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<https://jurnal.ugm.ac.id/rpcpe>

# RPCPE

ISSN 2613-943X (print)  
 ISSN 2620-5572 (online)

Review of Primary Care Practice and Education  
 (Kajian Praktik dan Pendidikan Layanan Primer)

## Fluid Intake and Hydration among Children

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To cite this article:

Saftarina F, . Fluid intake and hydration among children. Rev Prim Care Prac and Educ. 2023; 6(1): 5-8.

### ABSTRACT

**Background:** Children have a greater chance of dehydration and desiccation than adults. As many as 22% of children in Indonesia do not drink enough fluids. Many studies found that children often came to school in a dehydrated state. **Objectives:** The purpose of this study was to describe the fluid intake and hydration state among children at an elementary school in Lampung, Indonesia. **Methods:** This study used an analytical observational design. The sample was 69 children, collected with total sampling technique. The study was conducted from Sept 2019 to Jan 2020, at a primary school in Bandar Lampung. Fluid intake was obtained from the Beverage Uptake Questionnaire and hydration state was obtained from measurements of urine specific gravity. **Results:** The results of the study indicated that a total 48 children (69.6%) had good fluid intake, with 47 children (68.1%) drinking water more than 3 times a day, but 42 children (60.9%) had clinical dehydration. **Conclusion:** Further research is needed to measure the adequacy of children's fluid intake with other methods and instruments.

**Keywords:** fluid intake, hydration, children, Lampung

### BACKGROUND

Body water balance is measured by the ratio of water input and output into and from the body. Water balance seems to be a basic requirement that is the same for all of the age ranges, but children have a bigger ratio of their water level to body weight compared to when they are grown-up. Also, they tend to experience more water loss from the skin, and in under thermoneutral conditions compared to adults<sup>1</sup>.

Children have a bigger risk to be dehydrated than adults. The study conducted by Barker et al. in 2012 experimented on 452 children in England with 9-11 years of age and found that 60% of subjects had mild dehydration when arriving at school<sup>1</sup>. Similarly, another experiment from The Indonesian Regional Hydration Study (THIRST) in 2009 about water intake in Indonesia showed that mild dehydration in teenagers reach 49.5% and was higher than adults (42.5%)<sup>2</sup>.

Body water balance condition can be reflected from hydration status measured by urine; by its frequency output, urine color and turbidity, urine osmolality, and also urine specific gravity (USG)<sup>2</sup>. A recent study showed that those who drink more water will get clearer urine, although it still depends on other factors such as drink types, food intake, and medicine<sup>3</sup>.

Recent research of Indonesian children showed that 22% of surveyed children drink insufficient amounts and tend to drink after being given instructions, not due to their own

needs. Based on the places where they are consuming fluids, from 866 Indonesian children there were 88% of them who drink at home, 10% at school, and 2% in other places<sup>3</sup>. Besides, children have various drinks to choose from as options for hydration when they are thirsty and need to replenish their water level. More than plain water, as many as 70% children like to drink milk or tea at home and some flavored drinks at school<sup>4</sup>.

Based on our pre-survey in a primary school at Bandar Lampung to define hydration status by urine specific gravity, the findings showed that from 10 students tested, there were 4 students with good hydration, 5 students have poor hydration, and 1 was dehydrated. This result and the high dehydration rate condition in Indonesia led us to have a research about fluid intake and hydration among children at a primary school in Bandar Lampung.

### METHODS

This descriptive observational study was conducted with a cross-sectional design. The population was 72 students of 4-6 grade primary school in Bandar Lampung, that served as the sample collected by total sampling method but there are 3 students excluded because of their very thin nutritional status, so there were 69 students in total.

The variables of this study included fluid intake and hydration state. Total fluid intake was counted with the

“The Beverages Intake Questionnaire” developed by Hedrick and team from the Virginia Polytechnic Institute and State University<sup>4</sup>. This questionnaire consists of how often and how much is consumed each time in drinking from each type of beverages for the past month. Total fluid intake from the questionnaire is matched to fluid need to define that it was good intake or not. Fluid intake need was counted by bodyweight as 100 ml for the first 10 kgs, 50 ml for the second 10 kgs, and 20 ml for every next kilogram.

Hydration state defined by measuring the USG by Refractometer Brix at noon while respondents were doing their daily activities. The results were categorized as

a dehydration grade by USG: <1.015 is good hydrated, 1.016-1.020 is mild dehydrated, 1.021-1.025 is moderate dehydrated, 1.026-1.030 is dehydrated, and >1.030 is clinical dehydrated. The data were analyzed by frequency distribution. This research protocol has been approved by the Ethics Team of the Faculty of Medicine, University of Lampung in the Ethics Approval Sheet No. 3203/UN26.18/PP.05.02.00/2020.

## RESULTS AND DISCUSSION

The following Table 1 shows about respondents' characteristics as below:

**Table 1. Respondent Characteristics with Standard Deviation (SD)**

Category	f(n)	%
<b>Sex</b>		
Boy	30	43.5
Girl	39	56.5
<b>Total</b>	<b>69</b>	<b>100</b>
<b>Age</b>	$\bar{x} \pm SD$	10.10 $\pm$ 0.843
<b>Nutritional Status</b>		
Thin	9	13
Normal	47	68.1
Overweight	9	13
<b>Obesity</b>	4	5.8
<b>Total</b>	<b>69</b>	<b>100</b>

The data show that most of the respondents are female students at 10.10  $\pm$  0.843 years of age as major with a normal nutritional status. The nutritional status data were also used for further analysis of any correlations to hydration status.

Table 2 shows that most of the children in the primary school at Bandar Lampung has good fluid intake. Beside plain water, there are some various beverages that were consumed by respondents as below:

**Table 2. Fluid Intake among Children in Primary School**

Water Consumption Status	f(n)	%
Good intake	48	69.6
Less intake	21	30.4
<b>Total</b>	<b>69</b>	<b>100</b>

**Table 3. Types of Beverages Consumed by Children in Primary School**

How Often	Beverages
$\geq 1x$ /day	Water and tea
$\geq 1x$ /week	Milk, drinks without soda, no-alcoholic drinks, sweetened juice beverage/drink
Never or <1x /week	Hypo/isotonic drink, soft drink, low fat milk, 100% vegetable juice, tea or coffee without artificial sweetener, coffee with cream and/or sugar, diet soft drink, and energy drinks.

Table 4 below shows data about hydration status of Children in Primary School Bandar Lampung.

That data show the most of children in Primary School Bandar Lampung with as many as 60.9% have a clinical dehydrated status.

In the analysis, the results for the fluid intake indicate that 48 children (69.6%) had good intake and 21 children (30.4%) had less than sufficient intake. These two categories were

formed by match-linking the fluid intake need by body weight calculation with the fluid intake data from The Beverage Intake Questionnaire, which is a questionnaire of drink habits for the past month using a recall method. The questionnaire also gives additional information about the type of beverages consumed by respondents, which are mostly water and tea. Children like to drink various kind of beverages to fulfill their fluid needs, while the distribution mechanism in the body has still not been clearly tested yet<sup>9</sup>.

Table 4. Hydration Status Distribution of Children in Primary School

No.	Hydration Status Category	Interval Category	f(n)	%
1	Good Hydrated	$\leq 1.015$	6	8.7
2	Mild Dehydrated	1.016 – 1.020	3	4.3
3	Moderate Dehydrated	1.021 – 1.025	9	13.0
4	Dehydrated	1.026 – 1.030	9	13.0
5	Clinical Dehydrated	$> 1.030$	42	60.9
	<b>Total</b>		<b>69</b>	<b>100</b>

Next, in the analysis, the result of the hydration status shows that there were 42 (60.9%) children in a clinical dehydrated status. This finding correlates to another study that found  $60 \pm 24\%$  of children (about 10-98%) who did not fulfill the water intake recommendations and were less hydrated based on the biomarkers<sup>10</sup>. Besides, based on<sup>4</sup> recent research, the result shows that children who could not fulfill the TWI-F recommendation have 1.009-1.002 times higher risk for being hypohydration than other children who fulfill the recommendation.

Those two results of fluid intake and hydration status seem uncorrelated, which may be because of using a different time standard in taking water consumption data and measuring the USG. The water consumption data collection reflected the daily or weekly drink habits for the past month, but the urine was just tested once which means the results were just representing hydration status at that time point, and this method could not show the children's average status of hydration in a whole month. So, even though respondents may have a good habit of consuming sufficient fluids, they may not have had enough to drink on the day the urine was being tested. Accordingly, for the next research on this topic, it is important to use more empirical methods in sample collections and the time line in collecting the data. Fluid intake data by questionnaire can be taken by the "Water Intake Record" before being inputted to "The Beverage Intake Questionnaire" or use another questionnaire such as the "Total Water Intake Fluids (TWI-F)" taken for 2 continuous days. Then for measuring the USG, it can be done periodically.

Taking data of fluid consumption in children can be a difficult because of the recall method, since some of their parents could not accompany them in the research testing because of their business or a poor education record, so the children need a surrogate person to accompany them when filling out the data in the questionnaire. Even if they have clear instructions to fill out the questionnaire, children have a lower capability of memorizing and following instructions than adults, so it can blur the result. Also, for the next research, we recommend using a shorter recall period such as a 24-hour recall that can make it easier to remember their intake.

Urine osmolality that indicates hydration status is also influenced by some factors including gender, ethnicity, nutritional status, and age. Besides, food intake, physical activity, climate change, and taking medicine; all of which can be influencing factors of hydration status<sup>12</sup>.

Total body water is considered by gender and body size. In sweat production, a male child tends to be higher in total body water than a female, because males have more muscle and body mass but their activities are also higher than the females. Total body water in males is about 60% of their body weight; but in females, it is generally about 50% of their body weight. In one research<sup>13</sup>, with 30 (43.5%) boys and 39 (56.5%) girls, the boys had higher sweat production which caused less urine output and it was thicker than usual, which makes the USG increase and indicated they were dehydrated.

There is a correlation between nutritional status based on Body Mass Index (BMI) and hydration status<sup>1</sup>, which means that when there is more bodyweight amount, there is also more likelihood in getting dehydrated<sup>1</sup>. Basically, someone with a high BMI has a higher chance to be dehydrated, since someone with obesity needs more water intake than normal due to the water-related to metabolism average, body surface area, and body weight. Besides, water intake needs will increase with increased BMI based on high energy needs, food intake, and the result of body metabolism production. This research identified 9 (13%) children in the overweight category based on their BMI and 4 (5.8%) children in the obesity category<sup>3</sup>. This condition can be related to the theory concerning children who are in the fat or obesity category who will need more water intake. The results showed that those 13 children have a similar drink habit to others in the normal category. However, the regression analysis of nutritional status compared to the hydration status indicated there was no significant correlation in the results.

Higher physical activity level can lead to higher water loss, but it can be compensated by consuming more water. In the active condition, it is important to prevent being dehydrated or maintain a good hydrated status. But, if the water loss does not get replaced soon, it can also lead to dehydration<sup>4</sup>.

Some beverages that are caffeine-based such as coffee, tea, soda, and energy drinks have a mild diuretic effect on the body that can dehydrate the body. Also, sugar-sweetened drinks can prevent and stop the water absorption process in the body. This concern can be found in sweetened juices and isotonic drinks as sources of electrolytes that have sugar included in the water<sup>17</sup>. Some of the respondents in this research usually drink tea and coffee, which also have a diuretic effect causing more frequent and faster urination and different hydration status.

Body water output has several ways including urine, sweat, Insensible Water Loss (skin and lungs), and feces with 450 ml/day of water diffusion through the skin. Furthermore, water can be lost from the body by the evaporation process when breathing. In the normal physical activity, water loss can reach 250-300 ml/day. Then, for sweat production there are different amounts lost in people based on their physical activities, ambient temperature, and/or air humidity<sup>18</sup>. These kinds of water output besides urine can be the unidentified factors that are unrelated to the measurements of water consumption and hydration status in this research.

## CONCLUSIONS

Dehydration status among children at the primary school in Bandar Lampung was counted as 42 (60.9%) children with clinical dehydration, 9 (13.0%) dehydrated children, 9 (13.0%) moderately dehydrated children, 3 (4.3%) mild dehydrated children, and only 6 (8.7%) children who were considered in the category of good hydration.

Fluid intake among children at Primary School Bandar Lampung indicated 48 (69.6%) children have good intake and 21 (30.4%) children had less than sufficient intake. The types of beverage with the most frequently consumed drinks were in the form of water and tea.

## RECOMMENDATIONS

Children need to pay attention to the consumption of fluids in their daily lives, both from the amount they drink and the type of drink. In addition, it is also necessary to pay attention to environmental weather and high physical activity to adjust the amount of fluid consumption.

Teachers and parents should further enhance their role in paying attention to students/children related to fluid consumption, physical activity, and nutritional intake in order to achieve a good degree of health for their family and for their class of students, respectively.

For future researchers who want to conduct research related to fluid consumption with hydration status, it is advisable to collect urine in the morning when the activity level is still minimal. As for filling out the questionnaire, individual assistance can be provided or with a clearer description of the questionnaire. Also, a water intake record can be used to record fluid consumption over a certain period of time to make it easier to fill out the questionnaire.

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