Research Article

Exploring the Relationship Between Dietary Practices and Academic Performance of High School Students in Tamale Metropolis, Ghana

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There is a strong emphasis on achieving optimal health through nutrition by students; however, many students tend to care less about their nutritional requirements. A study was conducted to assess dietary practices and their effects on the academic performance of high school students in Ghana. The study hypothesized that dietary diversity has a significant influence on the academic performance of high school students. A cross-sectional analytical survey design was used. A sample of 800 students was randomly selected from five randomly selected senior high schools in the Tamale Metropolis. A questionnaire was used for data collection. Descriptive statistics, Pearson correlation, t-test, and ANOVA at a 0.05 probability level were used in the data analysis with SPSS computer software. The results indicated that breakfast was the most skipped meal, an average of three days a week. Dietary diversity was high among the students; 83.2% consumed six or more different groups of foods within the past 7 days. The majority of the students were from moderate (42.0%) and mild (32.8%) food-insecure households. The age of the students, household size, and parents' employment status significantly ($p<0.05$) affected the dietary diversity of the students. Higher dietary diversity was significantly ($p<0.05$) correlated with English language ($r = 0.119$) and social studies ($r = 0.184$) scores, while it had no significant relationship with mathematics and science scores. In conclusion, dietary diversity impacts the reading scores of students. Therefore, students must be diverse in their food intake for better performance.

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1. Introduction

Numerous factors, such as family characteristics like socioeconomic status (SES), parents' educational level, and attitudes toward education, as well as school quality indicators (like facilities, teaching quality, and allotted teaching time), have a significant impact on cognitive and academic performance [1][2]. While eating habits might have an impact on adolescents' cognitive function and behavior, food composition and meal patterns can have long-term positive or negative consequences since these factors may be related to cognition [3].

A healthy diet and way of life, especially one that includes whole grains, fruits, and dairy products that are high in fiber and nutrients, can have a good impact on children's health and general well-being [3]. Adolescents' ideal development at the physical, mental, and cognitive levels is largely influenced by nutrition and a healthy diet [4]. This is because better cognitive and mental health translates into a higher possibility of better academic success, giving learners more understanding and a more advanced set of abilities, which can then help them achieve a higher socioeconomic level [5].

Adolescent students' food preferences and habits have been linked to outcomes that have an impact on their overall academic achievement and performance [6][4]. Intellectual development may be negatively impacted by nutritional deficits throughout key stages of brain development. When an epidemiological transition occurs in developing or emerging economies like Ghana, where some noticeable gaps and inequalities are partly mirrored by poor nutritional status and/or nutrient deficiencies, this becomes more important to consider [6].

Children's health is at stake when they don't eat enough [7]. A child's health is harmed by coming from a home that lacks food, according to research by Alaimo et al. [8]. Children who did not have enough to eat were more likely to have problems with their health on a biological level, such as decreased food intake, poor food quality, or micronutrient deficiencies, as well as psychological problems, such as elevated stress, concern, and emotions of deprivation [9]. According to Alaimo et al. [8], ensuring that all children are fed adequately should be of utmost importance because it is essential to a child's overall health and well-being. According to a study by Jyoti et al. [10], pupils from households that experienced food insecurity saw their reading scores rise less than those from households that experienced food security.

The price of food is a major factor in determining what to eat [10]. The affordability of the cost is largely influenced by a person's income and socioeconomic standing. High- and middle-income households are

anticipated to generally have a lot more opportunities to buy healthful foods than low-income families [11]. Low-income populations are more likely to have imbalanced diets and consume fewer fruits and vegetables than other groups [12]. Students who lack access to a variety of healthy food options are more likely to be malnourished or to engage in unhealthy eating habits, such as consuming only what is available at home or what their family can afford. These behaviors negatively affect pupils' overall health, intellectual growth, and capacity for productive work [13]. Jyotiet al. [10] found that the majority of students who experience food insecurity at home are more likely to experience poor performance in school as well as difficulty focusing.

Tamale is one of several African communities that suffer from inequality and poor health. Students in Tamale Metropolis Senior High School (SHS) are struggling because of their unhealthful eating habits [14]. At the same time, considerable portions of the general population have poor diets because of food insecurity and/or limited access to food due to mostly financial factors [15]. Teenagers' high metabolic needs for the brain make good eating habits crucial. Up until the age of 16 or 18, children consume more brain glucose than adults [16]. Additionally, it is hypothesized that dietary quality, as represented by good eating habits, and the nutritional value of each item are both associated with academic achievement [17]. This is due to the possibility that one's socioeconomic status (SES) and other personal traits that may affect academic achievement are reflected in their overall diet quality.

Children in high school who consume poorly affect their health, cognition, and ultimately their academic success [18]. It's noteworthy that schoolchildren's diets in developing nations have a limited variety, with a low intake of animal foods, fruits, and vegetables, and a rise in industrially produced foods [19].

Moreover, despite the strong emphasis on meeting nutritional requirements every day to achieve optimal health, many SHS students tend to care less about or neglect their nutritional requirements. It is, therefore, necessary for a study to be conducted to assess the dietary practices of SHS students and how they relate to academic performance in Tamale Metropolis, Ghana. It was hypothesized that dietary diversity has a significant influence on the academic performance of SHS students. This study will help to prompt the students as well as parents to pay attention to the dietary practices of students.

2. Materials and Methods

2.1. Study area

The study was conducted in the Tamale Metropolis, Northern Region of Ghana (Fig 1).

Tamale is the Metropolitan capital city and the regional capital of the Northern Region, Ghana Statistical Service [20]. The Metropolis lies between latitudes 9°16 and 9° 34 North and longitudes 0° 36 and 0° 57 West [20]. Tamale Metropolis has eight senior high schools that offer several programs, including general arts, science, home economics, business, and agriculture, among others.
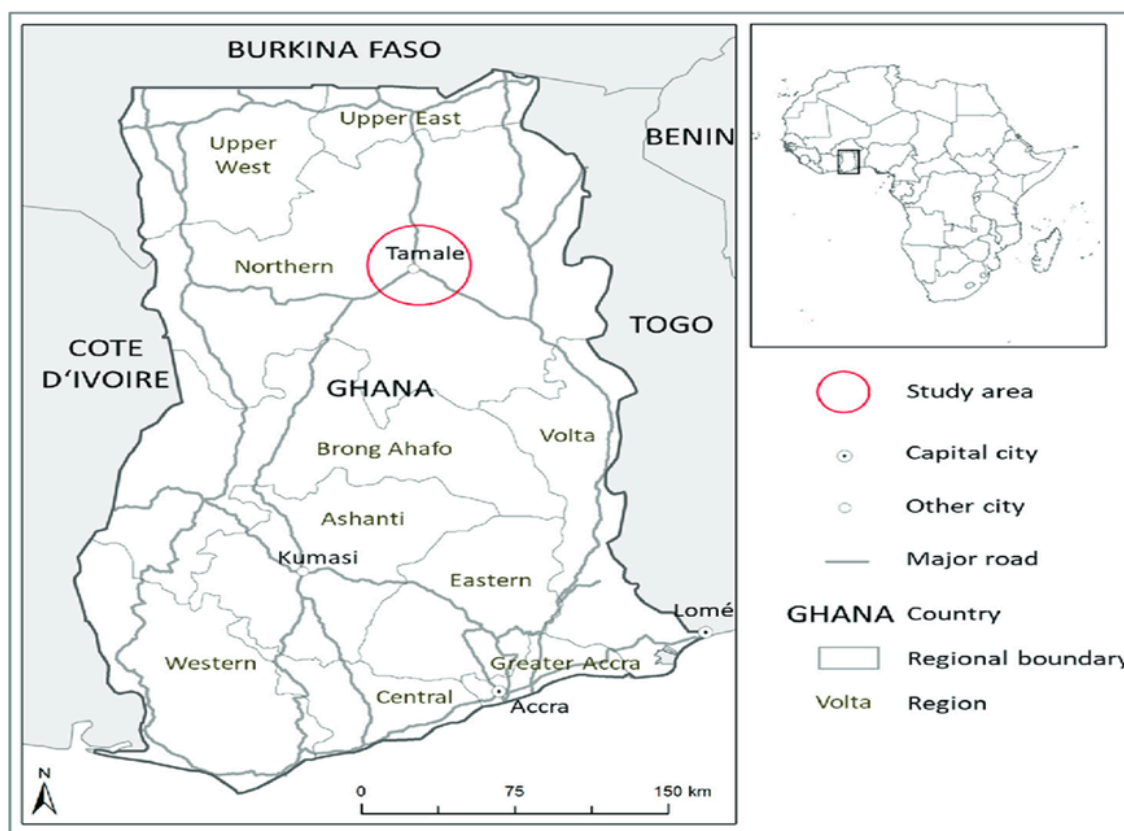

Fig. 1. Map showing the study area. Source: Karget al. [21]

2.2. Research design

The study followed an analytical cross-sectional survey research design. A survey was appropriate for the study because it enabled the researcher to obtain precise information from the respondents. It also

allowed for a multifaceted approach to data collection and analysis [22].

2.3. Sampling

The target population for this study was all senior high school students in Tamale Metropolis. These students were targeted because they make several decisions regarding their choice of food intake and the frequency at which they intend to satisfy their appetites. Five (5) out of eight (8) senior high schools in the Metropolis were randomly selected for the study. The population of the study was 15,250 students. By using the formula by Adam [23] (Eqn 1), a sample of 375 students was determined. For generalization purposes, the sample size was increased to 800 students. The study employed a simple random sampling technique to select 800 students as respondents. The sample selected was able to provide the relevant information required to achieve the objectives of the study.

$$n = \frac{x^2 NP(1-P)}{d^2(N-1) + x^2 P(1-P)} \tag{1}$$

Where: 'N' is the population size (15,250 students), 'n' is the sample size, 'P' is the expected proportion of the population of students accessible = 50% (0.5), 'x^2' is the table value of chi-square at 0.05, which is 3.84, and 'd' is the margin of error, which in this case is (0.05).

$$n = \frac{3.84 \times 15250 \times 0.5 \times (1-0.5)}{0.05^2 \times (15250-1) + 3.84 \times 0.5(1-0.5)} = \frac{14640}{39.0825} = 374.592$$

$$n = 375 \text{ students}$$

The sample size (n=800) was then distributed among the schools by dividing each school's population by the total population, then multiplying by the sample size to get each school's sample allocation.

2.4. Instrumentation

The main source of data was gathered from the respondents during questionnaire administration. Both closed and open-ended questions were used. Secondary data on students' academic performance scores in the four core subjects, which form the basis for entry qualification into tertiary institutions in Ghana, were assessed by the schools.

To assess dietary practices, a dietary diversification table was used. The dietary diversity table consisted of a list of commonly consumed foods. The respondents indicated whether they had consumed different groups of foods from the possible 13 food groups. A score of ≤3 was considered low dietary diversity, 4-6

was considered moderate, and a score of ≥6 was considered high dietary diversity [24]. The 13 food groups were adopted from FAO [25] guidelines for measuring household and individual dietary diversity. The food groups were adopted since the various food groups listed meet the social and cultural context of meals commonly taken and available in the study area.

Household food insecurity was determined using the household food insecurity access scale. This was determined by summing the frequency of occurrence codes [26]. The higher the score, the more food insecurity (access) the household experienced. The lower the score, the less food insecurity (access) a household experienced [26].

2.5. Validity and reliability

The research questionnaires were given to a panel of five experts from the Faculty of Education, University for Development Studies, to validate them. Their comments were used to reconstruct the questions before data collection.

To establish the reliability of the research instrument, the instrument was pilot-tested among three high schools with a sample size of 200 students in the Tolon district. The schools and students had the same characteristics but were not part of the main study. The reliability coefficient (r) was computed using the Cronbach Alpha formula. Reliability was calculated to establish internal consistency, and the outcome had to be between 0.60 and 0.90 to be considered reliable. The reliability of the instrument was 0.771, indicating that the instrument was reliable for data collection.

2.6. Ethical consideration

The significance, purpose, and objectives of the study were adequately explained to the participants so that they could decide whether to partake in the study or not. The respondents were made to understand that their data would be treated with confidentiality. All respondents appended their signatures to the copies of the questionnaire to give their consent to participate in the study.

2.7. Statistical analysis

Descriptive statistics such as frequency and percentages were used to analyze the data collected. Pearson correlation was used to assess the relationship between dietary diversity and student academic performance. T-test and one-way analysis of variance (ANOVA) were used to test the differences in socio-

demographic characteristics, dietary diversity, and household food insecurity. All statistical tests were conducted with SPSS (version 25) at a 0.05 (p<0.05) probability level.

3. Results

3.1. Socio-demographic characteristics of respondents

The mean age of the respondents was 16.1 years, ranging between 13 and 23 years. The majority of the respondents (65.5%) were female. The majority of the respondents' parents were self-employed. It was also revealed that most of the respondents (43.7%) came from larger households (Table 1).

Socio-demographic characteristic	Frequency	Percentage (%)
Gender		
Male	41	34.5
Female	78	65.5
Employment of father		
Self-employed	72	60.5
Formal sector	31	26.1
Unemployed	16	13.4
Employment of mother		
Self-employed	88	73.9
Formal sector	17	14.3
Unemployed	14	11.8
Household size		
1–3	11	9.2
4–6	35	29.4
7–9	21	17.6
10 and above	52	43.7

Table 1. Socio-demographic characteristics of respondents

3.2. Dietary practices of students

3.2.1. Skipping of meals

The majority of the respondents (65.5%) sometimes skipped meals. Breakfast was the most skipped meal, on average three days a week. The top reason for skipping breakfast was being late for school, while lunch and dinner were skipped because the students did not like the available food (Table 2).

Breakfast	%	Lunch	%	Dinner	%
Lack of appetite in the morning	32.8	Did not like the available food	34.5	Did not like the available food	32.8
Lateness for school	52.1	Lack of appetite	20.2	Lack of appetite	18.5
Food for breakfast is not available	19.3	Was still satiated with the breakfast	9.2	Ate lunch late	15.1
Self-perceived overweight	10.9	Had no food or money to buy lunch	24.4	Slept off	15.1
Fasting for religious reasons	9.2	Fasting for religious reasons	11.8	Fasting for religious reasons	11.8
				Had no food or money for food	9.2

Table 2. Reasons for skipping meals

3.2.2. Dietary diversity of the students

The majority of the students were diverse in their food intake (83.2%) (Table 3). Within the past 7 days, the three most consumed foods were all starchy foods (90.8%), all other flesh foods and miscellaneous small animal proteins (90.8%), and small fish eaten whole (86.6%) (Table 4).

Sore range	Frequency	Percentage
Low	3	2.5
Moderate	17	14.3
High	99	83.2

Table 3. Dietary diversity score of the students

Food groups	Yes (%)	No (%)
All starchy staples	90.8	9.2
All legumes and nuts	79.8	20.2
All dairy	52.1	47.9
Eggs	52.9	47.1
Small fish eaten whole	86.6	13.4
All other flesh foods and miscellaneous small animal protein	90.8	9.2
Vitamin A-rich dark green leafy vegetables	84.9	15.1
Vitamin A-rich deep yellow, orange and red vegetables	63.0	37.0
Vitamin A-rich fruits	50.4	49.6
Vitamin C-rich vegetables	76.5	23.5
Vitamin C-rich fruits	52.1	47.9
Vitamin supplement	30.3	69.7
All other fruits and vegetables	83.2	16.8

Table 4. Dietary diversity of the students

3.3. Household food insecurity status

The majority of the respondents were from moderate (42.0%) and mild (32.8%) food-insecure households. The average household food insecurity score was 6.4 (Table 5).

Score	Household food insecurity status	Frequency	Percentage	Household food insecurity mean score
0	Food secure	15	12.6	
1–3	Mild food insecure	39	32.8	
4–6	Moderate food insecure	60	42.0	6.44
7–9	Severe food insecure	15	12.6	

Table 5. Household food insecurity status

3.4. Dietary practices and academic performance

There was a statistically significant and positive relationship (p<0.05) between dietary diversity and students' academic performance in the English language (r = 0.119) and social studies (r = 0.184) scores (Table 6).

Meal skipping	Pearson correlation coefficient (r)			
	English	**Mathematics**	**Science**	**Social studies**
Dietary diversity	0.119*	0.109	0.223	0.184*
Household Food Insecurity	–0.061	–0.119	–0.084	0.059

Table 6. Relationship between dietary diversity, household food insecurity, and academic performance

*Correlation is significant at the 0.05 level.

3.5. Comparing socio-demographic characteristics with dietary diversity and household food insecurity

There was a statistical difference (p=0.02) in the food security status between male and female students (Table 7). The age of the students positively correlated (p<0.05) with dietary diversity scores (Table 8). Moreover, there was a significant difference in the dietary diversity of the students based on the

employment status of their parents (Table 9). There was a significant difference in the household food insecurity status between the household sizes of the students (p = 0.01) (Table 10).

Variable	Gender	N	$\bar{x}$	SD	t/test	P– value
Dietary diversity	Male	41	9.39	0.99	1.58	0.12^{ns}
	Female	78	8.69	0.42		
Household food insecurity	Male	41	5.07	0.37	–2.30	0.02*
	Female	78	7.15	0.86		

Table7. Differences in student's dietary diversity and household food insecurity according to gender

^{ns} = not significant (p>0.05); * = significant (p<0.05)

Variable	Pearson correlation coefficient (r)
	Age
Dietary diversity	0.199*
Household Food Insecurity Access Scale	0.040

Table 8. Relationship between age, dietary diversity, and household food insecurity

* Correlation is significant at the 0.05 level.

Variable	Employment status	N	$\bar{x}$	SD	F	P- value
	The employment status of the father					
Dietary diversity	Self–employed	72	9.21	1.01	3.52	0.03*
	Formal sector	31	9.00	1.02		
	Unemployed	16	7.56	1.08		
	The employment status of the mother					
Dietary diversity	Self–employed	88	9.13	1.02	6.36	<0.01**
	Formal sector	17	9.53	1.06		
	Unemployed	14	7.00	1.06		

Table 9. Differences in employment status of parents and dietary diversity

*** = significant (p<0.01)*

Variable	Household size	N	$\bar{x}$	SD	F	P- value
Dietary diversity	1-3	11	9.64	1.06	0.97	0.41ns
	4-6	35	9.29	1.38		
	7-9	21	8.71	1.41		
	10 and above	52	8.63	1.32		
Household food insecurity	1-3	11	4.64	1.40	3.76	0.01*
	4-6	35	5.31	1.09		
	7-9	21	5.29	1.33		
	10 and above	52	6.44	1.08		

Table 10. Differences in household size, dietary diversity, and household food insecurity

ns = not significant (p>0.05); * = significant (p<0.05)

4. Discussions

4.1. Socio-demographic characteristics of respondents

In the current study, more girls than boys displayed eating behaviors that more closely mirrored those recommended by national and international nutritional guidelines [14][27][28]. These gender discrepancies may be explained by women's higher health consciousness [29]. Concerning food security, females received a considerably higher mean score (7.2) than males (5.1), which suggests that females experience greater food insecurity than men. This might be explained by the fact that men are less concerned with their nutritional demands than women are. Waweru [30] asserts that female adolescents may be more concerned with weight-controlling behaviors than male adolescents.

The average age of the respondents was 16.1 years, ranging from 13 years old to 23 years old. According to Elhassan et [31], this stage of life has the highest nutritional requirements. To guarantee optimal health and physical growth, it is therefore important to monitor the consumption of necessary minerals and

energy. Age and dietary diversity had a statistically significant and favorable connection (p 0.05). This implies that advances in nutritional diversity are related to increasing age or perhaps to growth and maturity. According to Health Behaviour in School-aged Children (HBSC), age differences may be partially related to children being more independent in their food selection as they become older [32].

The students' parents were mostly independent workers. These parents primarily engage in minor trading and subsistence farming. In the Northern region, farming is primarily done once a year, during the rainy season. Due to the likelihood that most parents won't be able to purchase food for their families during the off-cropping season, this may result in financial hardships and food insecurity at the household level. High- and middle-income households are anticipated to generally have a lot more opportunities to buy healthful foods than low-income families [11]. The ANOVA results, which showed that students with employed parents had higher levels of dietary diversity and household food security than students with unemployed parents, confirmed this.

Once more, it became clear that the majority of respondents (61.3%) came from larger families with seven (7) or more individuals. A larger household in Ghana suggests that more money is required to provide for basic needs and boost livelihoods [33]. This suggests that parents may care more about providing basic foods and more starchy foods than they do about providing veggies and fruits. It was discovered that smaller homes with 1-3 persons are more likely to have access to food (mean value of 4.6) than bigger households with 10+ members (mean value of 6.4). Asikhia [34] emphasized that large families are less attentive to their children's needs, which causes problems for the kids.

4.2. Dietary practices of students

Breakfast was the most skipped meal, on average three days a week. Previous studies have reported similar findings [35][36]. The reason for skipping breakfast was being late for school and a lack of appetite in the morning. Lunch and dinner were skipped on average twice a week because the students either did not like the available food or lacked an appetite for eating. In line with these findings, Onyiriukaet al. [37] found a similar trend of meal skipping for the same reasons among adolescents in Nigeria. Teenagers who skip meals do so out of an unhealthy eating habit. According to studies, missing meals, especially breakfast, negatively affects adolescents' nutritional condition, cognitive function, and quality of life [38][37].

Food diversity was high among the students, with 83.2% of them consuming six or more different groups of foods within 7 days. The findings on the high dietary diversity among adolescents were consistent with the findings of Rathiet al. [39] and Kherkheulidzeet al. [40] but were in contrast with the report of Vakiliet al. [41] who found low dietary diversity among adolescents. Since adolescents require a varied diet fortified with micronutrients to prevent the depletion of bodily reserves, higher food diversity is a good sign [42].

Within the past 7 days, over 70% of the students consumed all starchy foods, all other flesh foods and miscellaneous small animal proteins, small fish eaten whole, vitamin A-rich dark green leafy vegetables, all other fruits and vegetables, all legumes and nuts, and vitamin C-rich vegetables. Data from the study indicated that there was a high (90.8%) daily consumption of starchy food. This finding is not surprising, as carbohydrates constitute the staple food in Ghanaian communities, whether urban or rural. Similarly, high daily consumption of carbohydrates was reported among Nigerian [37] and Iranian adolescent school girls [43].

4.3. Household food insecurity status

The findings revealed that most of the students were from moderate and mildly food-insecure households. Moreover, the average household food insecurity score of 6.4 out of 27 indicated the moderate food insecurity status of the students. According to Coateset al. [26], a household that experienced less food insecurity (access) lowers its score on the scale. Alaimoet al. [8] asserts that ensuring that all children are nourished adequately is of utmost significance because it is essential to a child's entire health and well-being. Since pupils may have access to food for healthy growth and cognitive development, the current food insecurity status (moderate) may be a good indicator. However, care must be taken to monitor the students' food insecurity status to prevent it from becoming a serious problem. The outcome of this relationship is that in food-insecure households, dietary diversity will be low.

4.4. Dietary practices and academic performance

The dietary diversity of the students was significantly and positively correlated with the students' academic performance in English language and social studies. This indicates that students with low dietary diversity were more likely to have poor reading scores compared with students who had an adequate variety of diets. Similar observations were made by Amaahet al. [44] in Ghana, Ogunsile [45] in

the Ekiti State of Nigeria, Uzosike et al. [46] in the River state of Nigeria, Abudayya et al. [47], Kim et al. [48] in Korea, and Florence et al. [49] in Canada. These researchers observed that the quality of food, including dietary diversity, which implies nutrient adequacy, was significantly associated with academic performance.

There was no significant relationship between dietary diversity and the academic performance of the students in mathematics and science. This could be attributed to the poor performance of the students in these subjects, the cause of which might not only be nutritional but other interrelated factors. These factors may have a strong confounding effect on mathematics (arithmetic) and science scores. As stated by Jaiswal and Choudhuri [50], a student's academic performance is influenced by socioeconomic factors, child factors, school factors, and nutritional factors, among other unforeseen circumstances.

5. Conclusion

It can be concluded that high school students in Tamale Metropolis, Ghana, are diverse in their food intake. Moreover, higher dietary diversity leads to improvements in academic performance in English language and social studies scores. It is important to emphasize that student dietary practice exerts a significant impact on academic performance; nevertheless, more research is needed to identify strategies to induce a positive behavioral change in students' nutrition and dietary habits, involving the school setting and families.

Statements and Declarations

Ethics

The study involving human participants was reviewed and approved by the University for Development Studies, Department of Agriculture and Consumer Sciences Education Ethics Board. Written informed consent was obtained from all adult participants. For participants under the age of 18, written informed consent was obtained from the participants' legal guardian/next of kin, and assent was obtained from the participants themselves where appropriate according to institutional guidelines. Written informed consent was obtained from the individual(s) and/or their legal guardian/next of kin for the publication of any potentially identifiable data included in this article.

Data Availability

There is no limitation on the disclosure of the data in this research. Data will be made available upon reasonable request.

Acknowledgments

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Declarations