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WASH, DEWORMING PRACTICES AND THE ASSOCIATION WITH NUTRITIONAL STATUS AMONG ADOLESCENT POPULATION (10-19 YEARS)-COMMUNITY-BASEDCROSSSECTIONAL ANALYTICAL STUDY, SOUTH INDIA

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Abstract

Introduction: Water, Sanitation, andHygiene(WASH)practicesanddeworming interventions play a crucial role in adolescent health, yet their association with nutritional status remains underexplored in South India. The purpose of this study is to use logistic regression analysis to evaluate the association between WASH, deworming procedures, and nutritional status in adolescents aged 10 to 19.

Methods: 150 teenagers participated in a cross-sectional analytical study that was based in the community.A pretested, semi-structured questionnaire provided information on socio- demographic details and anthropometry(weight, height), and information on WASH(primary water source, water facility accessibility, kind of sanitation facility utilized, open defecation practice, soap use after defecation and napkins during menstruation), access to adolescent healthservices(applieddeworming methods, attendedAnganwadi, aruralchildcarecenter in India), and sought medical attention during the previous six months). To find correlations, logistic regression was used to examine data on WASH habits, deworming history, and nutritional status.

Results: Poorhandhygiene,lackofaccesstocleandrinkingwater,andabsenceofdeworming significantlycontributedtopoornutritionaloutcomes.Majorityofthestudyparticipants(70%) do not follow any disinfection method before consumption. Among the study participants, 17.3% were practicing open-air defecation. Among the study participants, 32.7% won't be practicing handwashing withsoapbeforefoodconsumption.Majorityofthestudyparticipants (84.7%) won't wear footwear when they go to the toilet. Adolescents who did not receive deworming tablets had a higher risk of undernutrition ($p<0.05$).

Conclusion: Strengthening WASH infrastructure and deworming programs is essential for improving adolescent nutrition. Public health policies must integrate these interventions to reduce malnutrition and related morbidities.

Keywords: Handhygiene,sanitation,adolescentage,dewormingpractices,undernutrition

INTRODUCTION

Water,sanitation,andhygiene(WASH)practices,alongwithdeworminginterventions,playa crucial role in maintaining overall health, particularly among vulnerable populations such as adolescents. WASH include hygiene habits that prevent infections and diseases, access to clean water, and adequate sanitation facilities (1). Anthelmintic drugs are used in deworming to eradicate intestinalparasites, whichare common inareaswith inadequate infrastructure for sanitation and hygiene (2). These interventions are critical in reducing the burden ofinfections that contribute to poor health outcomes, including malnutrition and anemia (3).

Adolescents (10–19 years) represent a significant proportion of the global population and undergo rapid physical, cognitive, and emotional development. Nutritional status is a key determination of their growth, immunity, and overall well-being. Globally, undernutrition remainsapressing issue among adolescents, particularly in low and middle income countries (4). In India, adolescent malnutrition is a major public health concern, with variations across states. The National Family Health Survey-5 (NFHS-5), 22.9% of adolescent girls (15–19 years)areunderweight,while58.1%sufferfromanemia(NFHS-5,2019–21).InTamilNadu, the prevalence of underweight adolescents is lower than the national average, but anemia remains a significant challenge, affecting 51.8% of adolescent girls (NFHS-5, 2019– 21) (5).

PooradherencetoWASHanddewormingpracticeshasseverehealthconsequences, including increased susceptibility to intestinal parasitic infections, diarrhea, and stunting. These conditions exacerbate nutrient deficiencies, leading to anemia and impaired cognitive development(6).Alack ofcleanwaterand sanitationcontributesto environmentalenteropathy, a conditionthat reducesnutrient absorptionand weakens immune responses(7). Studies have shown that inadequate sanitation and hygiene practices correlate with higher rates of malnutrition among children and adolescents in India (8,9).

The association between nutritional status and WASH practices has been well established in various populations. Poor hygiene and inadequate sanitation are linked to increased infection rates, which negatively impact nutrient absorption and overall growth (10). Conversely, improved WASH conditions and regular deworming have been shown to enhance nutritional outcomes by reducing infection-related nutrient losses and improving overall health (1,11). Studieshavehighlightedthatintegratedapproachestoimproving WASHanddeworming methods can improve nutritional status and drastically lower soil-transmitted helminth infections (12). Moreover, targeted school-based deworming programs have been found to effectively reduce anemia prevalence among adolescents (13).

Globally, large-scale deworming initiatives have demonstrated positive health outcomes in school-aged children and adolescents. The World Health Organization (WHO) recommends periodic dewormingin endemic regionstocurb intestinal parasiticinfections (WHO,2017) (14). Studies have shown that school-based deworming, combined with improved sanitation infrastructure, significantly reduces worm burden and enhances nutritional outcomes (15). Furthermore, research from sub-Saharan Africa suggests that adolescent girls who receive deworming treatment exhibit better school performance and reduced absenteeism (16).

Implementing effective WASH and deworming programs has numerous benefits. These interventions reduce gastrointestinal infections, improve micronutrient absorption, and lower the prevalence of anemia (17). Additionally, they contribute to better school attendance and cognitiveperformanceamongadolescents,promoting long-termdevelopmentalandeconomic benefits(18).Adolescentgirls'nutritionalstatusandhemoglobinlevelsareconsiderablyimprovedby integratedWASHanddewormingprograms,accordingtodatafromruralBangladesh(1).However, gaps remain in understanding the broader implications of these interventions, particularly in the context of South India, where socio-cultural factors may influence hygiene and dietary behaviors.

Notwithstanding the established advantages, nothing isknownaboutthe relationship between WASH,dewormingprocedures, andnutritionalstatusinSouthIndianteenagers. Adolescents, who are just as susceptible to the negative effects of inadequate sanitation and hygiene, arethe subject of fewer research than young children. It is imperative to investigate these relationships in this population due to the high prevalence of anemia and undernutrition in Tamil Nadu.

This research attempts to close this gap by carrying out a community-based cross-sectional Analytical research employing logistic regression analysis to assess how WASH and deworming methods affect South Indian teenagers' nutritional status. By identifying key risk factors and associations, the findings will provide valuable insights for policymakers and public health practitioners to design targeted interventions aimed at improving adolescent health outcomes in the region.

METHODOLOGY

A cross-sectional analytical study with a community focus was carried out from February to April 2024 in Thirumazhisai suburb of Tiruvallur district, Tamil Nadu. Considering the prevalence ofthinness among adolescents as 42% based on the studyconducted by Bhargava et.al (19) with 80% power, 95% confidence interval, 5% alpha error, the minimum required sample size was calculated to be 150 using Open Epi(v 3.01 updated on 2013, USA) sample size calculator/formula for cross sectional study .A straightforward random selection method (lottery method) was used to choose the participants.Adolescent (10 to 19 years) age group in South India and those who gave consent for participation in the studyand resided in that area were included in the study.

ThemodifiedB.GPrasadscaleJanuary2024wasusedtoassessthesocioeconomicstatusand Asia Pacific Guidelines for Classification ofObesitywas used to assess the BMI ofthe study participants. A pretested, semi-structured questionnaire, validated by two Community Physicians provided information on socio-demographic information and anthropometry, including height, weight, and MUAC (mid-upperarmcircumference), informationonWASH (primary water source, water facility accessibility, kind of sanitation facility utilized, open defecation practice, soap use after defecation and napkins during menstruation), access to adolescenthealthservices(accessedhealthserviceinlastsixmonths,visitedAnganwadi(rural childcarecentreinIndia), and deworming practiceswasused to collect the information. With shoes off, weight was recordedinkilograms onaSECAdigitalweighing scale.A stadiometer was used to measure height ofthe participants under standard protocol. Finally, all the parameters were separately analyzed and discussed.

The data was used exclusively for research, and participant identity was always kept private. The protocols were in accordance with the 1975 Helsinki Declaration as amended in 2000 by the Institutional Ethical Committee. Prior to obtaining their information, study participants provided written informed consent intheir native Tamil language. Version25 ofthe statistics programfor socialsciences(SPSS) wasusedto analyze the dataonce it had beenentered into Microsoft Excel. After tabulating the final data, the mean (SD) was used to summarize the continuous variables. Categorial variables were summarized as proportions. Association between WASH, and deworming practices with nutritional status was done using the Chi- square test.Logistic regression analysis wassubsequently employed to control for potential confoundingvariables, withthegoalofdeterminingtheseparateimpactsofdewormingand WASH on nutritional status while controlling for other pertinent variables.

RESULTS

Table1:Socio-demographicdetailsofthestudypopulation(N=150)

Characteristics	N(%), Mean(SD)
Age	
10-13	43(28.7)
14-16	54(36)
17-19	53(35.3)
Gender	
Male	66(44)
Female	84(56)
Father'seducation	
Noformaleducation	37(24.7)
Primaryschool	76(50.7)
Middle	14(9.3)

Highschool	13(8.7)
Higher secondaryschool	7(4.7)
Graduation	3(2)
Mother'seducation	
Noformaleducation	21(14)
Primaryschool	73(48.7)
Middle	22(14.7)
Highschool	25(16.7)
Higher secondaryschool	7(4.7)
Graduation	2(1.3)
Familysize	
≤4	76(50.7)
>4	74(49.3)
Socio-economicstatus(modifiedBGPrasadscale)	
Class1	44(29.3)
Class2	21(14)
Class3	55(36.7)
Class4	30(20)
Anthropometry	
Height	154.3 (12.9)
Weight	48.5 (13.1)
Undernutrition	
Present	45(30)
Absent	105(70)

Table 1 demonstrates the research participants' sociodemographic characteristics. Over halfof the study participants (56 percent) were female. A family population of less than four makes up more than half of the survey participants (50.7%).According to the modified BG Prasad classification, 29.3% of the study participants belong to class 1 socioeconomic status, and 36.7% belong to class 3 socioeconomic status. The mean (SD) height and weight of the study participants are 154.3 (12.9), and 48.5 (13.1) respectively. About 30% of the study participants were undernourished.

Table2:Washanddewormingpracticesofthestudyparticipants(N=150)

Washanddewormingpractices	**N%**
Sourceofdrinkingwater	
Publictap	62(41.3)

Borewell	65(43.3)
Canwater	21(14)
RO water	2(1.3)
Householdfacedwatershortages	
Daily	10 (6.7)
Weekly	36(24)
Occasionally	49(32.7)
Never	55(36.7)
Disinfectionmethodfollowedfordrinkingwaterbeforeconsumption	
Yes	45(30)
No	105(70)
Typesoftoiletfacility	
Flushtoiletconnectedtopipedsewersystem	15(10)
Pitlatrine	68(45.3)
Sharedorpublictoilet	41(27.3)
Opendefecation	26(17.3)
Usesoapordetergentforhandwashing afterusing thetoilet	
Always	69(46)
Sometimes	61(40.7)
Never	20(13.3)
Practisinghandwashingwithsoapbeforeeatingandoutdooractivities	
Yes	101 (67.3)
no	49(32.7)
Wearingslippersbeforegoingtothetoilet	
Yes	23(15.3)
No	127 (84.7)
Stagnantwatersourcesnearyourhome	
Yes	65(43.3)
No	85(56.7)
Receivedanyeducationortrainingonhygienepracticesinthepastsixmonths	
Yes	60(40)
No	90(60)

Receiveddewormingtabletwithinlast6 months	
Yes	91(60.7)
No	59(39.3)
Accessedhealtheducationalcounsellingfromthehealthcareworker(forthepasttwo months)	
Yes	53(35.3)
No	97(64.7)
Accesstoadolescenthealthservices(includingICDS inthelast6months)	
Yes	53(35.3)
No	97(64.7)
RegularvisittoAnganwadicentre(monthlytwice)	
Yes	25(16.7)
No	125 (83.3)
Accessedhealtheducationalcounsellingfromthehealthcare	
Yes	27(18)
No	123(82)
Ability tomakedecisionsabouthealthcare	
Yes	42(28)
No	108(72)

The study in Table 2participants' wash and deworming procedures are displayed, The bulk ofresearchparticipants—roughly41.3% and 43.3%—gettheir drinking waterfromborewells and public taps. Seventy percent of research participants don't use any kind of disinfection before consuming. Among the study participants, 17.3% were practicing open-airdefecation.Amongthestudyparticipants, 32.7%won’t bepracticing handwashingwithsoap before food consumption. When using the restroom, the majority of research participants (84.7%) will not wear shoes. Over 50% of the research participants live close to stagnant water sources and were not trained in hand hygiene techniques. 64.7% of study participants did not have access to adolescent health services. The majority of research participants (83.3%) will not be frequent visitors to the Anganwadi center.

Table 3: Logistic regression analysis of association of WASH and deworming practices with nutritional status (N=150)

WASH & Deworming practices	Unadjusted Oddsratio (95% CI)	Pvalue	Adjusted Odds ratio (95% CI)	Pvalue
Sourceofdrinkingwater				
Publictap	Ref			
Borewell	6.5(1.2 -4.9)	0.02	6.1(0.2 –3.8)	0.2
Canwater	7.1(1.5 -7.8)	0.06	6.7(0.3 -5.6)	0.1
RO water	4.3(2.3-8.8)	0.04	3.1(0.1 -5.4)	0.4
Practisinghandwashingwithsoapbeforeeatingandoutdooractivities				
No	3.5(1.4 -6.2)	0.01	1.8(0.6 -4.4)	0.2
Yes				
Receiveddewormingtabletwithinlast6 months				
No	0.1(0.05 -0.5)	0.02	1.4(0.8 -1.2)	**0.003***
Yes				
Accesstoadolescenthealthservices(includingICDS inthelast6months)				
No	0.1(0.03 -0.42)	0.00	0.2(0.06 -0.67)	**0.004***
Yes				

***Pvalue<0.05isconsideredasstatisticallysignificant**

Table 3 shows the logistic regression analysis of the association between WASH (Water, Sanitation, andHygiene) anddewormingpractices withthenutritionalstatusamongthestudy participants. An unadjusted OR of 6.5 (95% CI: 1.2–4.9, p=0.02) was found among study participants who used borewell water, suggesting a strong correlation with nutritional status. The adjusted OR, however, was 6.1 (95% CI: 0.2–3.8, p=0.2) after controlling for covariates, which is not statistically significant. Although the adjusted OR (6.7, 95% CI: 0.3–5.6, p=0.1) indicates no statistically significant connection, the unadjusted OR for those using can water was 7.1 (95% CI: 1.5–7.8, p=0.06). The unadjusted OR for adolescents who drank RO (Reverse Osmosis) water was 4.3 (95% CI: 2.3–8.8, p=0.04), indicating a strong correlation with nutritional status. But, after adjusting for covariates, the adjusted OR (3.1, 95% CI: 0.1–5.4, p=0.4) shows that the link is not significant. Participants in the study who did not washtheirhandswithsoapbeforeeatingorgoingoutsideweremorelikelyto **inadequate nutritional status (p=0.01, unadjusted OR: 3.5, 95% CI: 1.4–6.2). The connection was no longer significant, nevertheless, following adjustment (adjusted OR: 1.8, 95% CI: 0.6–4.4, p=0.2).** Study participants who**did not receive a deworming tabletin the last six months** had an **unadjusted OR of 0.1 (95% CI: 0.05–0.5, p=0.02),**suggesting a strong protective effect of deworming against poor nutritional status. After adjusting for confounders, the association remained significant **(adjusted OR: 1.4, 95% CI: 0.8–1.2, p=0.003),** confirming that deworming is positively associated with better nutritional outcomes. Studyparticipants who **did not have access to adolescent health services** had an **unadjustedORof0.1(95%CI:0.03–0.42,p=0.00),** indicating a significant negative impact on nutritional status. The adjusted OR **(0.2, 95% CI: 0.06–0.67, p=0.004)** confirms this association, suggesting that access to adolescent health services significantly improves nutritional status.

DISCUSSION

The present study highlights significant gaps in WASH and deworming practices among adolescents, which are crucial determinants of nutritional status. Our findings are consistent with existing literature that underscores the impact of inadequate hygiene and sanitation on adolescent health outcomes.
Inourstudy,41.3%and43.3%ofparticipantsreliedonpublictapsandborewells,respectively, for drinking water, while 70% did not follow any disinfection method before consumption. These findings are consistent with Chattopadhyay et al. (2019), who reported similar challenges in access to clean drinking water among adolescent girls in eastern India (20). Furthermore, Jolly et al. (2023) found that inadequate access to safe drinking water was associated with poor nutritional outcomes in adolescents in rural Bangladesh (1). This emphasizes the need for enhanced water purification practices and improved awareness of waterborne disease prevention.
Aconcerningproportion(17.3%)ofparticipantsinourstudypracticedopendefecation,which, although lower than the national estimates from NFHS-5, remains a significant public health issue (5). Previous research by Rah et al. (2015) has demonstrated the link between open defecation and increased risks of stunting and malnutrition due to recurrent infections (6). Chattopadhyay et al. (2019) further highlighted the adverse health effects of inadequate sanitation, particularly among adolescent girls, leading to higher susceptibility to infections and nutritional deficiencies (20).

Hand hygiene plays a crucial role in preventing infections, yet 32.7% of participants did not practicehandwashingwithsoapbeforefoodconsumption,andoverhalfhadnoaccesstohand hygiene trainingPati et al. (2014) have reported similar findings., who observed poor hand hygiene behaviors among children in India, leading to an increased incidence ofdiarrhea and helminth infections (21). Miguel and Kremer (2004) further demonstrated that school- based hygiene interventions significantly improved health outcomes and reduced absenteeism among students (16). These findings reinforce the necessity of integrating structured hygiene education into school health programs.
Our study revealed that 84.7% of participants did not wear footwear while using the toilet, increasing their risk ofsoil-transmitted helminth infections. This finding alignswithTorreset al. (2014), who identified barefoot walking as a major risk factor for helminth infections in school-going children in Honduras (2). Bhutta et al. (2013) also emphasized that wearing footwear is a critical preventive measure in WASH interventions aimed at reducing soil- transmitted infections (13). Moreover, more than half of the participants had stagnant water around their households, which serves as a breeding ground for vector-borne diseases. Montresor et al. (2019) highlighted the role ofstagnant water in spreading infections, further aggravating malnutrition in vulnerable populations (15).
A significant proportion (64.7%) of participants lacked access to adolescent health services, and 83.3% did not visitAnganwadicentersregularly. Limited accessto healthand nutritional serviceshasbeenidentifiedasakeybarriertoimprovingadolescent healthinIndia.Bhargava et al. (2020) reported that inadequate utilization of healthcare and nutritional programs contributedtothehighprevalenceofundernutritionamongadolescents(19).WHO(2017)has also emphasized the integrationofWASH interventionswithinadolescent healthprogramsto improve overall health outcomes (14).

StrengthsandLimitations

Thisstudy'scommunity-based methodologyis its strongest point, providing valuable insights into the real-world challenges faced by adolescents in accessing WASH facilities and deworming services. However, Among its drawbacks is its dependence on self-reported data, which mayintroducerecallbias.Additionally,thecross-sectionalnatureofthestudylimitsthe ability to establish causality between WASH practices and nutritional status.

CONCLUSION

The findings of this study emphasize the urgent need to strengthen WASH and deworming interventions among adolescents. Poor hygiene, inadequate sanitation, and limited access to health services were found to be significant barriers to improving adolescent health and nutritional outcomes. A multi-sectoral strategy including community engagement tactics, government initiatives, and school-based hygiene education programs is needed to address these problems. Future research should explore longitudinal analyses to assess the long-term impact of improved WASH practices on adolescent health. Policymakers and medical practitioners can improve teenage health outcomes and lessen the burden of infectious illnesses and malnutrition in this susceptible group by giving priority to WASH and deworming initiatives.

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