

RESEARCH ARTICLE

Open Access



Evaluation of physical and mental health status of orphan children living in orphanages in Sonitpur district of Assam: a cross-sectional study

Putul Mahanta^{1*}, Kahua Das Thakuria², Pinky Goswami³, Chandana Kalita⁴, Ranjumoni Knowler⁵, Madhab Chandra Rajbangshi⁶, Senjam Gojendra Singh⁷, Jagadish Basumatary⁸ and Plabita Majumder³

Abstract

Background: Orphan children living in orphanages are often neglected. These children's physical and mental health status is essential as they are highly prone to malnourishment and psychosocial distress. We aim to evaluate the orphan children's physical and psychosocial status living in orphanages.

Methods: This study adopted a cross-sectional research design conducted with the children living in the orphanages using a pretested, predesigned schedule. A total of 83 children (aged 5 to 19 years) living in three different orphanages in the Sonitpur District of Assam were randomly selected for the study. Body Mass Index (BMI) for age and height were then determined using WHO standards. Thinness was defined as BMI for age below -2 SD (Standard Deviation) and thinness as height for age below -2 SD. The behavioural and mental status of children aged 10–19 years were evaluated using the Strengths and Difficulties Questionnaire (SDQ-21) with a cut-off value of SDQ score > 15 as the presence of emotional and behavioural distress.

Results: Almost 50% of orphans were in the age group of 10–14 years, 62.7% were females, and 42.2% had a primary level of education. 52.5% of orphans exhibited severe thinness for < -3 SD. Observed severe thinness more among the 5–9 years and 10–14 years (p -value < 0.05) group and among the male orphans (p -value < 0.05). Of 65 children aged 10–19, 18.5% had behavioural and mental distress. Emotional (32.3%) and poor conduct problems (23%) were observed significantly among male adolescents.

Conclusions: Orphaned children, particularly those living in orphanages, are at risk of malnutrition and experience behavioural and psychosocial problems. Frequent assessments of their physical and mental health are advocated for early detection, prevention, and timely intervention.

Keywords: Balanced diet, BMI, Thinness, Homeless children, Mental health

Background

An orphanage is a residential institution for taking care of and educating orphans. Children living in orphanages are a socially vulnerable group often neglected by mainstream society and are more prone to malnutrition [1].

About 24 million children worldwide live without their parents [2], out of which about 8 to 10 million are infants

*Correspondence: drpmahanta@gmail.com

¹ Forensic Medicine and Toxicology, Assam Medical College, Dibrugarh 786002, Assam, India

Full list of author information is available at the end of the article



and children who live in orphanages [3]. In socioeconomically poor Asian countries, placing deprived children in orphanages has long been practised with few or no emotional and financial resources [4, 5].

Children in institutionalised care are continually in danger of undernutrition, overweight and micronutrient deficiencies [6], and they tend to be neglected [7]. Urban malnutrition is an increasing problem globally [8] and is more severe among children living in orphanages. Apart from malnutrition, children in orphanages also suffer from infectious diseases [9].

With its continuing concern for the health and well-being of children, particularly those existing in underprivileged living conditions, the United Nations Emergency Fund proposed a series of systematic studies under the auspices of different research agencies, including the social welfare ministry and the Government of India [4].

The most vulnerable children are those who have lost both parents. They lack the emotional and physical maturity to address their psychological trauma [5] and are at greater risk of developing depression and anxiety disorders [10]. Children living under institutional care often suffer from developmental and behavioural problems due to the lack of family care and support [11]. Various works suggest that the prevalence of mental and behavioural problems among those underprivileged children ranges from 18 to 60% [12–15]. The child's overall development is influenced by behavioural and mental problems, which may negatively impact their academic and social outcomes as adults [16].

Though limited in number, most of the orphanages in the Sonitpur district of Assam are in urban areas. Many of these orphans report various illnesses related to nutritional deficiency and are brought to the only tertiary care hospital in the Sonitpur district of Assam for different diseases. Also, research about those underprivileged children's behavioural and mental status is scarce in this region. Therefore, the present study evaluates the physical and psychosocial status of orphan children living in orphanages.

Methods

A cross-sectional study was carried out at Tezpur Medical College and Hospital, Tezpur, Assam, among children aged 5 to 19 years living in orphanages in the Sonitpur district from October 2017 to October 2019. A pretested, predesigned questionnaire has been used for the data collection on the physical health of orphan children. A total of 83 orphan children living in three different orphanages of Sonitpur district meeting the inclusion criteria were randomly selected for the study.

The pretested and predesigned questionnaire included the participants' socio-demographic profile, anthropometric measurements, and physical and dental examination status. Anthropometric measurements were used to estimate the nutritional condition of teenagers. Height was recorded using a Stadiometer (Raja Industries, Agra, India) and weight by an electronic weight scale (Industrial weighing Machine (Activa Corporation, Tamil Nadu) wearing no shoes with light clothing. WHO guidelines were used to calculate BMI and height for age. Thinness was defined as BMI for age below -2 SD and stunting as height for age below -2 SD. Trained medical practitioners did physical health assessments for various nutritional disorders and dental health problems among the participants. Before implementation, the questionnaire was presented to an expert panel for validation. Also, it was pretested on four children each from the three orphanages, and further modifications were incorporated. To assess the behavioural and mental status of orphans of age ten years and above, the Strengths and Difficulties Questionnaire (SDQ self-report version) was used [17]. An SDQ score of > 15 was considered as the existence of emotional and behavioural problems.

The SDQ is a brief mental and behavioural problem screening questionnaire for children and adolescents. It comprises 25 attributes divided into five scales, i.e., emotional, conduct, hyperactivity/inattention, peer relationship, and pro-social behaviour, consisting of five items each. Several versions of the questionnaire are available to fulfil the needs of various users. There are SDQ versions for parents or educators of children aged 2–17 years and self-rated SDQ versions for 11–17-year-olds with or without impact supplements [18]. The impact supplements questions include chronicity, distress, social impairment, and burden to others, thus offering additional information for the observers. It has the advantage of a short format, is effective in identifying hyperactivity and inattention compared to other similar tools [17, 19], and is widely used globally [11, 20, 21]. Goodman et al. reported sensitivity of SDQ ranging from 81%–90% and specificity of 47% to 84% [22].

Statistical analysis

The study findings were described through counts and percentages. To test the association between categorical variables, the Chi-square test was used. For small sample sizes with greater than 20% of cells having expected cell counts less than 5, Fisher exact test was performed for statistical significance testing, considering a *p*-value of less than 0.05 as significant.

Table 1 Distribution of the orphans according to socio-demographic characteristics

Socio-demographic characteristics		No. of orphans (n = 83)	Percentage
Age (in years)	5–9	18	21.7
	10–14	41	49.4
	15–19	24	28.9
Gender	Male	31	37.3
	Female	52	62.7
Educational Level	Illiterate	11	13.2
	Primary School	35	42.2
	Middle School	13	15.7
	Drop-out	24	28.9

Ethics approval

Ethical clearance was obtained from the Institutional Human Ethical Committee of Tezpur Medical College and Hospital, Tezpur, Assam, India, with Ref: 20/17 dated 08/08/2017. Before collecting the data, informed consent was taken from the participant and the legal guardian in the case of a minor.

Results

A large number of orphans (49.4%) were between the ages of 10–14, and 62.7% were represented by females with a primary level of education for 42.2% of participants, as shown in Table 1.

A relatively greater number, 32(38.6%) orphans, exhibited severe thinness (< -3SD). The height-for-age was normal (> -2SD) for all 83(100%) orphans, as shown in Table 2.

Severe thinness was more among the orphans aged 5–9 years and 10–14 years than those in the 15–19 age group, which was found significant (p-value < 0.05). Severe thinness was also more among the male orphans than the females (p-value < 0.05), as shown in Table 3.

On physical examination, pallor was detected in 4(5%) cases. During a clinical dental examination, 33(40%) orphans showed unhygienic dental habits like dental staining and dental caries in 4% of cases, besides other findings like calculus and decay, as shown in Table 4.

The behavioural and psychological conditions of the study children were assessed with SDQ. Out of 65 children of age ten years and above, 12(18.5%) had an SDQ score > 15, among whom the majority of 8(66.7%) children belonged to the 15–19 years age group (p-value = 0.018). Out of the 12 children having an SDQ score for positive psychosocial distress, 7(58.3%) were males. However, no statistically significant association was observed between the psychological condition of the children and gender, as shown in Table 5.

Emotional problems were observed among 21(32.3%) children. Almost 26% of the children had poor pro-social behaviour, and 23% had conduct problems. Emotional

Table 2 Nutritional status of the orphans

Nutritional status of the orphans			No. of orphans (n = 83)	Percentage
BMI for Age	Severe thinness	< -3 SD	32	38.6
	Thinness	< -2 SD to -3 SD	24	28.9
	Normal	-2 SD to + 1 SD	27	32.5
	Overweight	> + 1 SD to + 2 SD	0	0
	Obesity	> + 2 SD	0	0
Height for age	Severely stunted	< -3 SD	0	0
	Stunted	< -2 SD to -3 SD	0	0
	Normal	> -2 SD	83	100

BMI Body Mass Index, SD Standard Deviation

Table 3 Age and gender-wise distribution of thinness in orphans

Demographic Characteristics		Severe thinness ¹ (32)	Thinness ² (24)	Normal ³ (27)	p-value
Age (In years)	5–9 (n = 18)	11(61.1)	5(27.8)	2(11.1)	0.01
	10–14 (n = 41)	18(43.9)	11(26.8)	12(29.3)	
	15–19 (n = 24)	3(12.5)	8(33.3)	13(54.2)	
Gender	Male (n = 31)	21(80.0)	3(6.7)	7(13.3)	< 0.001
	Female (n = 52)	11(36.0)	21(20.0)	20(44.0)	

Figures in the brackets are the percentages; ¹Severe thinness was defined as BMI for age below -3 SD; ²Thinness was defined as BMI for age < -2 SD to -3 SD; ³Normal defined as BMI for age -2 SD to + 1 SD

BMI Body Mass Index, SD Standard Deviation

Table 4 Distribution of orphans as per the dental examination

Signs/Symptoms	Number of orphans (83)	Percentage
Normal	8	9.6
Enamel Stain	33	39.7
Malocclusion	27	32.5
Calculus	31	37.3
Gingival recession	11	13.2
Decay	16	19.3
Missing teeth	11	13.2
Irregular spacing	6	7.2
Dental caries	4	5.0
Upper anterior spacing	4	5.0

Table 5 Age and gender-wise distribution of SDQ score in orphans

Demographic Characteristics		SDQ Score > 15	SDQ Score ≤ 15	p-value
Age	10-14 (n=41)	4	37	0.018
	15-19 (n=24)	8	16	
Gender	Male (n=24)	7	17	0.08
	Female (n=41)	5	36	

(*p*-value=0.019) and conduct problems (*p*-value=0.03) were observed significantly more among the 15–19 years age group, while hyperactivity (*p*-value 0.8), poor pro-social behaviour (*p*-value=0.18) and peer problems (*p*-value=0.70) were mostly experienced among 10–14 years age group, as shown in Fig. 1.

Similarly, genderwise analysis showed that emotional problems (*p*-value=0.004), conduct problems

(*p*-value = 0.006) and hyperactivity or inattention (0.046) were significantly more among males, as shown in Fig. 2.

Discussion

The result reports that a majority (49.4%) of orphans are in the 10–14 age group. Vaida N [4] also reported similar findings in his study.

The majority (38.6%) of the orphans were malnourished, reflected by severe thinness of <-3SD. Reddy SB et al. [1] also reported similar findings in their study on orphans. The same research has indicated that malnourishment is 57.7%, and stunting is 53.3% among orphan children. In their research, Chowdhury, ABMA et al. [7] mentioned about 60.03% of malnourishment among the studied children agree with the current findings.

Malnourishment, specifically undernutrition, was observed more among younger children than older children, supported a study [6]. There is a statistically significant association between thinness and age and gender; these findings were well tallied with some research investigations [1, 7].

The condition was normal concerning the height for age, as 100% of children were healthy in the current study. Similarly, as per Waterloo’s Classification in a survey of Vaida N [4], height for age was normal for more than half of the children studied.

On general physical examination, 79(95%) orphans were normal without any signs of pallor, found only in 4(5%) cases. The findings were similar to those reported in research [4]. The same research also supports the stained dental enamel observed in 40% of patients in the present study. In contrast to our findings, a study from Jammu and Kashmir reported nutrition-specific morbidities among 53% of the participants [23]. Another study

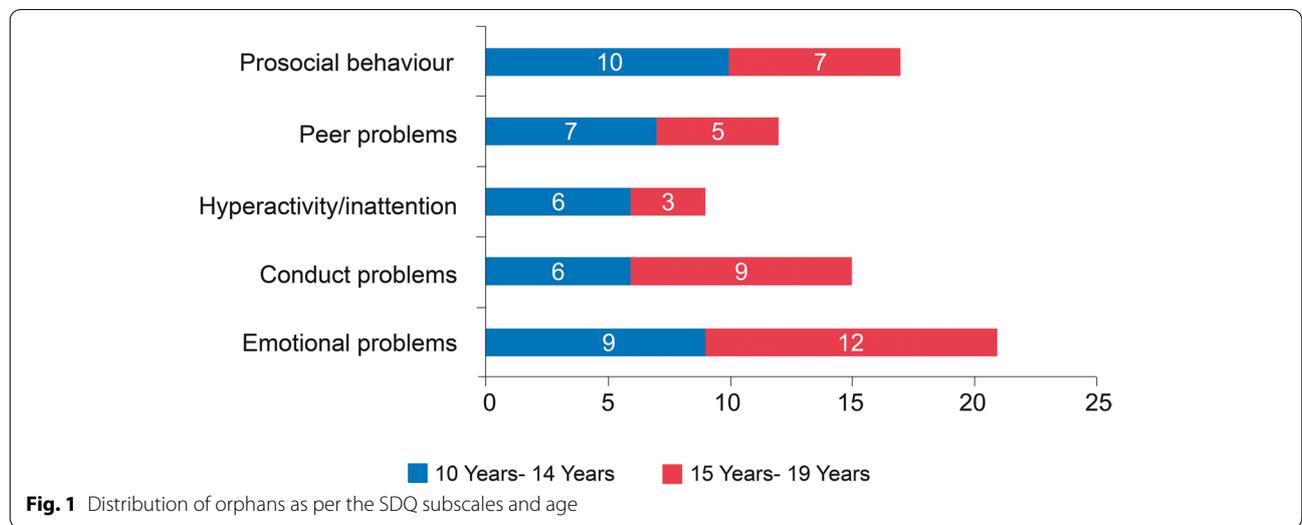
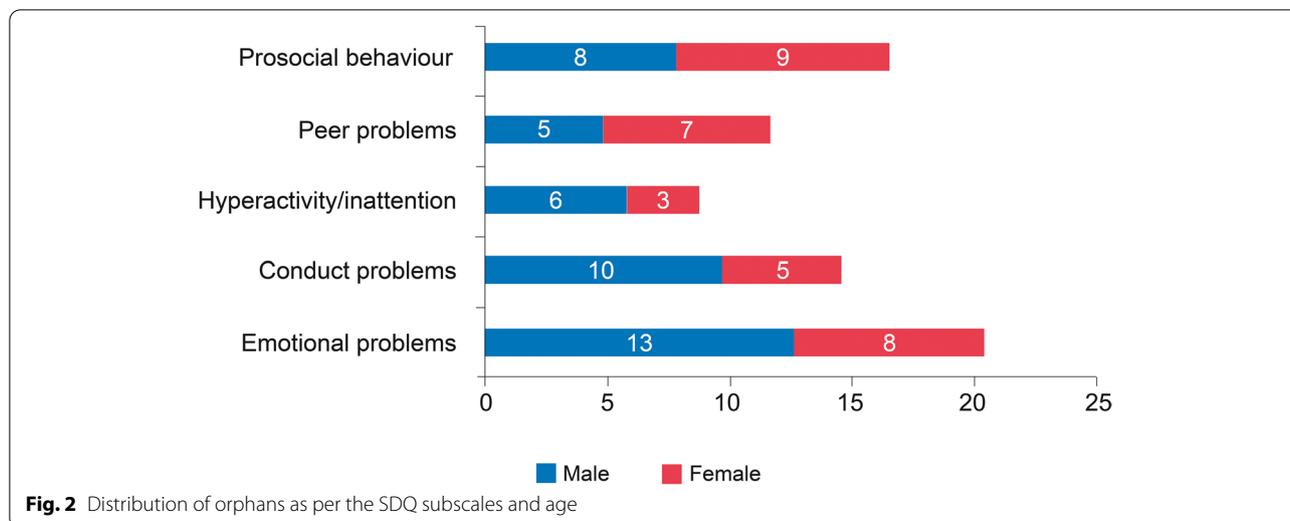


Fig. 1 Distribution of orphans as per the SDQ subscales and age



from southern India reported poor physical health with multiple morbid conditions in 65% of the orphan children they studied [24, 25].

Dental caries in 5% of children in the present study were observed. It may be caused by the demineralisation of the enamel and the dentine by organic acids released from the sugars in the diet, supporting a study [26]. The organic acids increase the solubility of the calcium hydroxyapatite present in the teeth’ hard tissue, resulting in demineralisation, as described in research [27].

Further, the results in the present study also revealed malocclusion in 32.5%, calculus in 37.3%, and gingival recession in 13.2%, besides decay in 19.3% of orphans, which were the signs of bad oral hygiene. The findings demonstrate a connection between diet and oral health, and the excellent state of oral health is correlated with a balanced diet. At the same time, incorrect nutritional intake relates to a form of oral disease. Some studies support these present findings [28–30]. A recent study conducted among children of various age groups living in orphanages in Kerala reported very high rates of dental caries, which contradicts our findings [31]. The same study suggested that those who had been shown by someone how to clean their teeth were 40% less likely to get caries [31].

In the present study, 18.5% of the 10–19 years old orphan children were contained with behavioural or mental distress. A study [11] reported similar findings in their research outcome. As per recent literature, the global prevalence of behavioural and emotional problems ranged from almost 18% to 65% among orphans and other susceptible children [11]. As these children

are more exposed to abuse and mistreatment, often neglected in mainstream society and lack love and care, they are more prone to psychosocial distress.

Conduct and emotional issues were mainly found among orphans of adolescent age and males. A recent review [32] supports this result that orphan children are more prone to develop various behavioural and mental illnesses like depression, anxiety, and post-traumatic stress disorder. Like our research, multiple studies have cited age and gender as significant factors affecting the psychosocial status of orphan children [11, 32, 33]. Children growing up and living in orphanages have low social connections and risk a lack of education, and job opportunities are the reason for their various behavioural and mental illnesses. They are more prone to develop symptoms requiring psychopathological evaluations [34] to support the needs of this kind of research. A recent study observed that children out of parental care are more prone to develop behavioural disorders than those who live under parental care [35]. To lessen the burden of behavioural problems in orphan children living in orphanages, improvised institutional care is essential.

Limitation

An average dietary recall of 24 h could have been considered though the shelter home did not permit it. It is a single-centre study. For better evaluation of different variables, a multicentre study comprising a large number of samples could have been initiated, which was not done in this study.

Conclusion

Malnutrition is predominantly found in orphans living in orphanages, and this aspect of malnourishment needs to be analysed systematically and addressed scientifically. The children living in orphanages need to be checked frequently so that early detection, prevention, and timely intervention may improve their nutritional status.

A poor diet is significantly associated with increased oral diseases. Dietary advice for preventing oral diseases must be a part of routine patient education practices, mainly in shelter homes. Screening of these underprivileged children's mental and psychological status should be integrated with primary health care. Specifically, counselling and mental support should be advocated for healthy well-being among adolescents.

Abbreviations

BMI: Body Mass Index; SD: Standard Deviation; SDQ: Strengths and Difficulties Questionnaire.

Acknowledgements

We acknowledge the department's staff members who have helped us complete this project by providing the department's necessary infrastructures. Thanks to M Dutta and B Basumatary for their help in the execution of the research.

Recommendation

A large sample may reflect the severity of the problem in the national context. However, the desired number of orphans was not found in the age group studied in the current study.

Authors' contributions

All authors contributed significantly to work reported, whether in the conception, study design, execution, acquisition of data, analysis and interpretation. PM, KDT, PG, CK, JB, SGS, RK, PM and MCR mainly took part in data collection and drafting. All the authors and RK were involved primarily in revising or critically reviewing the article. All the authors gave final approval of the version to be published, agreed on the journal to which the article has been submitted, and agreed to be accountable for all aspects of the work.

Funding

The North-eastern centre for human and urban development (NECHURD), an academic organization, provided financial support for the study, a charitable organization at Wireless, Dispur-781006, Guwahati, Assam, India. The funding was basically to provide logistical and data collection support.

Availability of data and materials

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Ethical clearance was obtained from the Institutional Human Ethical Committee of Tezpur Medical College and Hospital, Tezpur, Assam, India, with Ref: 20/17 dated 08/08/2017. Written informed consent was taken from the participant and the parent or legal guardian of participants below 16 years before the data collection.

Consent for publication

Not applicable.

Competing interests

None declared.

Author details

¹Forensic Medicine and Toxicology, Assam Medical College, Dibrugarh 786002, Assam, India. ²Physiology, Tezpur Medical College, Tezpur 784010, Assam, India. ³Dentistry, Lakhimpur Medical College, 787001, Lakhimpur, Assam, India. ⁴Govt Dental College, 786002 Dibrugarh, Assam, India. ⁵Radiology, Fakhrudin Ali Ahmed Medical College and Hospital, Barpeta, Assam, India. ⁶Surgery, Tezpur Medical College, Tezpur 784010, Assam, India. ⁷Psychiatry, Regional Institute of Medical Sciences, Imphal 795004, India. ⁸Anesthesiology, Tezpur Medical College, Tezpur 784010, Assam, India.

Received: 19 May 2022 Accepted: 30 November 2022

Published online: 19 December 2022

References

- Reddy SB, Jyothula N, Kandula I, Chintada GS. Nutritional status and personal hygiene of children living in the orphanages of Bhubaneswar: capital city of Odisha. *Int J Community Med Public Health*. 2019;6(1):379–86.
- Wete AT, Zerfu TA, Anbesse AT. Magnitude and associated factors of wasting among under-five orphans in Dilla town, Southern Ethiopia 2018: a cross-sectional study. *BMC Nutr*. 2019;5:33.
- Laurie A. Orphanages are no place for children. *The Washington Post* 2013 Aug 9. https://www.washingtonpost.com/opinions/orphanages-are-no-place-for-children/2013/08/09/6d502fb0-fadd-11e2-a369-d1954abcb7e3_story.html. Accessed 14 Apr 2020.
- Vaida N. Nutritional status of children living in orphanages in district Budgam, J and K. *Int J Humanit Soc Sci Invent*. 2013;2(2):36–41.
- Ahmad LM, Ganesan P. Health and nutritional status of orphan children's living in orphanages with special reference to the district of Anantnag of Jammu and Kashmir. *Int J Indian Psychol*. 2016;3(2):163–9.
- DeLacey E, Tann C, Groce N, et al. The nutritional status of children living within institutionalised care: a systematic review. *Peer J*. 2020;8:e8484.
- Chowdhury ABMA, Wasiullah S, Haque MI, Muhammad F, Hasan MM, Ahmed KR. Nutritional status of children living in an orphanage in Dhaka city. *Bangladesh Malays J Nutr*. 2017;23(2):291–8.
- Elizabeth WKM, Penny AH, Jean-Christophe F, et al. Food security and nutritional outcomes among urban poor orphans in Nairobi. *Kenya J Urban Health*. 2010;88(2):282–97.
- Shalini D, Tulsi DC, Ashish KD. HIV and malnutrition: effects on immune system. *Clin Dev Immunol*. 2012;2012:784740.
- Audrey RT, Lauren W, Lawrence HP, Nicole SR, Linda LC. Childhood parental loss and adult psychopathology: effects of loss characteristics and contextual factors. *Int J Psychiatry Med*. 2008;38(3):329–44.
- Kaur R, Vinnakota A, Panigrahi S, Manasa RV. A Descriptive Study on Behavioral and Emotional Problems in Orphans and Other Vulnerable Children Staying in Institutional Homes. *Indian J Psychol Med*. 2018;40(2):161–8.
- Rahman W, Mullick MSI, Pathan MA. Prevalence of behavioral and emotional disorders among the orphans and factors associated with these disorders. *Bangabandhu Sheikh Mujib Med Univ J*. 2012;5:29–34.
- Nese E, Zeynep S, Ozgur O, Kerim M. Behavioral and emotional problems among Turkish children at ages 2 to 3 years. *J Am Acad Child Adolesc Psychiatry*. 2005;44(1):80–7.
- Doku PN, Minnis H. Multi-informant perspective on psychological distress among Ghanaian orphans and vulnerable children within the context of HIV/AIDS. *Psychol Med*. 2016;46(11):2329–36.
- Shanthi K, JerydaGnanajaneEljo JO. Emotional and behaviour problems of institutionalized street children. *Indian J Appl Res*. 2014;4:135–7.
- Breslau J, Miller E, Breslau N, et al. The impact of early behavior disturbances on academic achievement in high school. *Pediatrics*. 2009;123:1472–6.
- Goodman RM, Meltzer H, Bailey V. The Strengths and Difficulties Questionnaire: a pilot study on the validity of the self-report version. *Eur Child Adolesc Psychiatry*. 1998;7(3):125–30.
- SDQ: Information for researchers and professionals about the strengths and difficulties questionnaires; 2012. [cited 2021 Sept 19]; Available from: <http://www.sdqinfo.com/ahtml>
- Goodman R, Scott S. Comparing the strengths and difficulties questionnaire and the child behavior checklist: is small beautiful? *J Abnorm Child Psychol*. 1999;27:17–24.

20. Sharp C, Venta A, Marais L, et al. First evaluation of a population-based screen to detect emotional-behaviour disorders in orphaned children in sub-Saharan Africa. *AIDS Behav.* 2014;18:1174–85.
21. Suzuki K, Kita Y, Kaga M, et al. The association between children's behavior and parenting of caregivers: a longitudinal study in Japan. *Front Public Health.* 2016;4:17.
22. Goodman R, Ford T, Simmons H, Gatward R, Meltzer H. Using the Strengths and Difficulties Questionnaire (SDQ) to screen for child psychiatric disorders in a community sample. *Br J Psychiatry.* 2000;177:534–9.
23. Ashly Elizabeth Emmanuel, Maheswari S. A study to assess the physical health status of children aged between 6–12 years in selected orphanages of Udipi district during 2008 to 2010. *Int J Bioassays* 6. 01 (2017): 5214- 5217. <https://doi.org/10.21746/ijbio.2017.01.006>
24. Toutem S, Singh V, Ganguly E. Morbidity profile of orphan children in Southern India. *Int J Contemp Pediatr.* 2018;5(5):1947–51.
25. Scardina GA, Messina P. Good oral health and diet. *J Biomed Biotechnol.* 2012;2012:720692.
26. Sheetal A, Hiremath VK, Patil AG, Sajjansetty S, Kumar SR. Malnutrition and its oral outcome-a review. *J Clin Diagn Res.* 2013;7(1):178–80.
27. Scardina GA, Messina P. Good oral health and diet. *J Biomed Biotechnol.* 2012;26(2012):720692.
28. Singh A, Bharathi MP, Sequeira P, Acharya S, Bhat M. Oral health status and practices of 5 and 12-year-old Indian tribal children. *J Clin Ped Dent.* 2011;35(3):325–30.
29. Chicago Dental Society. Good oral health starts with exercise, eating right. *CDS Rev.* 2011;104(2):34.
30. Dye BA, Barker LK, Li X, Lewis BG, Beltrán-Aguilar ED. Overview and quality assurance for the oral health component of the national health and nutrition examination survey (NHANES), 2005–08. *J Public Health Dent.* 2011;71(1):54–61.
31. Christian B, Ummer-Christian R, Blinkhorn A, Hegde V, Nandakumar K, Marino R, Chattopadhyay A. An epidemiological study of dental caries and associated factors among children residing in orphanages in Kerala, India: Health in Orphanages Project (HOPE). *Int Dent J.* 2019;69(2):113–8.
32. Kalpana M. Who will cry for orphans? A review article on orphans' mental health. *Int J Indian Psychol.* 2020;8(3):433–40.
33. Shiferaw G, Bacha L, Tsegaye D. Prevalence of depression and its associated factors among orphan children in orphanages in Illubabor zone, South-west Ethiopia. *Psychiatry J.* 2018;15(2018):6865085.
34. Earls F, Raviola GJ, Carlson M. Promoting child and adolescent mental health in the context of the HIV/AIDS pandemic with a focus on sub-Saharan Africa. *J Child Psychol Psychiat.* 2008;49(3):295–312.
35. Datta P, Ganguly S, Roy BN. The prevalence of behavioral disorders among children under parental care and out of parental care: A comparative study in India. *Int J Pediatr Adolesc Med.* 2018;5(4):145–51.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Ready to submit your research? Choose BMC and benefit from:

- fast, convenient online submission
- thorough peer review by experienced researchers in your field
- rapid publication on acceptance
- support for research data, including large and complex data types
- gold Open Access which fosters wider collaboration and increased citations
- maximum visibility for your research: over 100M website views per year

At BMC, research is always in progress.

Learn more biomedcentral.com/submissions

