.003	-.078	.084	.145	-.029	-.107
	p			.	.004	.963	.242	.207	.028	.659	.105
	df			0	227	227	227	227	227	227	227
Oxytocin	r				1.000	-.100	-.212	.333	.242	.120	-.159
	p				.	.133	.001	.000	.000	.069	.016
	df				0	227	227	227	227	227	227
BMI	r					1.000	.214	.319	.259	.028	-.036
	p					.	.001	.000	.000	.669	.592
	df					0	227	227	227	227	227
WHR	r						1.000	.091	-.197	-.076	.227
	p						.	.171	.003	.251	.001
	df						0	227	227	227	227
WHTR	r							1.000	.329	-.046	-.211
	p							.	.000	.486	.001
	df							0	227	227	227
MAP	r								1.000	.094	-.133
	p								.	.155	.044
	df								0	227	227
FBG	r									1.000	.048
	p									.	.465
	df									0	227

r – correlation coefficients, p – two tailed significance, df – degree of freedom. BMI – body mass index (weight in kg/height in met sq.), FBG – fasting blood glucose, MAP –mean arterial pressure, WHR – waist-to-hip ratio, WHtR- waist-to-height ratio, PSC35 – pediatric symptom checklist 35.

As the 95% CI of PSC35 of all participants was found (20.8 – 22.6) in Table-2, the cut-off for PD was taken ≥23. Thus, a table was constructed based on this cut-off (PSC35: <23 vs. ≥23, Table-5) for comparisons of the investigated variables. None of the neurotransmitters differed except OT, which was found significantly lower in the PSC35 ≥23 group than those with PSC35 <23 (p=0.015).

Table-5: *Students with normal PSC35 compared with those with higher PSC35 <23 vs. ≥23)*

Variables	**PSC35 < 23 n =159**		**PSC35 ≥23 n =91**		***P***
	Mean	**SD**	**Mean**	**SD**	
BMI	17.7	2.7	17.7501	3.84512	*0.975*
WHR	0.83	0.07	0.85	0.07	*0.020*
WHTR	0.38	0.10	0.36	0.12275	*0.215*
SBP	111.4	15.09	105.5	13.8	*0.002*
DBP	66.9	8.8	66.1	9.06	*0.508*
MAP	81.7	9.5	79.2	9.4	*0.053*
FBG	6.3	0.88	6.3	0.8	*0.939*
Dopamine, pg/ml	38.7	23.7	34.9	22.5	*0.204*
Cortisol, ng/ml	108.3	55.0	106.8	54.0	*0.831*
Serotonin, ng/ml	146.8	51.6	138.3	53.7	*0.224*
Oxytocin, pg/ml	168.3	125.7	130.0	114.2	*0.015*

BMI – body mass index (weight in kg/height in met sq.), DBP – diastolic blood pressure, FBG – fasting blood glucose, MAP –mean arterial pressure, SD- standard deviation, WHR – waist-to-hip ratio, WHtR- waist-to-height ratio, SBP – systolic blood pressure; PSC35 – pediatric symptom checklist 35.

Figure-1A showed a declining trend of OT with the increasing PSC quartiles. At PSC<16, OT level was found 177 pg/ml, which came down to 126 pg/ml at PSC >26, though not significant. The other neurotransmitters showed no change with PSC35 level. Again, in Figure-1B obesity variables (BMI, WHtR), FBG and MAP did not show any change with varying PSC35 levels.

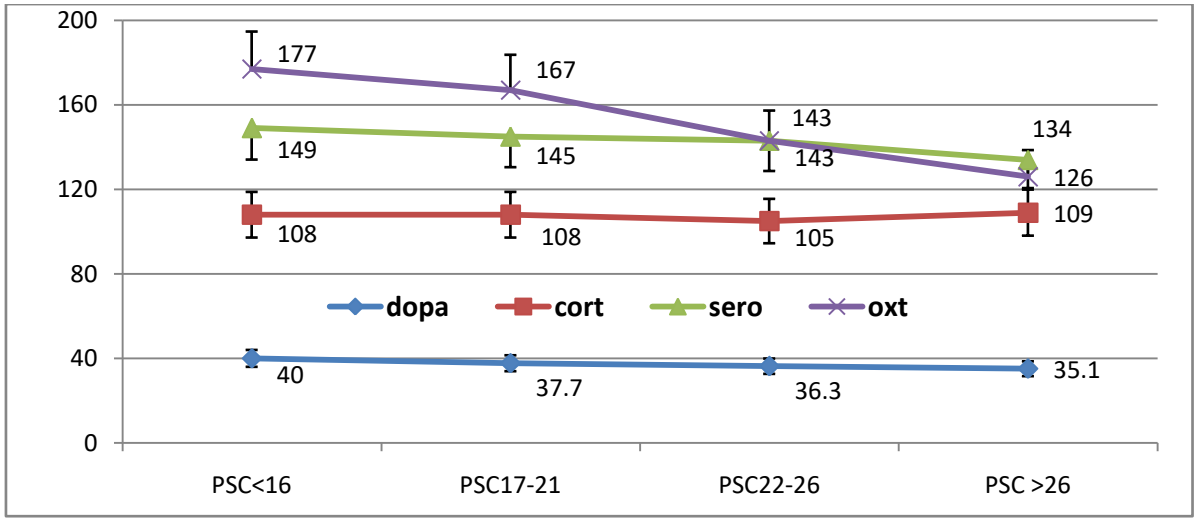

Figure-1A: *Mean values of Dopamine, Cortisol, Serotonin and Oxytocin by quartiles (Q1 = <16, Q2 = 17-21, Q3 = 22-26, Q4 = >26) of PSC35. Oxytocin showed declining as PSC35 rising, though not significant. Other neurotransmitters showed no change.*

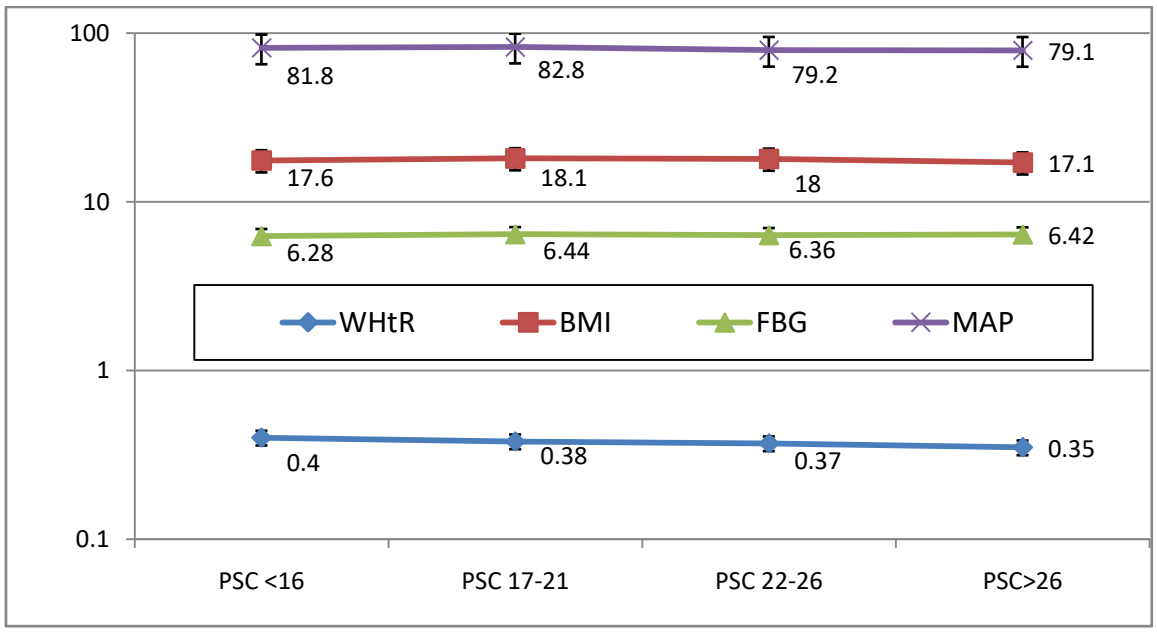

Figure-1B: *Mean values of WHtR, BMI, FBG and MAP by quartiles (quartiles (Q1 = <16, Q2 = 17-21, Q3 = 22-26, Q4 = >26) of PSC35) of PSC35.*

Multiple comparisons of biophysical variables, based on PSC –tertiles, were estimated by ANOVA (Post-hoc, Scheffe) in Tables-6a and 6b. Of all four neurotransmitters, only OT was found to be associated with higher PSC (182.6 pg/ ml in the first tertile vs. 124.3 pg/ ml in third tertile; p = 0.008). This finding indicates that PD was significantly associated with lower OT level.

Furthermore, the studied risk variables were estimated by binary logistic regression taking PSC35 ≥23 as the dependent variables (Table-7). The analysis also proved low OT (<110 pg/ ml) was a significant predictor of psychological dysfunction.

Table-6a: *ANOVA: multiple comparisons of biophysical variables by post hoc (Scheffe) based on PSC35 Tertiles of Pediatric symptoms Checklist 35 as dependent*

Descriptive statistics of variables by PSC35 tertiles

Variables	PSC tertiles	N	Mean	SD	95% CI	
BMI	1.00	93	17.8	2.6	17.2	18.3
	2.00	78	17.8	2.95	17.1	18.4
	3.00	79	17.6	3.9	16.7	18.5
	Total	250	17.7	3.20	17.3	18.1
WHR	1.00	93	0.81	0.08	0.80	0.83
	2.00	78	0.85	0.06	0.84	0.87
	3.00	79	0.85	0.07	0.83	0.87
	Total	250	0.84	0.07	0.83	0.85
MAP	1.00	88	82.9	10.1	80.8	85.1
	2.00	76	79.5	9.4	77.4	81.7
	3.00	78	79.5	8.5	77.6	81.4
	Total	242	80.8	9.5	79.6	82.0
FBG	1.00	92	6.3	0.82	6.1	6.5
	2.00	77	6.4	0.97	6.2	6.6
	3.00	78	6.3	0.88	6.1	6.5
	Total	247	6.3	0.88	6.2	6.4
Dopamine	1.00	93	40.0	25.05	34.8	45.1
	2.00	78	37.6	22.7	32.4	42.7
	3.00	79	34.09	21.7	29.2	38.9
	Total	250	37.3	23.3	34.4	40.3
Cortisol	1.00	93	106.1	60.4	93.7	118.6
	2.00	78	113.5	52.2	101.7	125.3
	3.00	79	104.0	49.4	92.9	115.0
	Total	250	107.7	54.5	100.9	114.5
Serotonin	1.00	93	146.2	53.5	135.2	157.2
	2.00	78	148.3	50.4	136.9	159.6
	3.00	79	136.3	53.0	124.4	148.2
	Total	250	143.7	52.4	137.2	150.3
Oxytocin	1.00	93	182.6	142.5	153.3	212.0
	2.00	78	151.2	102.7	128.0	174.3
	3.00	79	124.3	109.1	99.9	148.7
	Total	250	154.4	122.8	139.1	169.7

BMI – body mass index (weight in kg/height in met sq.), FBG – fasting blood glucose, MAP –mean arterial pressure, WHR – waist-to-hip ratio, PSC35 – pediatric symptom checklist 35.

Table-6b: *ANOVA: multiple comparisons of biophysical variables by post hoc (Scheffe) based on PSC35 tertiles of Pediatric symptom Checklist 35 as dependent*

Multiple Comparisons Post Hoc (Scheffe)

			Mean Diff (I-J)	Std. Error	Sig.	95% CI	
BMI	1.00	2.00	-.00460	.49332	1.000	-1.2195	1.2103
		3.00	.18876	.49162	.929	-1.0219	1.3995
	2.00	1.00	.00460	.49332	1.000	-1.2103	1.2195
		3.00	.19336	.51287	.931	-1.0697	1.4564
	3.00	1.00	-.18876	.49162	.929	-1.3995	1.0219
		2.00	-.19336	.51287	.931	-1.4564	1.0697
WHR	1.00	2.00	-.04036*	.01142	.002	-.0685	-.0123
		3.00	-.03853*	.01138	.004	-.0665	-.0105
	2.00	1.00	.04036*	.01142	.002	.0123	.0685
		3.00	.00183	.01187	.988	-.0274	.0311
	3.00	1.00	.03853*	.01138	.004	.0105	.0665
		2.00	-.00183	.01187	.988	-.0311	.0274
MAP	1.00	2.00	3.41348	1.47955	.072	-.2309	7.0579
		3.00	3.44114	1.46934	.066	-.1781	7.0604
	2.00	1.00	-3.41348	1.47955	.072	-7.0579	.2309
		3.00	.02767	1.52287	1.000	-3.7234	3.7787
	3.00	1.00	-3.44114	1.46934	.066	-7.0604	.1781
		2.00	-.02767	1.52287	1.000	-3.7787	3.7234
FBG	1.00	2.00	-.0812	.1375	.840	-.420	.257
		3.00	-.0038	.1370	1.000	-.341	.334
	2.00	1.00	.0812	.1375	.840	-.257	.420
		3.00	.0773	.1430	.864	-.275	.429
	3.00	1.00	.0038	.1370	1.000	-.334	.341
		2.00	-.0773	.1430	.864	-.429	.275
Dopamine	1.00	2.00	2.37904	3.58223	.802	-6.4428	11.2009
		3.00	5.91341	3.56987	.256	-2.8780	14.7048
	2.00	1.00	-2.37904	3.58223	.802	-11.2009	6.4428
		3.00	3.53437	3.72420	.638	-5.6371	12.7058
	3.00	1.00	-5.91341	3.56987	.256	-14.7048	2.8780
		2.00	-3.53437	3.72420	.638	-12.7058	5.6371
Cortisol	1.00	2.00	-7.36569	8.38761	.680	-28.0216	13.2902
		3.00	2.16053	8.35869	.967	-18.4241	22.7452
	2.00	1.00	7.36569	8.38761	.680	-13.2902	28.0216
		3.00	9.52622	8.72003	.551	-11.9483	31.0007
	3.00	1.00	-2.16053	8.35869	.967	-22.7452	18.4241
		2.00	-9.52622	8.72003	.551	-31.0007	11.9483
Serotonin	1.00	2.00	-2.07197	8.05007	.967	-21.8966	17.7527
		3.00	9.90995	8.02232	.467	-9.8463	29.6662
	2.00	1.00	2.07197	8.05007	.967	-17.7527	21.8966
		3.00	11.98192	8.36911	.360	-8.6284	32.5923
	3.00	1.00	-9.90995	8.02232	.467	-29.6662	9.8463
		2.00	-11.98192	8.36911	.360	-32.5923	8.6284
Oxytocin	1.00	2.00	31.43134	18.56273	.240	-14.2825	77.1451
		3.00	58.32431*	18.49872	.008	12.7681	103.8805
	2.00	1.00	-31.43134	18.56273	.240	-77.1451	14.2825
		3.00	26.89297	19.29841	.380	-20.6326	74.4185
	3.00	1.00	-58.32431*	18.49872	.008	-103.8805	-12.7681
		2.00	-26.89297	19.29841	.380	-74.4185	20.6326

** The mean difference is significant at the 0.05 level.*

Table-7: *Binary logistic regression estimated the risks for psychological dysfunctions taking PSC35 ≥23 as the dependent and others as independent variables. Method – Backward stepwise, conditional*

	Independent variables	B	SE	Sig.	Exp(B)	95% CI for EXP(B)	
						Lower	Upper
Step 1a	whtr2(1)	.301	.293	.305	1.351	.760	2.399
	fbg2(1)	.307	.306	.315	1.359	.747	2.474
	dopa2(1)	.315	.279	.259	1.370	.793	2.367
	cortis2(1)	-.294	.298	.323	.745	.415	1.336
	serotn2(1)	.467	.278	.093	1.596	.925	2.753
	oxt2(1)	.663	.306	.030	1.940	1.066	3.531
	Constant	-1.480	.375	.000	.228		
Step 2a	whtr2(1)	.303	.292	.300	1.354	.763	2.401
	fbg2(1)	.286	.304	.346	1.331	.734	2.413
	dopa2(1)	.313	.278	.261	1.368	.793	2.361
	serotn2(1)	.444	.277	.108	1.559	.907	2.681
	oxt2(1)	.554	.283	.050	1.740	.999	3.031
	Constant	-1.550	.369	.000	.212		
Step 3a	whtr2(1)	.205	.272	.452	1.227	.720	2.091
	dopa2(1)	.324	.278	.244	1.382	.802	2.382
	serotn2(1)	.428	.275	.120	1.533	.894	2.630
	oxt2(1)	.622	.274	.023	1.862	1.088	3.186
	Constant	-1.371	.312	.000	.254		
Step 4a	dopa2(1)	.317	.277	.253	1.373	.798	2.364
	serotn2(1)	.428	.275	.120	1.534	.895	2.630
	oxt2(1)	.613	.273	.025	1.845	1.080	3.152
	Constant	-1.254	.268	.000	.285		
Step 5a	serotn2(1)	.483	.270	.074	1.622	.955	2.754
	oxt2(1)	.657	.270	.015	1.930	1.137	3.276
	Constant	-1.141	.246	.000	.320		

a) Variable(s) entered on step 1: whtr2, fbg2, dopa2, cortis2, serotn2, oxt2; b) variables removed from equations – cortisol on step2, FBG on step3, WHtR on step4 and dopamine on step5.

Discussions

The study is the first of its kind with regard to – a) screening of behavior and conduct disorder in childhood and adolescence in a Bangladeshi population; b) addressing some major biological risks (neurotransmitters) related to PD (ADHD, CD, ODD). The importance of the study is focused on identifying risks in early life, which may help prevent juvenile crimes, eventually preventing serious adult delinquencies. Therefore, the future impact of this study is enormous, expecting acrime-free healthy society.

There have been a substantial number of studies related to "mental health disorders" conducted in Bangladesh [1,13-16]. Most studies addressed prevalence, causes and / or risks of juvenile delinquencies in Bangladesh. All these study conclusions were mostly limited to incriminating – family disharmony, inequality, illiteracy, migration, poverty and social environment. None of them addressed biologic risks like nutritional abnormalities (malnutrition, obesity), metabolic abnormalities (blood pressure, blood glucose) and those related to neurotransmitters (dopamine, serotonin, cortisol, OT). In this regard, this study explored a new horizon to delve into.

Many studies justify future research on the role of OT in psychological development and maintenance [3,5,6–10]. More and more studies are emphasizing neurotransmitters' (chemical messengers) role in

modulating behavior, personality, empathy, emotion, socializing aptitude and so on [17–22].

This study encompassed some biologic variables to determine whether any of them had an association with PD. The collected data was presented in eight tables and two figures. The baseline information on these variables related to mental health dysfunction could not be compared due to the scarcity of such studies among the secondary school children. The study findings may be taken as future reference for this age group population.

All the presented data (Table-4, 5, 6a, 6b and figure-1A) indicated lower OT was significantly associated with psychological dysfunction. Additionally, binary logistic regression (Table-7), of all the investigated variables unequivocally proved, low OT to be an important predictor of this disorder. The risk association of this study is consistent with all the above cited literature.

It is not overemphasized that this study attempted to create public awareness regarding the starting point of juvenile delinquencies, as varying psychosocial disorders among childhood originate very insidiously. Neither the children nor their parents, teachers, caretakers are aware of the effect of neurotransmitters on psychosocial abnormalities. These OT deficient children are usually traumatized by their family members, neighbors, teachers, friends and peers. These innocent and underdog children born with OT deficiency, lacking social bonding ability, behave unfriendly, receiving unkindness in return, are often traumatized. Thus, this creates a vicious cycle. This is an unfortunate condition, exposed to an unfavorable society with no love, no affection and no empathy leading them only to despair–likely to commit crimes.

Some literature had extensive reviews explaining OT regarding diverse mechanisms, physiological effects, Nature's' medicine and therapeutic promise [5,8,9,10]. Its multifaceted physiological effects invite the attention of mental health professionals for psychiatric, developmental, and neurodegenerative disorders.

Denoting our limitations, we could not analyze the association between OT deficiency and metabolic syndrome, though central obesity had a significant negative correlation with OT ($r= -0.212$, $p<0.01$). Endorphin and encephalin, the other neurotransmitters could not be included. Finally, the history of parenting, socio-economic status, dietary habits, sleep, physical activities and cultural practices, which influence mental health, could not be assessed.

Conclusions

The study estimated the prevalence of PD among the school students. Additionally, it investigated the biological variables influencing mental health problems. It studied neurotransmitters along with obesity, blood pressure and blood glucose for the association with psychosocial abnormalities. Low OT level was proved to be an important risk. Further study may be initiated to confirm or establish the study findings.

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Authors' contribution

NT: Protocol writing, questionnaire development; RM, NA, SA: questionnaire development; AHGM: performed biochemical tests; MAS: research idea, study design, data analysis, manuscript writing.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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