Water Consumption in Primary School Students: Health Implications, Physical Activity, and the Impact of Education

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ABSTRACT

Proper hydration is very important regarding the health and cognitive abilities of the children, especially at the primary school. This paper will survey water intake in terms of primary school students and concentrate on the discrepancies in water intake, the effects of dehydration on school performance, and roles played by physical activity and school programs. The main aim was to measure the methods of hydration and the prerogative of the efficacy of available ecological and environmental studies in marketing water consumption. This conclusion shows that there is a major difference in hydration practices with a high number of students not achieving the recommended daily intake rate hence experiencing subclinical instances of dehydration which impacts on the thinking process, concentration, and academic performance. Even though physical activity raises the levels of hydration, its practice is not always followed by the appropriate level of water intake, which affects the student performance and recovery. The review of the curriculum demonstrates a poor coverage of water education, which is more common in life sciences and suggests an interdisciplinary and more comprehensive solution to the issue, ensuring that the approach toward achieving sustainable hydration behaviors is more coherent. This paper is proposing the integration of hydration education into school's curriculum to increase young learners to develop healthier water consumption behaviors.

Keywords: Hydration, Dehydration, Physical education, Water drinking, Curriculum analysis.

1. Introduction:

- Water comprises about 60 percent of body weight of a child and is important in vital body functions like thermoregulation, provision of nutrients, and removal of wastes in the body [1];[2]. The case with primary school students, a group with a rapid physical and cognitive development, optimum hydration is not only important in advancing growth but also in maintaining academic interest [3]. There have been preceding studies showing that a slight dehydration may affect cognitive abilities like the working memory, selective attention and speed of information processing- the three vital aspects in an academic achievement [4].
- The problem of hydration in the school setting has been identified to be at the backseat of nutrition and lately water is assigned to the second position in the dietary practices of kids [5]. But the increasing cases of obesity among children and the overindulgence of sugary drinks have heightened the pressing need to reevaluate the position of water in the diets of children. Although nutrition and food decisions are the focus of widespread discussion, hydration has often been not regarded as a crucial factor. Schools being organized settings represent an imperative avenue through which the establishment and assessment of healthy hydration behaviors take place. In this connection, ecological education must go further as a conservation of resources but include the personal needs of the human body and the symbiotic association between personal health and the management of global water resources [6];[7].
- The issue of water education has been covered in some school subjects, especially life sciences and physical education. Nevertheless, its success as an integration is still questionable, largely because it has been a scattered concept that is also not particularly transdisciplinary with the linkages of hydration education to other learning environments [8]. A number of studies have also pointed out high rates of variation in water consumption as a result of socio-economic and cultural factors. However, very little research has been done on the convergence of physiological hydration demands of primary students, education programs at the institutions and the quantifiable impacts of dehydration on student achievement [9];[10];[11].
- There has been a found gap in literature in the association of mild dehydration and academic performance of children, especially at the primary school. Although much of the research on the subject has centred on the physical health consequences of dehydration, few studies have been done on the cognitive consequences of the same in young students. Moreover, the literature that has investigated the hydration behaviors in schools has not categorically considered the role of physical activities in determining the hydration requirements of students, never mind that it has also failed to investigate how the existing school curricula covers this. This has led to incomplete understanding of the role of hydration as far as thorough research is concerned hence narrowed the scope of intervention to be used in order to enhance the practice of hydration behaviors [12]; [13].
- This has further led to the fact that the importance of implementing hydration education as a curriculum in school systems has been undervalued even though it can make a difference in health and academic performances. There is a very strong need to address this gap through an in-depth study of the hydration dynamics of primary school students that would enable the educational policymakers to effect the much-needed reform in the approach to education as well as public health.
- This paper will address this gap by conducting research on the topic of hydration dynamics in primary school children. To be more exact, the research hopes to: (1) measure and describe the trends in water drinking; (2) determine how mild dehydration affects cognitive abilities and classroom discipline; (3) identify how physical activity influences the hydrating requirements; and (4) evaluate the place of water education in the school curriculum. Finally, the study aims to give policymakers an idea about how hydration education can be included in the midst of the concept of public health and ecological responsibility, and the practices of hydration could be changed in schools as a preventive health strategy and the continuity of environmental educational efforts.

2. Methodology:

- This research used mixed-method design where both qualitative and quantitative data was utilized hence making the analysis to be thorough in examining the practice of hydration among students in primary schools. The methodological design also attempted to designate the behavioral and the physiological outcomes of dehydration and it also assessed the existing condition of the hydration education in the curriculum. This decision was influenced by the necessity of the ecological validity since in such a way, it was possible to contextualize physiologic data in the realities of everyday life in the school setting. The reason why this triangulation approach was chosen is to optimize the depth of the information and combined observational and reported data, and the ability to make a strong comparison involving the disparate sources of data.

2.1 Study Site and Sampling:

- The study carried out during that school year, the 2024-2025, in a primary school in the Khenifra of Morocco. This particular school was chosen based on the socio-cultural context of that school that reflects the issues with water access in semi-rural settings. Besides, this area is defined by different degrees of ecological consciousness, which makes it a reasonable location to consider hydration habits as a part of an environmental education process. The number of participants involved was 309 (students (aged 5-11), teachers and school personnel). The proportion of the genders was registered as 32% men and 68% women which represents the local population structure. The school administration gave consent to the ethical approval and informed consent was gained with the legal guardians or parents of the students. With the guidelines of ethics, the school staff was also given the consent by the administrative bodies, making the research in line with the ethical guidelines of conducting educational research [14].

2.2 Data Collection Methods:

- The study made use of three primary concepts in order to gather information on hydration behaviours: ethnographic observation, semi-structured interviews and documentary analysis. These procedures were aimed to cover various aspects of approaches to hydration with some being direct observation of student behavior and others the curriculum description [15];[16].

2.3 Ethnographic Observation:

- A 5-week ethnographic study was conducted as a measure of the actual hydration behavior amidst the students. This observation period did not target one particular setting no matter how favorable it might seem, but rather a number of different classrooms, recess time, cafeteria, physical education. The non-participant observations were used in order not to influence the observed behaviors. The most noted variables were the frequency and amount of drink consumption (water, sugary beverages, etc.), drinking water availability, and observable indicators of dehydration, including the cases of dry mouth, fatigue and lethargy. Behavior of students in the classroom was also monitored, since there might be any alteration in their concentration or involvement which could be a sign of dehydrated effects. The observed data were written on a daily basis based on the ethnographic model described by Spradley and that provided the opportunity to study the hydration patterns of the students in detail. This was accompanied by environmental factors that could have informed drinking patterns like water supply and the schedules of breaks. These data came in handy in providing an in-depth report of the hydration habits of the students and would be used to compare with the other sources of data [17].

2.4 Semi-Structured Interviews:

- Semi-structured interviews were held with 15 teachers (who represented different levels of the primary school) and 5 administrators of schools. These interviews were aimed at discussing the way they see the significance of hydration in the health of students including their performance in school with regards to the level of their awareness of hydration practices in school. Teachers were questioned regarding their observations of the symptoms of dehydration in

the classroom and what methods they used to prompt the student intake of water. Also, some questions were asked concerning their perspective on the role of hydration education in the official curriculum. The interview procedure was semi-structured so that it would be flexible enough to have a broad variety of responses and it would be consistent enough in the nature of responses discussed. An interview guide was prepared to be thematized in such a way that it was able to focus the discussion on areas of concern, which included the role of education in instilling the practice of hydration and obstacles to the adoption of effective hydration practices in the school. The recordings of the interviews were transcribed and analyzed thematically to determine the similar themes and observations [18].

2.5 Documentary and Curricular Analysis:

- Documentary and Curricular Analysis Analysis of documents. To measure the inclusion of water education in the official Moroccan school curricula, an exhaustive visit was conducted on the official school curricula of Morocco to assess the inclusion of water education within the subjects of life sciences, physical education and environmental studies. The main focus was to determine how far the curriculum covered the topic of hydration, water conservation, and the ecological significance of water. Specific emphasis was put on the process of situating hydration into the wider setting of health education and communication and the inclusion of hydration in the general well-being. Curricular sources, such as textbooks and learning manuals, were examined to define the frequency and coverage of hydration material. The interest addressed in the analysis was the incorporation of water education in the curriculum at various levels of education. As an illustration, the degree to which the concepts concerning the role played by water in human health were covered, as opposed to the issues surrounding water conservation were tested. This information gave a picture on the existing water education system in the school system and its possible shortcomings in ensuring that the students become conscious of hydration [19].

2.6 Data Analysis:

- Thematic analysis was used as one of the preliminary tools of analyzing the data collected during the ethnographic observation and interviews with the research participants. The data were analyzed according to the methods proposed by Mekonnen Kifle et al. (2024) [20] inductively by looking at the common themes and patterns in regards to hydration practices among students, teacher perceptions and inclusion of hydration education in curriculum. The thematic analysis was performed through numerous cycles that included the domain analysis, taxonomy development and component analysis which aided in grouping the data by various themes. The descriptive statistics were used to analyze quantitative data collected during the observation, including the frequency of water consumption and the proportion of students exhibiting dehydration symptoms. This also involved the computation of means, standard deviations, and relative frequencies of the observed behaviors to measure the observed behaviors and compare them to the recommended hydration levels as stipulated in the guidelines given by the French Agency of Food, Environmental, and Occupational Health and Safety [21]. These statistical scale measures made it possible to objectively evaluate the hydration patterns of the school setting and its correspondence to the recommended guidelines. Combining the qualitative and quantitative data allowed the comparison of the observed practices to the educational intentions (interview and curriculum data) and help to understand the factors of impact on hydration practices to a greater extent. This combined methodology was useful in determining the discrepancies existing between the hydration program and the education interventions, which enabled constructing evidence-based solutions to enhancing school student hydration [22];[23].

2.7 Challenges and Limitations:

- There were a number of practical issues that were faced in the data collection phase. This was due to the fact that access to water sources, in and outside of the classrooms, was inconsistent

and, therefore, limited the students in terms of sustaining a smooth supply of hydration during the school day. Although it was put on the agenda to monitor and measure the hydration habits, it became apparent that the accessibility of drinking water among students was strongly determined by the position and the accessibility of water fountains or other water-distribution channels. This inconsistency of access became a major challenge of obtaining an accurate measure of the hydration behaviors as in many instances students failed to be able to freely hydrate during classes. The other difficulty was the difference in the interest of teachers in hydration education. The availability with respect to hydration awareness was moderate and others showed great concern to hydration and when it came to taking action, teachers were found promoting hydration with a lot of consideration of the symptoms of dehydration and knowledge on how to promote hydration. This lack of consistency in the methods of teaching posed problems in the evaluation of the overall success of the existing hydration education in the curriculum. Lastly, the nature of the ethnographic observation was that time was constrained and, thus, the ethnographic study did not consider seasonal changes in the behavior of the participants with regards to hydration. As an example, students can show varying trends of hydration in warm conditions when there is more physical activity or higher temperatures, which impose higher levels of hydration requirement. An extended period of observation would have given a better perspective of these effects of the seasons [24]; [25].

3. Results:

3.1 Patterns Characterization of Water Consumption:

- The drinking habits of primary school children were collected and analyzed, which showed a large discrepancy in the drinking pattern among the students. Although water was the most taken drink, 28% of the students were found carrying sugary food which includes industrial juices and sodas particularly on hot days. Their inclination towards sweet drinks meant that amongst other issues with regard to hydration, the students could be playing a role in promoting poor dietary practices that may intensify poor water consumption. Water drinking in itself was largely restricted at certain intervals of the day especially at the recess and lunch time. Nevertheless, there was not much water consumption throughout the day at the time of class and this was usually because of lack of access to drinking water at the classrooms [26].
- It was observed that the mean daily amount of water ingested by students per student was considerably less than the advised amounts in the guidelines of hydration. During non-physical education days, there was a serious shortage of water. Such a gap between the reported levels of water intake and the health requirements suggested the existence of the gap that requires the reevaluation of the current hydration related practice in schools. The French Agency of food, environmental and occupational health and safety (AFSSA) indicates that children who are 4 to 8 years old are supposed to drink 1.0 to 2.0 liters of water a day (Table 1) [27]. But the results of the analysis have shown that a lot of the students have not performed these simple hydration requirements. The mean water intake was steadily lower than that of AFSSA, which means that the gap between the recommended improvement of hydration and the real consumption patterns in a school setting is enormous. According to multiple factors, this disparity was attributed to a few factors. Inadequate provision of drinking water in the classes became a significant obstacle to regular hydration. There were not helpful accesses to water fountains or water bottles in many classrooms as this undermined the students and their desire to drink regularly throughout the school day. Also, social and environmental considerations were found to be contributing. The problem was further aggravated by peer-related behaviors, culture, and ignorance with regards to the need to conserve the body by drinking water since it helps to promote better health and academic performance [28].
- The consumption of sweetened beverages especially during hot days was found to be one of the factors that led to poor hydration. Although they contained fluid, they were rich in sugar thereby reducing their effectiveness in ensuring that people were not dehydrated. Also,

negative health effects were observed to be associated with the consumption of sugary beverages like obesity and dental issues that may have long term consequences on the overall health and well-being of students. The above findings highlight the importance of introducing measures by schools that would enhance the practice of hydration. The regular access to the water source and the daily teachings to students on the need to drink more water and to minimize the use of sugary drinks are the necessary steps to resolve the problem of hydration deficits. As well, creating awareness among the students and staff regarding the importance of hydration in supporting cognitive ability and well-being in general may result in healthier hydration habits [29].

Table 1. Calculated amount of water that should be taken by children and infants daily.

Age Group	**Recommended Daily Intake (L/24h)**
Preterm Infants	150-200 mL/kg
Infant 1-3 months	150 mL/kg
Infant 3-6 months	125 mL/kg
Infant 6-12 months	100 mL/kg
Infant 12-24 months	80 mL/kg
Children 4-8 years	1-2 L/24 hours
Children 9-13 years	1.6 - 1.8 L/24 hours
Adolescents 14-18 years	1.8 - 2.6 L/24 hours

3.2 Impact of Dehydration on Academic Performance:

- Dehydration has been extensively known to be one of the factors that have a significant effect on the cognitive ability, particularly academic [30], give a description of the distribution of water intake and output in the human body which serves as the essential information on how the body maintains a balance of water (Figure 1). Water consumption majorly comes through beverages (60 percent of all consumption), food 30 percent of all consumption and the other 10 percent is as a result of endogenous production (water produced as a result of metabolic processes). Alternatively, water is majorly lost through the urine (50%), sweat constituting 30 percent and the rest 20 percent being lost to evaporation during breathing. This balance emphasizes the need to have an adequate intake-output system that can make a person hydrated and thus in the mental state. Even the mild dehydration which was considered the loss of 1-2 percent of body weight was directly shown to affect cognitive performance. In the present case, about 15 percentage of the students showed signs of mild dehydration in classes especially those in the late morning or afternoon. These were the period when symptoms of the disease were the most apparent (i.e. dry mouth, fatigue, and lack of alertness). These findings are supported by the teachers who noted that students who exhibited such symptoms were unable to concentrate and engage in classroom activities. These symptoms of dehydration had a strong relationship with the severe deterioration of the attention and concentration, which are both crucial in academic performance [31].

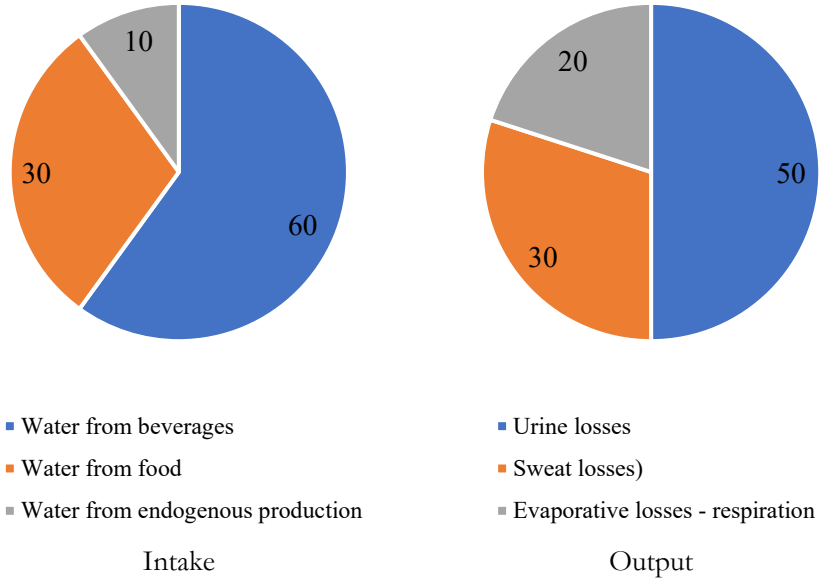

Figure 1. Water intake and water output as a percentage.

- The effects of dehydration on cognition are well-established in the literature, and this paper also confirmed that the impact of dehydration exists even in the form of mild dehydration orientation. There was also a significant effect on memory retention, attention and reaction times, whereby students who were dehydrated were inepter at the memorization and processing of academic content. Such upheavals greatly interfered with their response capability when dealing with activities in the classroom. The results point out the need to stay adequately hydrated (and especially so during educational institutions). The mental impairments that arise as a result of dehydration have been noticed (poor attention, poor memory performance, and poor interaction in classrooms) which in itself highlights the necessity of schools to start taking hydration seriously. It is important to put in place measures which would make sure that students regularly take sufficient amounts of water during the school day [32];[3]. This can involve making water available throughout the lesson, supporting hydration breaks, and informing the students about the benefit of hydration to achieve maximum academic success (Table 2).

Table 2. Dehydration and water related diseases.

Mild to Moderate Dehydration Symptoms	Severe Dehydration Symptoms	Diseases Caused by Pathogenic Water Consumption
Dry mouth with sticky saliva	Extreme thirst	Diarrhea
Insomnia	Extreme agitation	Cryptosporidiosis
Fatigue	Irritability and confusion	Fever
Decreased urine output	Absence of sweating	Severe dehydration in extreme cases
Absence or very few tears when crying	Very little or no urination	Campylobacter jejuni
Muscle weakness	Hypotension	Rotavirus
Headache	Tachycardia	Dysentery
Dizziness or lightheadedness	Weight loss of 1-2% in adults	Cholera

3.3 Effects of Physical Activity on Hydration:

- Exercise is also associated with a high level of hydration requirements because of the loss of fluid during sweats. In this study also, they observed that students who took physical education classes were more likely to drink water as opposed to their counterparts who took sedentary activities. Nevertheless, the time of drinking water was still an issue. Access to water was only before or after the physical exercise, so the mid-day time was not paid much attention to. This dehydration in the physical activities led to some early signs of fatigue and low levels of motor performance, especially to those students that had not taken the necessary amount of water before physical activity. The evidence points out that although physical exercises raise awareness of the need to stay hydrated, they do not always lead to the best practices identifying hydration unless the drinking of water is supported and stimulated throughout the entire activity. The results show that physical education might need a much better practice of hydration. Since physical education is crucial in the creation of hydration awareness, schools should be advised to adopt more organized hydration measures in physical education classes [33]; [34]. It would be beneficial to keep the students hydrated by offering water during the period of the activity to ensure better performance and recovery (Table 3).

Table 3. Hydration During Physical activity (Observations in physical Education).

Observation Period	**Average Hydration (mL) per Student**	**Symptoms of Dehydration**
Pre-Physical Education	100 mL	None
Post-Physical Education	150 mL	Mild fatigue, muscle cramps
During Physical Activity	50 mL	Fatigue, dizziness

3.4 Curriculum Effect of School and Water Education:

- The school curriculum review showed that there is a high level of inconsistency regarding the topic of water education in different academic disciplines (Table 4). The issues that concerned water were mainly presented in pieces, and they were mostly presented in the context of the life sciences, where the significance of water in the human body, water conservation and the value of water to the environment were mentioned. These matters were however frequently approached individually and never as a cross-curricular unit where water is viewed as both an ecological unit as well as a health unit. The curriculum mainly aimed at introducing water as an ecological resource with some accentuating on water cycle, water conservation and environmental sustainability. But not much was done concerning the role of water in human health especially when it comes to hydration and its effect on student performance. This knowledge gap in the curriculum led to the situation when the students are not informed enough about the essential relationship that exists between hydration and their everyday performance directly influencing their cognitive functions and physical health. The lack of formal hydration education on each tier of the curriculum limited the knowledge of the students on the effect of hydration on their daily lives both at the classroom and in other aspects. Poor implementation of hydration education in the classroom routine increased the problem. There was no promotion of regular and healthy hydration practices particularly among the students, thus with irregular water consumption practices. This was insensitive towards hydration leading to the formation of bad hydration habits that were not easy to change in the long run. In most of the education systems, the syllabus that was taught mainly talked about the environmental side of water as opposed to its health importance [35]; [36]; [37]. Level 1 (CP) students were provided with the simplistic concept of what makes the physical and cognitive performance of the body to remain optimal, namely, that to be adequately hydrated is required to have a solid life force. The curriculum was expanded in senior classes (CE1, CM1, CM2, and CE6), but once more, was less health-related and rather ecological in nature, and little was said about hydration in health. To sum up, the curriculum

analysis reflected a missed chance to include the education on hydration to the context of health education. The deficit in the importance attributed to hydration as a key to cognitive and physical performance in students explains the necessity of revising curricula in future. The involvement of hydration education in current classroom activities accompanied by environmental education would help students to gain more knowledge about their hydration requirements and lead to healthier long-term behaviors.

Table 4. The Hydration Education Topics in the School Curriculum in Morocco Primary Education.

Unit	Theme	Title	Objectives	Textbook	Page
Level 1 (CP)	Nutrition and Growth	S7: Why Do I Eat?	Recognize that water and food are essential for life.	"New in the Scientific Activity"	32
		S8: I Eat Three Meals After Washing Hands	Nourish and drink three times a day. Wash hands regularly throughout the day.	"New in the Scientific Activity"	33
	Water and Nature	S1: Water in My Life	Recognize the various uses of water.	"New in the Scientific Activity"	52
		S2: Where Does Water Come From?	Recognize some sources of water.	"New in the Scientific Activity"	53
		S3: Is Water Indispensable to Life?	Understand the necessity of water in life. Recognize the consequences of water shortage.	"New in the Scientific Activity"	54
		S7 + S8: How to Preserve Water?	Recognize ways to preserve water. Distinguish between clean and dirty water.	"New in the Scientific Activity"	59
Level 2 (CE1)	Oral Activities	Oral Activities 1: Teach about the importance of water.	Learn about the importance of water.	"Textbook"	-
		Oral Activities 2: What Pollutes Potable Water?	Understand pollution of water sources.	"Textbook"	-
		The Water Cycle	Learn about the water cycle and water's role in life.	"Textbook"	-
		The Pollution of Water	Understand what happens when water is polluted and why it should be protected.	"Textbook"	-
Level 3 (CM1)	Natural Resources	S1: Water Resources	Recognize renewable and non-renewable natural resources.	"Textbook"	78
		S2: Importance of Water Conservation	Learn about the conservation of water and purification techniques.	"Textbook"	79
Level 4 (CM2)	Water and Life	S1: Freshwater Sources	Recognize freshwater sources and their uses.	"Textbook"	70
		S2: Water Treatment	Understand the importance of water treatment, purification, and desalination.	"Textbook"	72

Level 5 (CE6)	The Properties of Water	S1: Oceans, Seas, and Water Bodies	Recognize the importance of seas and oceans and their properties.	"Geography Textbook"	79
		S2: Importance of Oceans and Seas	Understand the importance of oceans and seas for life on Earth.	"Geography Textbook"	95

4. Discussion:

- This research brings a number of valuable insights into the information about the hydration practices of primary school children and the considerable cognitive and health-related outcomes of the insufficient hydration. Another significant finding was the high difference between the current water consumption and suggested hydration needs that would have relevant implications to school practices and the national health policies. Among the most significant findings was the high level of consumption of sugary drinks, in which at least students arrived at school carrying pocket-sugary drinks like soda and juices, especially during warm days. Although it is not surprising, this tendency in favor of sugary beverages contributes an additional significant dimension to our body of knowledge about hydration practices. Although it is adequately recorded that sugary drinks lead to poor nutrition and obesity in children, their effects on hydration have received little focus. This work presents an indication that sugary beverages are not the place of water since they are commonly thought to be hydrating. Such drinks do not only increase poor eating habits, but also deteriorate low hydration habits. The fact that many students would find sugary drinks just as hydrating as water has much to do with cultural influences, as well as aggressive marketing that will place sugary drinks in the perspective of refreshing and thirst-quenching. This observation highlights the importance of targeting hydration perceptions, as well as simply adding water access to schools. Moreover, this research found out that inaccessibility to drinking water during the classes was a major impediment to hydration. Although issues related to access to water have been raised in the previous literature, the problem in this study is focused on unavailability of water during time of instruction. Water shortages (no water fountains or the inability to access water bottles in classes) contribute to the further decrease in the level of hydration, as the effectiveness of thought activity is highly dependent on being hydrated during the school day. This loophole necessitates schools to have water at hand at all learning sessions and not only when taking breaks, to enable one to have the best aspect of cognitive functioning.
- The cognitive impact of dehydration as the one in this research is consistent with the current research but the findings were stronger than anticipated. Teven the slightest form of dehydration (1-2 percent of body weight) had a nasty impact on the cognitive abilities of the students especially in regard to attention, memory, and involvement in the classroom. Those students who demonstrated indications of being dehydrated during the classroom (15% out of the total number of students) specifically during the afternoons and into the later morning, were well-documented regarding their cognitive impairment such as being fatigued, showing poor alertness, and non-concentration abilities. Such findings are in line with a considerable amount of literature that relates dehydration to poor cognitive functioning. Nevertheless, the degree to which dehydration influenced the memory retention, reaction times and participation in the study, in general, was most vivid in this study. This evidence supports the seriousness of consideration of hydration in the sphere of education when the intellectual performance is the key to success. Hydration is not an extravagant aspect, but it needs to be taken as part of academic performance.
- Interestingly, the teachers could have identified dehydration symptoms like fatigue and dry mouth but said that they did not know what to do to help. This is however contrary to the established factual evidence concerning the linkage of dehydration with the cognitive impairment, because there is no systematically organized training taken on the cognitive effects of dehydration. The lack of knowledge highlights the necessity of the improvement of training of the educators to learn the impacts of dehydration

on the performance of students along with the need to develop approaches that will promote hydration throughout the day.

- Another important piece of study was the role that physical activity has in creating hydration awareness. As can be noted, physical education students had a higher probability of drinking water compared to students who were involved in sedentary activities. It goes along with existing literature, asserting that physical exercise enhances the level of awareness to hydration amongst individuals. The researchers, however, found some shocking lack of awareness-practice congruence with actual hydration during physical education. Although the intake of water was more profound prior to and subsequent to physical education, the dehydration during physical activity was an issue. This is a significant conclusion since it implies that awareness concerning hydration is insufficient; an organization of hydration procedures is required to make sure students hydrate regularly during physical exercise. This lack of hydration during the activity itself could help to cause the early fatigue and reduce the performance. Therefore, physical education should have more organized hydration measures in schools to make students hydrate at every level of physical activity, not solely at the start and end of it.
- Another aspect that came as a shocking revelation was the piecemeal approach of water education in the school curriculum. Although the issue of water conservation and ecology was a part of the life sciences courses, the importance of the need to be hydrated in human life and in thinking abilities has mostly been ignored. The lack of coherent, cross-curricular solution in teaching hydration inhibits knowledge on the students of the significance of water in their academic and physical lives. The subject of hydration education is usually pushed to secondary or a stand-alone issue, predominantly addressed as an ecological issue of water but not health-related. Such a short-sided perspective fails to give students a chance to learn about the immediate correlation between hydration and cognitive functions.

5. Conclusion:

- The hydration practices in primary schools are critical issues that this research highlights the importance of studying them. Change of human hydration, the difference between the recommended hydration and the actual water intake and the popularity of sugary beverages have a direct effect on cognitive functioning and general health of students. The research indicates that schools need to make sure that water is easily accessible at the school time, and that educators have been trained at appreciating the cognitive effects of dehydration. In addition, it is the responsibility of physical education classes to implement systematic hydration guidelines so that the students can be properly rehydrating prior to, throughout, and following exercise. Another finding of the study is to demonstrate the huge gaps in the education of the school curriculum on hydration. Water education, which has been limited to the ecological issue, should be broadened in the light of the physiological significance of being adequately hydrated to the cognitive functioning and physical well-being. The incorporation of hydration education into various subjects and proper education of the students on the relevance of hydration to their academic achievements would facilitate the adoption of better hydration practices and enhance cognition as well as overall health. To sum things up, this study offers an urgent intervention on the part of policymakers, educators, and school administrators. Schools should also adopt holistic hydration solutions, include hydration education in their curriculum, as well as to ensure all teachers and students comprehend the importance of hydration to academic performance and health.

6. References:

Guelfi, G., Capaccia, C., Ratto, V. F., Bufalari, A., Leonardi, L., Mechelli, L., ... & Maranesi, M. (2025). The Emerging Role of Water Loss in Dog Aging. Cells, 14(7), 545.

Tripathi, M. K., Maheshwari, N. V., Kumar, A., Kumar, A., Kate, A., Jadam, R. S., ... & Chouhan, R. (2025). Nutrition biology: A new paradigm for human health. In Innovations in Ayurvedic nutrition: Principles and concepts (pp. 55-83). Springer Nature Singapore.

Yüksel, S., & Akıl, M. (2024). Mild Dehydration Triggered by Exercise Reduces Cognitive Performance in Children, But Does Not Affect Their Motor Skills. Journal of the american nutrition association, 43(7), 627-635.

Rosinger, A. Y., John, J. D., & Murdock, K. W. (2024). Ad libitum dehydration is associated with poorer performance on a sustained attention task but not other measures of cognitive performance among middle-to-older aged community-dwelling adults: A short-term longitudinal study. American Journal of Human Biology, 36(6), e24051.

Kołodziej, M., Jalali, A., & Łukasik, J. (2024). Point-of-care ultrasound to assess degree of dehydration in children: a systematic review with meta-analysis. Archives of Disease in Childhood, 109(4), 275-281.

Singh, B., & Kaunert, C. (2024). Adventure in high altitude of mountainous topographies and health impacts: lensing tourism sustainability via reducing ecological and sociocultural footprint and health emergency and medical assistance management. In Navigating Natural Hazards in Mountainous Topographies: Exploring the Challenges and Opportunities of Living (pp. 281-303). Cham: Springer Nature Switzerland.

Zborowski, M., & Skotnicka, M. (2025). The Role of Hydration in Children and Adolescents—A Theoretical Framework for Reviewing Recommendations, Models, and Empirical Studies. Nutrients, 17(17), 2841.

Xu, D., Wang, Z., Liu, C., Li, H., Ouyang, F., Chen, B., ... & Zhou, H. (2024). Water catchers within sub-nano channels promote step-by-step zinc-ion dehydration enable highly efficient aqueous zinc-metal batteries. Advanced Materials, 36(26), 2403765.

Cruickshank, V., Peralta, L., & Patterson, K. (2024). The influence of school location, enrolment and socio-economic status on participation and success in inter-school swimming and track and field athletics competitions. Sport, Education and Society, 1-16.

Lehmann Bannach, E., Bourgeois-Bougrine, S., Bianchi, A., & Delhomme, P. (2024). The path to sustainability: Psychological and environmental variables of adolescents' transportation choices. Sustainability, 16(22), 9934.

Tahernejad, A., Sohrabizadeh, S., & Mashhadi, A. (2025). Designing a conceptual model of forming the psychological resilience among farmers living in drought-affected regions in Iran: a grounded theory study. Current Psychology, 1-12.

Zhang, J., Chen, Y., Zhao, X., Li, X., Wen, W., Wu, W., ... & Qiu, J. (2025). Hydration behaviors, knowledge, and attitudes among Chinese recreational marathon runners: a cross-sectional study. Frontiers in Nutrition, 12, 1621966.

Florez-Garcia, V., Torres-Saballeth, J., Tuesca-Molina, R., Acosta-Reyes, J., Guevara-Romero, E., Nohora, N., ... & Acosta-Vergara, T. (2025). Water sources and educational attainment in Colombian adults: evidence from the national nutritional survey. BMC Public Health, 25(1), 1385.

Chen, C., Nadler, R., Sharkey, J. D., & Yang, C. (2024). Ethical and Legal Considerations in Balancing Mental Health of Sexual and Gender Minority Students and Parental Consent. Journal of applied School pSychology, 40(1), 38-61.

Quintela Do Carmo, G., Vinuesa, V., Dembélé, M., & Ayotte-Beaudet, J. P. (2024). Going beyond adaptation: An integrative review and ethical considerations of semi-structured interviews with elementary-aged children. International Journal of Qualitative Methods, 23, 16094069241247474.

Chand, S. P. (2025). Methods of data collection in qualitative research: Interviews, focus groups, observations, and document analysis. Advances in Educational Research and Evaluation, 6(1), 303-317.

Li, M. (2024). Non-native English-speaking (NNES) students' English academic writing experiences in higher education: A meta-ethnographic qualitative synthesis. Journal of English for Academic Purposes, 71, 101430.

Mukurunge, E., Nyoni, C. N., & Hugo, L. (2025). Context of assessment in competency-based nursing education: Semi-structured interviews in nursing education institutions in a low-income country. Nurse Education Today, 146, 106529.

Ağlar, C., Arslan, A., & Şahbaz, A. F. (2024). Analysis of Theses on Turkish Language Teaching Curriculum in Turkey: A Document Analysis. International e-Journal of Educational Studies, 8(16), 1-13.

Mekonnen Kifle, M., Terragni, L., & Morseth, M. (2024). Teachers' perception of their students' dietary habits in Addis Ababa, Ethiopia: a qualitative study. BMC nutrition, 10(1), 141.

Kesse-Guyot, E., Allès, B., de Lauzon-Guillain, B., Feillet-Coudray, C., Lapidus, N., Mariotti, F., ... & Nadaud, P. (2025). Scientific Opinion of the French Agency for Food, Environmental and Occupational Health & Safety on the establishment of dietary guidelines for people following a diet that excludes some or all foods of animal origin (vegetarians). Food Risk Assess Europe, 3(4), 0074E.

Chen, X., Yu, T., Dai, J., Jing, Y., & Wang, C. (2025). Unveiling learners' intentions toward influencer-led education: an integration of qualitative and quantitative analysis. Interactive Learning Environments, 1-19.

Teng, M. F. (2025). Metacognitive awareness and EFL learners' perceptions and experiences in utilising ChatGPT for writing feedback. European Journal of Education, 60(1), e12811.

Tafazoli, D. (2024). Exploring the potential of generative AI in democratizing English language education. Computers and Education: Artificial Intelligence, 7, 100275.

Al Labadi, L., & Ly, A. (2025). Enhancing statistics education through Project-Based Learning (PBL) and the emergence of ChatGPT. Teaching Statistics.

Sharma, M. K., Adhikari, R., Khanal, S. P., Acharya, D., & van Teijlingen, E. (2024). Do school Water, Sanitation, and Hygiene facilities affect students' health status, attendance, and educational achievements? A qualitative study in Nepal. Health Science Reports, 7(8), e2293.

Vieux, F., Maillot, M., Constant, F., & Drewnowski, A. (2016). Water and beverage consumption among children aged 4–13 years in France: analyses of INCA 2 (Étude Individuelle Nationale des Consommations Alimentaires 2006–2007) data. Public health nutrition, 19(13), 2305-2314.

Agyei, E. A., Annim, S. K., Acquah, B. Y. S., Sebu, J., & Agyei, S. K. (2024). Education infrastructure inequality and academic performance in Ghana. Heliyon, 10(14).

Mansour, N., & Alfojery, A. (2025). Exploring students' health awareness of personal hygiene and dietary behaviors in primary education in Qatar. Critical Public Health, 35(1), 2505760.

Da Silva, T. H. R. (2025). Understanding body fluid balance, dehydration and intravenous fluid therapy. Emergency Nurse, 33(1).

Peralta, E. M. E., Ebardo, G. M., Ebardo, G. N. M., Ebardo, G. J. M., Ebardo, A. M. M., Ebardo, G. J. M., & Fadare, S. A. (2025). Unraveling the global pandemic's impact on physical activity, nutrition, hydration, sleep and self care of educators. Salud, Ciencia y Tecnología-Serie de Conferencias, (4), 1562.

Watanabe, H., Kadokura, Y., Sugi, T., Saito, K., & Nagashima, K. (2024). Influence of sustained mild dehydration on thermoregulatory and cognitive functions during prolonged moderate exercise. European Journal of Applied Physiology, 124(11), 3457-3470.

Mathew, G. M., Nahmod, N. G., Master, L., Reichenberger, D. A., Rosinger, A. Y., & Chang, A. M. (2024). Effects of a 1-hour per night week-long sleep extension in college students on cardiometabolic parameters, hydration status, and physical activity: A pilot study. Sleep health, 10(1), S130-S139.

Moncada-Jiménez, J., Chacón-Araya, Y., & Carpio-Rivera, E. (2025). The effect of passive and exercise-induced dehydration on body composition using dual energy X-ray absorptiometry. Clinical Nutrition ESPEN.

Riouch, A., Benamar, S., Ezzeri, H., & Cherqi, N. (2025). Post-COVID Environmental Education in Morocco: School Clubs as Drivers of Student Engagement and Sustained Self-Reported Sustainable Practices. International Journal of Environment, Engineering and Education, 7(2), 119-134.

Idrissi, H. (2025). Examining STEM pre-service teachers' perceptions of climate change education: insights from Morocco. Environmental Education Research, 1-20.

El Alami, A. (2025). Natural resource conservation and climate change adaptation and resilience in Morocco: the role of citizens in saving water and energy. Journal of Analytical Sciences and Applied Biotechnology, 7(1), 25-37.

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8. Author Declaration:

- The authors declare that this work is original and has not been published previously, nor is it currently under consideration for publication elsewhere. All authors have contributed to the preparation of the manuscript and have approved the final version for publication.
- The authors declare that they have no conflicts of interest related to this study.