

Original Article

ASSOCIATION OF NUTRITIVE VALUE AND COGNITIVE PERFORMANCE IN ADOLESCENT GIRLS OF EASTERN UTTAR PRADESH

**Durgesh Singh¹, Shashi Prabha Singh¹, Kshitij Raj²,
Mirza R U Beg¹, Devraj Yadav³**

1. Department of Anatomy, Maa Vindhyavasini Autonomous State Medical College Mirzapur, India
2. Department of Community Medicine, Maa Vindhyavasini Autonomous State Medical College Mirzapur, India
3. Department of Paediatrics, Maa Vindhyavasini Autonomous State Medical College Mirzapur, India

ABSTRACT

Introduction: Food insecurity (FI) is a pressing concern affecting millions globally, particularly adolescents, impacting physical and cognitive health. Studies highlight its association with poor cognition, emphasizing the critical need for understanding and addressing this issue.

Materials and Methods: The study, conducted in urban slums of Saharanpur district, India, employed a community-based, cross-sectional design. Systematic random sampling was utilized, with 384 adolescent girls selected. Data collection included socio-demographic profiles, household food security assessment, cognitive performance evaluation, and morbidity analysis.

Results: Findings revealed a significant prevalence of morbid conditions among adolescent girls, including anemia, dental issues, and respiratory problems. Household food insecurity correlated with socio-demographic factors and significantly impacted cognitive performance, manifesting in high levels of anxiety, depression, and psychological distress.

Conclusions: Over 50% of adolescent girls in the study faced household food insecurity, with notable cognitive impairment and numerous morbidities. These results underscore the urgent need for public health interventions addressing food insecurity and socio-economic disparities, particularly in urban slum settings. Effective strategies should ensure access to nutritious food and promote socio-economic stability to mitigate the adverse effects of food insecurity on adolescent health and well-being.

Keywords : Cross-sectional study, Household food insecurity, Cognition, Adolescent girl, Urban slum, ICD 11

Address for Correspondence:

Dr. Durgesh Singh, Assistant Professor, Department of Anatomy, Maa Vindhyavasini Autonomous State Medical College Mirzapur, India
Email: dr.dpsingh84@gmail.com Mob: 9336404981

Date of Receiving: 19 Sep 2023

Date of Acceptance: 27 Oct 2023

ISSN: 0970-1842



INTRODUCTION

Food insecurity (FI) is the nutritionally capable ability to achieve the foods in culturally acceptable ways is narrow or ambiguous [1]. 79.5 crore people on earth face food insecurity [2], and FI is of swell care as less diet position changes the somatic and cognition of adolescents in the growing and mature world [3]. Studies on the correlation of food insecurity and poor cognition among adolescents describe that food insecurity will pace impaired cognition [4]. Studies of food deficient less gain of sufficient and nourishing nutriment article [5], decrease well-being, low functional health, shattered occupation, persistent health state, and increased depression and anguish [6]. Usual food instability is a mount people well-being complications of day-to-day less-earnings [7] and significantly positively identical with less employment and culture [8], large family size and food cost [9], and lower character of activity [10].

Cognition depicts a stage of happiness where the person knows to handle the normal stress of day-to-day happenings rapidly and is adept to make an addition to their own neighborhood [11]. The World Health Organization (WHO) described in the year 2014 almost 20% of adolescents go through poor cognition [12]. Adolescence is a critical cause of starting poor cognition, especially at an advanced juvenile stage [13]. Cognition in the midst of adolescents has a definite bond of presence at school, educational attainment,

and eventual energy and freedom [14]. Also, poor cognition adds considerably to health concern deeds and capacity [15].

However, knowledge to describe the relationship in adolescent girls & habitat in slum areas [16]. The community that breathes in urban slums achieves impaired cognition; 34% living down to the starvation edge, 35% have no access to government fitness care machinery, and 17% interdepend on historic physicians for fitness care onset [17].

MATERIAL AND METHODS

Ethics: The study code of conduct was accepted by the Institutional Ethics Committee, MVASMC Mirzapur. The study desires and the agenda were distinctly told to every participant, and they were informed that they were free to withdraw at once without bias. Written informed consent was collected from all study participants. Privacy and confidence were applied all over the study period.

Study Design: The present study was a community-based, cross-sectional study conducted between September 2021 and October 2022 in 6 of 70 urban slum localities in Saharanpur district, India. This urban area is the habitat of slums that have grown continuously since the British era. About 38% of the community are urban poor and slum people, and 70 slums are assigned throughout the city [18].

Sampling: We used a laminated systemic random sampling design to select community-based samples. Initially, 6 slums were selected from 44 based on applications of slum grade laminated by people with probability proportion to size (PPS). As the second sampling stage, families were systematically selected from the slum profile, and girls were randomly chosen [2, 24, 40]. One adolescent girl from each family was selected using a random statistic table. For calculating the sample size, because of the non-availability of data about the prevalence of malnutrition in adolescent girls and varying prevalence of different disorders, the average prevalence of 50% for a confidence level of 95% with a relative precision of 10%, the sample size was 384. Anxiety, depression, loss of behavioral control, and psychological distress were calculated among food-secure and insecure groups.

Selection of Study Participants:

Inclusion criteria: Adolescent girls aged 13 to 19 years.

Exclusion criteria: Adolescent girls with mental illness such as intellectual disability, developmental delay, autism, or any other condition that inhibited communication or the ability to participate in the study were not included.

Data Collection: The survey consisted of: (1) personal profile (socio-demographic and socio-economic characteristics), (2)

household food security, and (3) Cognitive performance. (4) Morbidity.

Food Insecurity: Food insecurity was measured with the Household Food Insecurity Access Scale (HFIAS), which divides participants into a) food-secure or b) mildly, c) moderately, or d) severely food-insecure over the previous 30 days based on the subject recall period. Defendants were interrogated to respond to questions with yes or no response based on their encounter during the previous 30 days. HFIAS scores were used as continuous measures of the degrees of family food insecurity and were calculated by adding outcomes for prevalence-of-event questions for each family. The highest outcome for a family was 27, i.e., the participant answered all nine prevalence-of-occurrence questions with a response code of 3 and the minimum score was 0, i.e., individuals answered “no” to all frequency-of-event questions. Thus, a higher outcome resulted in prominent food insecurity [19].

Cognitive Performance: Cognitive performance was measured with the PGI memory scale, which consisted of ten questionnaires and tasks to judge remote memory, recent memory, mental balance, attention & concentration, delayed recall, immediate recall, retention for a similar pair, retention for a dissimilar pair, visual retention, and recognition. The scale was based on a sketch-up of the last 30 days to go through

Cognitive performance	Level	Score	No of cases	Percentage
Anxiety	Low	9-24	6	1.5
	Medium	25-39	144	37.5
	High	40-54	268	69.79
Depression	Low	4-10	13	3.38
	Medium	11-16	164	42.7
	High	17-23	241	62.76
Loss of behavioral control	Low	9-22	1	0.26
	Medium	23-38	239	62.2
	High	39-53	178	46.3
Psychological distress	Low	24-60	1	0.26
	Medium	61-100	173	45
	High	105-142	244	63.5

Table 1. Cognitive performance of the study subjects

the ascent of anxiety, depression, behavioral control & psychological distress that further designed as low, medium, or high among adolescent girls aged ≥ 13 years. Moderate total memory scores (10 questionnaires, 15 marks each) were classified out of 150 as follows: (1) for anxiety, low 9–24, medium 25–39, and high 40–54; (2) for depression, low 4–10, medium 11–16, and high 17–23; (3) for loss of behavioral control, low 9–22, medium 23–38, and high 39–53; and (4) for psychological distress, low 24–60, medium 61–100, and high 105–142.

In our study findings for all components of cognitive performance, the proportion of participants logistic regressions were run (low vs. medium vs. high) as paired outcomes [20-21].

Morbidity: Physical examination revealed that adolescent girls were suffering from pediatric diseases, and morbidities were classified according to ICD-11 classification [22-23].

Socio demographic characters	Category	Food insecure	Food secure	Test of significance with p value
Age	13-16 years	107	92	$\chi^2=4.65$; df=1; *
	17-19 years	76	109	
Ethnicity	upper caste	13	30	$\chi^2=0.23$, df=2
	other backward caste	86	66	
	schedule caste	101	88	
Number of people in family	≤4	34	67	$\chi^2 = 55.19$; df = 4;***
	>4	123	160	
Number of siblings	≤2	30	65	$\chi^2=19.18$; df= 5; *
	>2	153	136	
Habitation in slum	≤30 years	178	193	$\chi^2=27.22$; df =3;***
	>30 years	5	8	
Education of subject	Primary and lower	98	154	$\chi^2=6.89$; df =2; *
	Secondary and upper	85	47	
Education of mother	Primary and lower	164	104	$\chi^2=22.34$; df =3; ***
	Secondary and upper	25	91	
Education of father	Primary and lower	104	66	$\chi^2 = 92.46$; df = 2; ***
	Secondary and upper	69	145	
Occupation of subjects	Student	140	193	$\chi^2 = 28.87$; df =1; ***
	Work outside	40	11	
Occupation of mother	Home maker	142	180	$\chi^2 = 18.4$; df = 1; ***
	Work outside	40	22	
Occupation of father	Agriculture/labor	88	170	$\chi^2=41.36$; df=2; ***,
	Service/business	70	56	
Family income	1 st tercile	121	19	$\chi^2=15.12$; df=1; ***
	2 nd tercile	40	78	
	3 rd tercile	6	120	

Table 2. Associations between household food insecurity and socio-demographic characteristics

Statistical Analysis: Socio-demographic aspects were transformed in all multivariable logistic regression analyses to conclude the consequences of food insecurity on cognitive performance. Independent variables included in the multivariate analyses were: age, caste, family member, number of siblings, habitation in slum; education level; education of mother; education of father; occupation; occupation of mother; occupation of father; family income. Results were expressed as odds ratios (OR) & with 95% confidence intervals (CI) for paired conclusions of cognitive performance. All tests were two-tailed and p-values of <0.05 were treated as significant. Morbidities were conveyed with percentage. A statistical software IBM-SPSS version 17.0 was used for statistical analysis.

RESULTS

57.8% of adolescent girls were found to have one or more morbid conditions (Fig-1). 372 morbidities were found to be present in 222 sick girls, accounting for 1.67 morbidities per sick girl. Pallor was observed in 55.4%, Jaundice in 1.4%, Clubbing of fingers in 3.2%, Enlarged Lymph node in 8.1%, Hair problems in 15.3%, Angular stomatitis in 4.1%, Dental caries in 35.1%, Geographic tongue in 5.9%, Thyroid problems in 2.7%, Eye problems in 5.9%, Ear problems in 4.9%, Respiratory (throat + Tonsil) problems in 17.6%, and Skin problems in 8.1% (Table 5).

The prevalence per 1000 adolescent girls affected by disorders was determined according to ICD 11. The morbidity reported

Mental Health Status	Level	Food insecure	Food secure	Test of significance with p value
Anxiety	Low	1	5	$\chi^2=75.91$; df =2;***
	Medium	20	24	
	High	18	10	
Depression	Low	2	11	$\chi^2 = 4.14$; df=1; *
	Medium	25	21	
	High	32	26	
Loss of behavioral control	Low	1	0	$\chi^2=38.85$; df 1; ***
	Medium	33	36	
	High	20	18	
Psychological distress	Low	1	0	$\chi^2=166.4$; df 2; ***
	Medium	14	19	
	High	31	20	

Table 3. Association between household food insecurity and cognitive performance
 $p<0.05^*$, $p<0.01^{***}$, $p<0.001$ =significant

	Characters	High anxiety	High depression	High loss of behavioural control	High psychological distress
		OR(95% CI)	OR(95% CI)	OR(95% CI)	OR(95% CI)
Food insecurity	No	1.00(ref)	1.00(ref)	1.00(ref)	1.00(ref)
	Yes	17.129(7.41-39.572)***	17.020(7.306-39.650) ***	8.35(5.29-13.16)	6.798(2.971-15.556) ***
Age	13-16 years	1.00(ref)	1.00(ref)	1.00(ref)	1.00(ref)
	17-19 years	0.974(0.0.517-1.832)	0.048(0.027-0.086)	0.277(0.135-3.572) **	0.048(0.027-0.086) ***
Ethnicity	upper caste	1.00(ref)	1.00(ref)	1.00(ref)	1.00(ref)
	other backward caste	1.349(0.838-2.173)	1.787(1.040-3.069)*	1.591(0.932-2.718)	1.54(1.13-2.08)*
	schedule caste	1.49(1.00-2.23)*	2.55(1.40-4.65)**	1.56(1.19-2.06)***	1.75(1.13-2.72)*
Number of family member	≤4	1.00(ref)	1.00(ref)	1.00(ref)	1.00(ref)
	>4	1.29(0.95-1.76)	1.84(1.16-2.93)	1.591(0.932-2.714)	1.370(0.849-2.209)
Number of siblings	≤2	1.00(ref)	1.00(ref)	1.00(ref)	1.00(ref)
	>2	1.21(0.67-2.18)	1.96(1.08-3.53)*	1.15(0.49-2.7)	1.68(1.20-2.36)*
Habitation in slum	≤30 years	1.00(ref)	1.00(ref)	1.00(ref)	1.00(ref)
	>30 years	3.64(2.17-6.08)***	2.22(1.45-3.40)**	1.97(1.36-2.87)**	1.52(1.15-2.01)*
Education of subject	Primary and lower	1.00(ref)	1.00(ref)	1.00(ref)	1.00(ref)
	Secondary and above	1.582(0.932-2.684)	1.912(1.025-3.566)*	1.90(1.10-3.28)	1.69(1.20-2.36)
Education of mother	Primary and lower	1.00(ref)	1.00(ref)	1.00(ref)	1.00(ref)
	Secondary and above	2.321(1.143-4.714)	3.08(1.67-8.52)	2.143(1.260-3.644)	2.29(1.53-3.43)
Education of father	Primary and lower	1.00(ref)	1.00(ref)	1.00(ref)	1.00(ref)
	Secondary and above	2.063(1.121-3.799)	3.42(2.19-5.34)	3.22(1.78-5.82)**	2.15(1.26-3.68)**
Occupation of subjects	Student	1.00(ref)	1.00(ref)	1.00(ref)	1.00(ref)
	Work outside	5.24(2.77-9.14)**	4.514(2.177-9.360)***	5.93(3.15-11.2)***	5.77(2.77-9.94)***
Occupation of mother	Home maker	1.00(ref)	1.00(ref)	1.00(ref)	1.00(ref)
	Work outside	2.78(1.86-4.14)***	2.925(1.205-7.099)***	1.737(1.014-2.975)*	2.020(1.093-3.735)**
Occupation of father	Service/business	1.00(ref)	1.00(ref)	1.00(ref)	1.00(ref)
	Agriculture/labour	2.778(1.149-6.718)***	3.746(1.743-8.049)**	3.511(1.9176.428)***	3.585(1.961-6.554)***
Family income	1 st tercile	1.00(ref)	1.00(ref)	1.00(ref)	1.00(ref)
	2 nd tercile	2.063(1.21-3.799)*	2.245(1.098-4.589)*	2.321(1.143-4.714)*	2.143(1.260-3.644)***
	3 rd tercile	6.798(2.971-15.556)***	7.177(3.344-15.409)*	7.575(3.511-16.343)*	9.05(4.81-17.1)***

Table 4. Logistic regression analyses of relations between cognitive performance and household food insecurity and subject characteristics determined by multivariate analysis of odds ratio(OR)&CI 95%.

Tuberculosis at 7.5, Scabies at 35, Nutritional anaemia at 307.5, Disorders of the thyroid gland at 15, Disorders of the conjunctiva at 12.5, Disorders of the external and middle ear at 27.5, and Acute upper respiratory infections at 97.5.

DISCUSSION

The present study reported high anxiety at 69.79%; high depression at 62.76%; medium loss of behavior at 62.2%; and high psychological distress at 63.5%. A similar study reported high anxiety, depression, psychological distress, and loss of behavioral control [24]. Living in urban slum households with poor quality of life was suggested to influence the mental health status of adolescent girls [25].

The present study reported associations between household food insecurity and socio-demographic characteristics. A study reported that 50% suffered from food insecurity, and 4.5% of households suffered moderately and severely from food insecurity, which is higher than studies conducted in the USA, Canada, France, Ethiopia, and South Africa [30]. In the present study, family member ≤ 4 vs. >4 , number of siblings ≤ 2 vs. >2 , and habitation in the slum ≤ 30 vs. >30 reported significant similarities to a study conducted in an urban slum [23].

This study found significant associations between the mother's occupation (homemaker vs. work outside) and father's occupation (agriculture/labour vs. service/business) and family income (1st tercile vs. 2nd tercile vs. 3rd tercile) [24, 26]. All cognition factors showed significance compared with a low family income in the first and second terciles, being more likely to have mental health issues [24, 26].

In the present study, associations were found between cognitive performance and household food insecurity and subject characteristics for paired conclusions of cognitive performance. All cognition factors related to household food insecurity showed significance in slum habitation. Similarly, it was reported that those living in lower socioeconomic status, disabled individuals, and housewives living in slums are at risk of poor mental health status [27]. Adolescent girls' occupation (student vs. work outside) was significant. Job shock has an impact on mental health [27]. Furthermore, they must work as adults, and elevated mental health problems are frequent among employed adolescent girls [29].

In our study, cognitive factors such as anxiety, depression, loss of behavioral control, and psychological distress were significant. Except for high loss of behavioral control, all factors showed significance in

food insecurity. A study of multivariate analysis showed that household food insecurity was strongly associated with high anxiety, high depression, high loss of behavioral control, and high psychological distress, which are consistent with the results of many other studies [30]. Despite no occasional mechanism between HFI and negative cognition being settled, the confusion of food supplies maintenance enhances stresses that might contribute to low cognition.

More importantly, HFI may increase the risks of anemia, lower nutrient intakes, cognitive problems, aggression, and anxiety. Studies have shown that anemia affects cognition by its direct neurochemical effect and by its indirect effect on behavior, as individuals become less attentive and less responsive. The main pathogenesis may be iron, throughout the white matter, being more in the basal ganglia. Iron deficiency anemia affects cognition by causing a decrease in the iron concentration in the brain, hence reducing neurotransmitter levels leading to hypomyelination and delayed neuromaturation [41, 43].

High depression and high psychological distress factors showed significance in siblings, and only the high depressed factor showed significance in the education of subjects. High depression and high psychological distress in the Other

Backward Class, and all factors in the Scheduled Caste, were significant, compared to similar studies, which also show adolescent girls from socio-economically disadvantaged groups (Scheduled Caste/Scheduled Tribe) [24].

In the present study, all factors were significant in the occupation of subjects and the occupations of the mother and father. A paper reported that socioeconomically disadvantaged adolescents with a persistent low socioeconomic status were more likely to develop mental health problems [33], and poverty has direct effects on adolescent mental health [26]. Subjects' education, mother's education, and father's education (primary & lower vs. secondary & upper) reported significant findings. Loss of behavioral control and psychological distress factors showed significance in the education of the father, compared to the study, where paternal education of primary or lower places teenage daughters at risk of mental health problems [24]. A study reported that fathers with a primary school level of education had significantly higher emotional and behavioral problem scores than fathers educated to higher levels [41].

In the present study, high loss of behavioral control and high psychological distress factors and the ratio of age 13-16 years vs. age 17-19 years reported significant findings compared to having lower levels of anxiety,

depression, and psychological distress than older teenage girls (17–19 years) [24]. Although most mental disorders begin between the ages of 12–24 years, they are often detected in later life [28]. A study reported that around half of lifelong mental disorders start before 14 years of age [29], and the Australian National Survey of Mental Health and Wellbeing (NSMHWB) found that 27% of 18- to 24-year-olds had mental disorders [42].

57.8% of adolescent girls were sick with one or more morbid conditions, and 372 types of morbidities were present in 222 sick girls, accounting for 1.67 morbidities per sick girl. Pallor was observed in 55.4%, dental caries in 35.1%, and respiratory problems in 17.6%. The prevalence of nutritional anemia was reported highest at 307.5 in adolescent girls compared to morbidity per 1000. Due to infection in the upper respiratory tract (97.5), diseases of the oral cavity (55), diseases of the skin including scabies (35), and the percentage of prevalence of diseases of the middle and external ear (27.5%), diseases of the thyroid (15%) were reported.

The study reported anemia (55.5%), dental caries (37.2%), pediculosis (31%), URTI (17.5%), refractory errors (13.4%), and acne (11%) [36]. Another study reported the prevalence of inadequate oral hygiene (55.4%), pediculosis (39.2%), cold & cough (25.8%), lymphadenopathy (22.2%), scabies

(16.2%), inflamed tonsils (7.8%), fever (7.5%), and ear discharge (7%) among adolescent girls [32]. A study reported that 94.5% of girls had one or more morbid conditions, with pediculosis (87.5%), dental caries, and skin disorders (50% each), worm infestation (18.3%), ENT disorders (17.5%), clinical anemia (5.8%), and defective vision (4.7%) [37].

Based on these reports, importance should be given to the importance of early mediation to improve mental health outcomes in adolescents. Our results do not rule out the possibility that poor mental health status among adolescent girls causes household food insecurity [34].

Limitations: The study has several limitations. First, we did not compare the degrees of associations between adolescent girls from households with marginal, low, or very low food security and mental health, or between adolescent girls and household heads. Because this study was conducted on a homogenous population of adolescent girls living in slum areas, we were unable to compare relations between adolescent girls living in slum areas and non-slum areas or between male and female adolescents. Second, we conducted the study with a small sample size that might suffer from poor external validity. Third, in the statistical analyses, we treated low and medium food insecurity as one category. Fourth, because

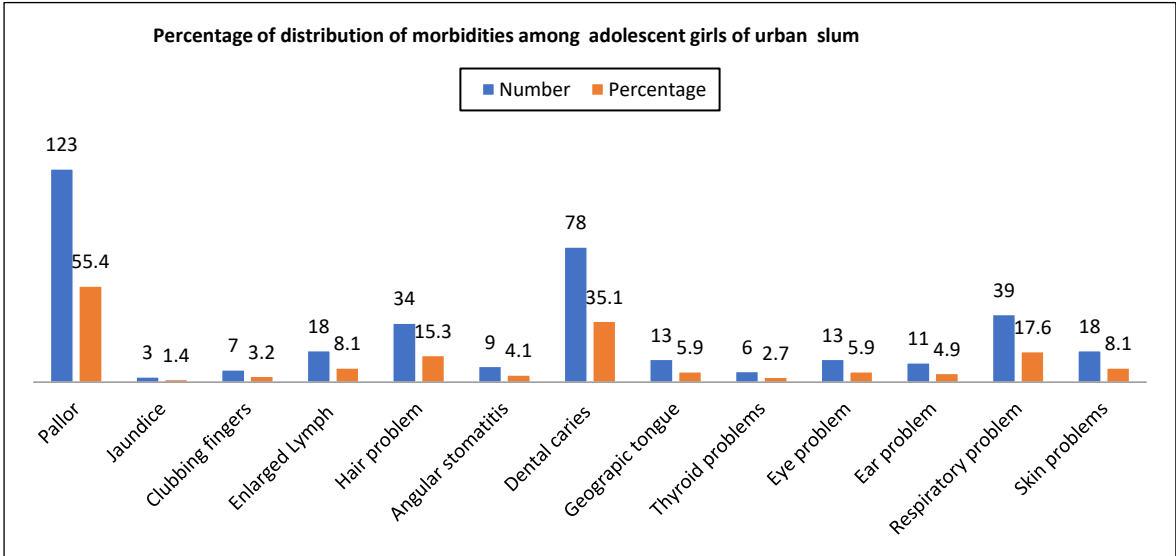


Fig. 1. Distribution of girls according to various morbidities

Code	Diseases	No.	Prevalence/1000
A15-A19	Tuberculosis	3	7.5
B85-B89	Scabies	14	35
D50-D53	Nutritional anaemias	123	307.5
E00-E07	Disorders of thyroid gland	6	15
H10-H13	Disorders of conjunctiva	5	12.5
H65-H75	Disorders of external and middle ear	11	27.5
J00-J06	Acute upper respiratory infections	39	97.5
K00-K14	Diseases of oral cavity, geographic tongue, angular stomatitis	22	55

Table 6. Prevalence of morbidities among adolescent girls

of the cross-sectional nature of the study, we report only associations as we could not determine causalities. Finally, some potential confounders, such as exposure to violence, were not adjusted for in the present study, which may have impacted mental health outcomes [35].

CONCLUSION

Approximately more than 50% of adolescent girls were affected by household food insecurity and experienced cognitive impairment, anxiety, depression, psychological distress, and loss of behavioral control, with 372 types of morbidities present in 222 sick girls, accounting for 1.67 morbidities per sick girl. These results are much greater than those reported in the developed world. In our study, food insecurity was independently associated with impaired cognition, requiring clear-cut public health interventions that include access to tolerable, safe, and nutritious food and socio-economic changes to be implemented. Food insecurity in Indian slums should be addressed by specific public health intervention programs that provide access to satisfactory, nutritious food.

REFERENCES

1. Anderson SA. Core indicators of nutritional state for difficult-to-sample populations. *J Nutr.* 1990;120:1555-1600.
2. Food and Agriculture Organization; International Fund for Agricultural Development and World Food Program. *The State of Food Insecurity in the World 2014. Strengthening the Enabling Environment for Food Security and Nutrition.* Rome, Italy: Food and Agriculture Organization; 2014.
3. Eicher-Miller HA, Zhao Y. Evidence for the age-specific relationship of food insecurity and key dietary outcomes among U.S. children and adolescents. *Nutr Res Rev.* 2018;10:1-16.
4. Pryor L, Lioret S, van der Waerden J, Fombonne E, Falissard B, Melchior M. Food insecurity and mental health problems among a community sample of young adults. *Soc Psychiatry Psychiatr Epidemiol.* 2016;51:1073-1081.
5. Bocquier A, Vieux F, Lioret S, Dubuisson C, Caillavet F, Darmon N. Socio-economic characteristics, living conditions and diet quality are associated with food insecurity in France. *Public Health Nutr.* 2015;18:2952-2961.
6. Vozoris NT, Tarasuk VS. Household food insufficiency is associated with poorer health. *J Nutr.* 2003;133:120-126.
7. Carter KN, Lanumata T, Kruse K, Gorton D. What are the determinants of food insecurity in New Zealand and does this differ for males and females? *Aust N Z J Public Health.* 2010;34:602-608.
8. Laraia BA, Siega-Riz AM, Gunderson C,

- Dole N. Psychosocial factors and socioeconomic indicators are associated with household food insecurity among pregnant women. *J Nutr.* 2006;136:177-182.
9. Ahmed UI, Ying L, Bashir MK, Abid M, Zulfiqar F. Status and determinants of small farming households' food security and role of market access in enhancing food security in rural Pakistan. *PLoS ONE.* 2017;12:e0185466.
10. Gregorio MJ, Rodrigues AM, Graca P, de Sousa RD, Dias SS, Branco JC, Canhao H. Food insecurity is associated with low adherence to the Mediterranean diet and adverse health conditions in Portuguese adults. *Front Public Health.* 2018;6:38.
11. World Health Organization. Adolescent Mental Health: Mapping Actions of Nongovernmental Organizations and Other International Development Organizations. Geneva, Switzerland: World Health Organization; 2012.
12. World Health Organization. 10 Facts on Mental Health, 2014. Available from: http://www.who.int/features/factfiles/mental_health/mental_health_facts/en/ (accessed May 5, 2018).
13. Thomsen PH. Schizophrenia with childhood and adolescent onset—A nationwide register-based study. *Acta Psychiatr Scand.* 1996;94:187-193.
14. Olweus D. Bully/victim problems among schoolchildren: Basic facts and effects of a school-based intervention program. *Eur J Psychol Educ.* 1991;17:411-448.
15. Stephens T, Joubert N. The economic burden of mental health problems in Canada. *Chronic Dis Can.* 2001;22:18-23.
16. United Nations Human Settlements Programme. The Challenge of Slums: Global Report on Human Settlements 2003. London, UK and Sterling, VA, USA: Earthscan Publications Ltd; 2003.
17. Jha DK, Tripathi V. Achieving millennium development goals and India vision 2020: Evidences from the slums of Varanasi city. *SAC.* 2015;2:4.
18. Census of India. Varanasi Slum Profile at Glance Report, 2011. New Delhi, India: Office of the Registrar General & Census Commissioner, India Ministry of Home Affairs, Government of India; 2011.
19. Coates J, Swindale A, Bilinsky P. Household Food Insecurity Access Scale (hfias) for Measurement of Food Access: Indicator Guide. Washington, DC, USA: Food and Nutrition Technical Assistance Project, Academy for Educational Development; 2007.
20. Kalita BC, Tripathi Y, Garg R, Chaudhary L. Effect of examination stress on cognitive performance and EEG in medical students. *Int Arch Integr Med.* 2019;6:15-20.
21. Kalita BC, Tripathi Y, Garg R, Chaudhary L. Effect of Examination Stress on Memory and EEG. *Ann Int Med Dent Res.* 2020;6:6-9.

22. Park K. Park's Textbook of Preventive and Social Medicine. 19th ed. India: Bhanot; 1999. p. 547.
23. Avci D, Selcuk KT, Kaynak S. The magnitude and determinants of emotional-behavioral problems in working adolescents in Turkey. *Arch Psychiatr Nurs*. 2018;32:44-50.
24. Veit CT, Ware JE. The structure of psychological distress and well-being in general populations. *J Consult Clin Psychol*. 1983;51:730-742.
25. Bairwa M, Rajput M, Sachdeva S. Modified Kuppuswamy's socioeconomic scale: Social researcher should include updated income criteria. *Indian J Community Med*. 2013;38:185-186.
26. Agarwal S, Sethi V, Gupta P, Jha M, Agnihotri A, Nord M. Experiential household food insecurity in an urban underserved slum of North India. *Food Secur*. 2009;1:239-250.
27. Rani D, Singh JK, Acharya D, Paudel R, Lee K, Singh SP. Household Food Insecurity and Mental Health Among Teenage Girls Living in Urban Slums in Varanasi, India: A Cross-Sectional Study. *Int J Environ Res Public Health*. 2018;15:1-15.
28. Jha DK, Tripathi V. Quality of life in slums of Varanasi city: A comparative study. *Transactions*. 2014;36:2.
29. Dashiff C, DiMicco W, Myers B, Sheppard K. Poverty and adolescent mental health. *J Child Adolesc Psychiatr Nurs*. 2009;22:23-32.
30. Lasalvia A, Bonetto C, Tosato S, Zanatta G, Cristofalo D, Salazzari D, Lazzarotto L, Bertani M, Bissoli S, De Santi K, et al. First-contact incidence of psychosis in northeastern Italy: Influence of age, gender, immigration and socioeconomic deprivation. *Br J Psychiatry*. 2014;205:127-134.
31. Knipe DW, Gunnell D, Pieris R, Priyadarshana C, Weerasinghe M, Pearson M, Jayamanne S, Dawson AH, Mohamed F, Gawarammana I, et al. Is socioeconomic position associated with risk of attempted suicide in rural Sri Lanka? A cross-sectional study of 165,000 individuals. *BMJ Open*. 2017;7:e014006.
32. Benvegna LA, Fassa AG, Facchini LA, Wegman DH, Dall'Agnol MM. Work and behavioural problems in children and adolescents. *Int J Epidemiol*. 2005;34:1417-1424.
33. Sorsdahl K, Slopen N, Siefert K, Seedat S, Stein DJ, Williams DR. Household food insufficiency and mental health in South Africa. *J Epidemiol Community Health*. 2011;65:426-431.
34. Kessler RC. The effects of stressful life events on depression. *Annu Rev Psychol*. 1997;48:191-214.
35. Singh J, Singh JV, Srivatava AK, Suryakant. Health status of Adolescent girls in slums of Lucknow. *Indian J Community Med*. 2006;31:102-103.
36. Reiss F. Socioeconomic inequalities and mental health problems in children and

- adolescents: A systematic review. *Soc Sci Med.* 2013;90:24-31.
37. Kaiser L, Baumrind N, Dumbauld S. Who is food-insecure in California? Findings from the California Women's Health Survey, 2004. *Public Health Nutr.* 2007;10:574-581.
38. Chilton MM, Rabinowich JR, Woolf NH. Very low food security in the USA is linked with exposure to violence. *Public Health Nutr.* 2014;17:73-82.
39. Gaur A, Subhash S. Morbidity pattern of adolescents in higher secondary school girls, Rohtak. In: *Souvenir XXX National conference Indian Association of Preventive and Social Medicine.* Belgaum; 2003. p. 92.
40. Srinivasan K, Prabhu GR. A Study of the Morbidity Status of Children in Social Welfare Hostels in Tirupati Town. *Indian J Community Med.* 2006;31:3.
41. Singh S, Garg G, Mishra S. A Community Based Study to Know The Impact Of Parental Educational Status On Nutritional Profile Of Adolescent Girls In Rural Areas of Hapur District. *Int J Dent Med Sci Res.* 2020;4:1-5.
42. Agarwal S, Kumar S, Ingole V, Acharya S, Wanjari A, Bawankule S, Raisinghani N. Does anemia affect cognitive functions in neurologically intact adult patients: a cross-sectional study at rural tertiary care hospital. *J Family Med Prim Care.* 2019;8:3005-3008.
43. Andrews G, Hall W, Teesson M, Henderson S. The Mental Health of Australians. Canberra, ACT, Australia: Mental Health Branch, Commonwealth Department of Health and Aged Care; 1999.
44. Khedr E, Sherif AH, Elbeih E, Shereef HE, Ahmed Y, Ahmed S. Iron states and cognitive abilities in young adults: neuropsychological and neurophysiological assessment. *Eur Arch Psychiatry Clin Neurosci.* 2008;258:489-496.
45. International Classification of Disease (ICD-11). Morbidity and Mortality Statistics.
46. Lee A, Lewis M. Testing the Price of Healthy and Current Diets in Remote Aboriginal Communities to Improve Food Security: Development of the Aboriginal and Torres Strait Islander Healthy Diets ASAP (Australian Standardised Affordability and Pricing) Methods. *Int J Environ Res Public Health.* 2018;15:1585.