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Journal of Medical Case Reports and Case Series ISSN: 2692-9880

Research Article Volume 1 Issue 2

The Incidence of Dehydration Changes in Children Between the Winter and the Summer Season: What Differences Emerged. A Pilot Study

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Received date: 01 August 2020; **Accepted date:** 11 August 2020; **Published date:** 17 August 2020

Citation: Vitale E, Massaro M, Vista A, Martiradonna R, Germini F (2020) The Incidence of Dehydration Changes in Children Between the Winter and the Summer Season: What Differences Emerged. A Pilot Study. J Med Case Rep Case Series 1(2): https://doi.org/10.38207/jmcrcs20201019

Abstract

Background: Highlight significant changes in dehydration between winter and summer periods.

Materials and method: Children aged from 0 to 12 years who arrived in the Pediatric Department of the "L. Bonomo" Hospital in Andria, Puglia, in the Southern Italy were enrolled in this study. Data collection carried out with demographic characteristics, weight, water loss, blood pressure, heart rate, skin turgidity, mucous membranes, ocular globes, mental state, thirst sensation. X^2 test was performed to evaluate data parameters among participants of the "summer" and the "winter" group, respectively.

Results: In January 2018, a total of 77 children arrived in the Emergency Department. Of these, 35 children were in dehydration condition (46.75 %). On the other hand, in July 2018, 61 children arrived in the Emergency Department. Of these 35 were in dehydration status (55.74 %).

Discussion: Dehydration is one of the most frequent causes of hospitalization and access to the emergency room in the pediatric age. Significant changes in the level of dehydration between winter and summer can also significantly change the course of treatment and should not underestimate dehydration in the winter.

Keywords: Dehydration in Children; Dehydration status; Summer Season; Winter Season.

Introduction

Water is an essential element for our body, just think that 50-70% of our body is made up of water. Water is important for many functions such as metabolism, transport of nutrients, blood circulation, body temperature regulation, electrolyte balance and the transmission of nerve impulses.

In an environment with a mild climate, a healthy man 1.75 meters tall and weighing 70 kg should consume at least 1.4 liters of water per day **[1,2]**.

A state of dehydration appears when there is a sharp reduction in fluid intake or a sharp increase in the loss of fluids, through sweat, especially urine. The subjects most physiologically predisposed to states of dehydration are children and the elderly. Furthermore, the state of dehydration can also increase the risk of infection **[3]**.

Is the association of thought that is commonly done thinking about the state of dehydration and associating it with high temperatures and with the summer season? However, even during the winter season there is a significant loss of water from our body. During the summer period it is natural to drink small drinks to children, as they sweat and lose fluids **[4,5]**. Moreover, dehydration risk exists also in the winter season: allow temperature there is the risk of dehydration since the cold reduces the stimulation of thirst and stimulates water elimination through urine **[6]**.

Our project research derived from these theoretical assumptions. By assuming that all children with diarrhea condition at least two days could be dehydrated, we analyzed dehydration among pediatric subjects in the summer and the winter period and if there are any changes in dehydration status by considering the different season.

Materials and Methods

This study was performed in accordance with the ethical considerations of the Helsinki Declarations. Informed consent was obtained by all patients included in this study. For all patient's anonymity was guaranteed. No economic incentives were offered or

provided for participation in this study. A formal authorization was requested from the hospital for data collection.

Children aged from 0 to 12 years who arrived in the Pediatric Department of the "L. Bonomo" Hospital in Andria, Puglia, in the Southern of Italy were enrolled in this study.

Patients included arrived in the Emergency Department with a dehydration diagnosis due to a diarrhea condition from at least 2 days ago.

As the winter period it was considered all children who arrived in the Pediatric Emergency Department from 1st to 31st January 2018; while as the summer period it was considered all children, who arrived in the emergency Department from 1st to 31st July 2018.

Children who agreed to participate in this survey during January 2018 were included in the "winter" group, while children who consented to get part during July 2018 were entered in the "summer" group, respectively.

For each participant we assessed sex, age and the presence or absence of previous pathologies. Moreover, as concern the diarrhea condition at least 2 days and the consequential dehydration condition all parameters mentioned in the **table 1** were collected to classify dehydration condition as mild, moderate, and severe **(Table 2) [7-9]**.

Table 1: Signs to evaluate dehydration status (6).

	Minimal dehydration	**Moderate dehydration**	**Severe dehydration**
Loss of body weight	< 3 %	3-9 %	> 9 %
Mental status	Well, alert	Fatigued, restless, irritable	Apathetic, lethargic, unconscious
Thirst	Normal, slight increase, or refusing	Increased, eager to drink	Very thirst or too lethargic to indicate
Heart rate	Normal	Normal to increased	Tachycardic with bradycardia in severe cases
Blood pressure	Normal	Normal	Normal to reduced
Pulse quality	normal	Normal to reduced	Weak, thread
Eyes	Normal	Slightly sunken orbits	Deeply sunken orbits
Mucous membranes	Moist	Dry	Parched
Anterior fontanelle	Normal	Sunken	Sunken
Skin turgor	Instant recoil	Recoil in < 2 seconds	Recoil in > 2 seconds
Capillary refill	Normal	Prolonged 1-2 seconds	Prolonged > 2 seconds
Extremities	Warm	Cool	Cold, mottled, cyanotic
Urine output	Normal to decreased	Decreased (< 1mL/kg/h)	Minimal (< 0.5 mL/kg/h)

Each parameter collected was associated with a Linkert scale in which the value 1 indicated the minimum condition statement and the value 3 the maximum condition for each parameter assessed both in the winter and in the summer period.

As regards the evaluation of the parameter of the "anterior fontanelles", since the latter are present until about the 18th month of life, this parameter was evaluated only for children admitted to the study who did not exceed the 18th month of life.

Finally, another important aspect to consider is that the treatment of dehydration resulting from diarrhea on the first and second day was treated with the same therapeutic protocol both in winter and in summer in order to better compare the data that emerged.

All data recorded were analyzed and performed using IBM SPSS 20 software. Population characteristics were assessed by the percentage distribution of qualitative variable prevalence.

As the distributions of the variables analyzed did not conform to Gaussian distribution, intra-group comparisons were assessed using the X^2 test. The threshold for probability of erroneous rejection of the null hypothesis H0 which is in fact not equal was assessed at 0.05 **(Table 2)**.

Results

A total of 70 participants were enrolled in the study, including 35 in the winter and 35 in the summer. Of the total, 30 (42.9 %) are females, of which 16 (22.86 %) belong to the summer period and 14 (20 %) belong to the winter period. 40 (57.1 %) participants are male, of which 19 (27.14 %) belong to the winter period. There is no statistically significant difference between the sexes of the two groups, either in the total or in the two time periods considered. Of the 70 participants, only 13 (18.6 %) were younger than 18 months. Of these, 7 (10 %) participants belong to the summer period and 6 (8.57 %) participants belong to the winter period. 16 (22.85 %) participants in total at the time of admission said they had previous pathologies. Among these 7 (10 %) participants belong to the summer group and 9 (12.86 %) belong to the winter group. There is no statistically significant difference between the demographic variables collected. As for the weight loss recorded in the period of dehydration, a total of 50 (71.4 %) participants recorded a minimum weight loss, of which 22 (31.43 %) in the summer period and 28 (40 %) in the winter period, 18 (25.7 %) recorded a moderate weight loss,

of which 12 (17.14 %) in the summer period and 6 (8.57 %) in the winter period, 2 (2.9 %) recorded a severe weight loss, of which 1 (1.43 %) belongs to the group summer and 1 (1.43 %) belongs to the winter group. There is no statistically significant difference in the group of participants about body weight loss (p = 0.252).

Regarding mental status, a total of 37 (42.9 %) are fatigued and 3 (4.3 %) apathetic. Specifically, in the summer period 20 (28.57 %) participants are well, 13 (18.57 %) are fatigued and 2 (2.86 %) are apathetic; while in the winter 17 (24.29 %) are well, 17 (24.29 %) are fatigued and 1 (1.43 %) are apathetic. There is no statistically significant difference between the group enrolled in winter and that enrolled in summer (p = 0.574).

Regarding the condition of thirst, a total of 31 (44.3 %) participants have a normal condition, 34 (48.6 %) have the sensation of increased thirst and 5 (7.1 %) have a feeling of excessive thirst. If we consider the two seasonal periods, there is a statistically significant difference between the two seasonal periods (p < 0.001), as of the 31 patients, 25 (35.71 %) belonging to the summer period have a normal feeling of thirst compared to 6 (8.57 %) in the winter period, 25 (35.71 %) participants in the summer period have an increased feeling of thirst compared to 9 (12.86 %) in the winter period and 4 (5.71 %) participants in the summer period have a much increased feeling of thirst compared to the single case of the winter period.

Considering the heart rate, there was a significant increase in it in the winter group compared to the summer group (p = 0.009). In fact, 56 (80

%) of the participants, of which 32 (45.71 %) in the summer period and 24 (34.28 %) in the winter period, recorded a normal heart rate; 13 (18.6%) participants recorded a tending heart rate, of which 2 (2.86 %) belong to the summer period and 11 (15.71 %) belong to the winter period and only 1 (1.43 %) participant has tachycardic pulse with bradycardia in severe houses in the summer.

As regards the quality of the pulse, a total of 37 (52.9 %) participants have a normal pulse, of which 19 (27.14 %) in the summer period and 18 (25.71 %) in the winter period; 30 (42.9 %) participants had a "normal to reduce" pulse. Of these 14 (20 %) belong to the summer period and 16 (22.86 %) belong to the winter period and finally 3 (4.3 %) participants have a weak pulse. Of these, 2 (2.86 %) belong to the summer period and 1 (1.43 %) belong to the winter group. There was no statistically significant difference between the two groups (p = 0.779). Regarding the parameter of the eyes, there is no statistically significant difference between the two groups of patients (p = 0.886). In fact, a total of 28 (40 %) patients have normal eyes, of which 13 (18.57 %) in the summer and 15 (21.43 %) in the winter. 40 (57.1 %) patients had slightly sunken orbits. Of these 21 (30 %) belong to the summer group and 19 (27.14 %) belong to the winter group and 2 (2.9 %) have deeply sunken orbits, of which 1 (1.43 %) of the summer group and 1 (1.43 %) of the group winter. Also, with regard to the mucous membranes no statistically significant difference was found between the two groups (p = 0.889).

A total of 32 (45.7 %) patients have moist mucous membranes, of which 15 (21.43 %) belong to the summer group and 17 (24.28 %) belong to the winter group. 36 (51.4 %) patients have dry mucous membranes, of which 19 (27.14 %) belong to the summer period and 17 (24.28 %) belong to the winter group and 2 (2.9 %) patients have parched mucous membranes, of which one for each group considered.

As regards anterior fontanelles assessment, an evaluation was performed only on 13 patients under the age of 18 months, given that by the eighteenth month the anterior fontanelles physiologically weld together.

There was no statistically significant difference between the two groups (p = 0.054). Of the 13 patients, 10 present normal conditions of the anterior fontanelles, of which 7 (10 %) belonging to the summer group and 3 (4.28 %) belonging to the winter group. Only 3 (4.28 %) patients belonging to the winter group have anterior fontanenelle as sunken.

As regards skin turgor, there were no statistically significant differences between the two groups (p = 0.153). In total 16 (22.91 %) patients have instant recoil, of which 11 (15.71 %) patients belong to the summer group and 5 (7.14 %) patients belong to the winter group. 54 (77.1 %) patients had recoil < 2 seconds, of which 24 (34.28 %) patients belong to the summer group and 30 (42.87 %) belong to the winter group. As concern capillary refill, there were no statistically significant differences between the two groups (p = 0.583). 46 (65.7 %) patients presented with normal capillary refill. Of these 21 (30 %) belong to the summer group and 25 (35.71 %) belong to the winter group. 22 (31.4 %) patients presented with prolonged capillary refill between 1-2 seconds. Of these, 13 (18.57 %) belong to the summer group and 9 (12.85 %) belong to the winter group. Only 2 patients have prolonged capillary refill over 2 seconds, one for each seasonal group considered.

As regards the extremities, no statistical significance is recorded between the two groups (p = 0.773). 47(67.1 %) patients have warm extremities. Of these 22 (31.42 %) they belong to the summer group and 25 (35.71%) belong to the winter group. 21 (30 %) patients present with cool extremities, of which 12 (17.14 %) belong to the summer group and 9 (12.85 %) belong to the winter group. 2 patients presented with cold, mottled, cyanotic extremities, 1 patient for each group.

Finally, as regards the urine output parameter, it is recorded a significant reduction in the summer group than in the winter group (p < 0.001). 47 (67.1 %) patients have urine output as normal to decreased, of which 16 (22.86 %) belong to the summer period and 31 (44.28 %) belong to the winter period. 22 (31.41 %) patients have a reduced urine output (< 1ml / kg / h) of which 18 (25.71 %) belong to the summer group and 4 (5.71 %) belong to the winter group and only 1 (1.43 %) patient belongs to the summer group has a reduced urine output (< 0.5ml / kg / h).

Table 2: Sample characteristics and signs assessed for dehydratation condition.

Characteristics/Signs	Total n (%)	Summer n (%)	Winter n (%)	p value
Participants	70(100 %)	35(50 %)	35(50 %)	------
Sex:				
Female	30(42.9 %)	16(22.86 %)	14(20 %)	0.809
Male	40(57.1 %)	19(27.14 %)	21(30 %)	
Age:				
Until 18 months	13(18.6 %)	7(10 %)	6(8.57 %)	0.758
Over 18 months	57(81.4 %)	28(40 %)	29(41.43 %)	
Previous pathologies:				
Yes	16(22.9 %)	7(10 %)	9(12.86 %)	0.777
No	54(77.1 %)	28(40 %)	26(37.14 %)	
Loss of body weight:				
Minimal	50(71.4 %)	22(31.43 %)	28(40 %)	0.252
Moderate	18(25.7 %)	12(17.14 %)	6(8.57 %)	
Severe	2(2.9 %)	1(1.43 %)	1(1.43 %)	
Mental status:				
Well	37(52.9 %)	20(28.57 %)	17(24.29 %)	0.574
Fatigued	30(42.9 %)	13(18.57 %)	17(24.29 %)	
Apathetic	3(4.3 %)	2(2.86 %)	1(1.43 %)	
Thirst:				
Normal	31(44.3 %)	6(8.57 %)	25(35.71 %)	<0.001*
Increased	34(48.6 %)	25(35.71 %)	9(12.86 %)	
Very thirst	5(7.1 %)	4(5.71 %)	1(1.43 %)	
Heart rate:				
Normal	56(80 %)	32(45.71 %)	24(34.28 %)	0.009*
Normal to increased	13(18.6 %)	2(2.86 %)	11(15.71 %)	
Tachycardic with bradycardia in severe cases	1(1.43 %)	1(1.43 %)	0(0 %)	
Blood pressure:				
Normal	52(74.3 %)	21(30 %)	31(44.28 %)	0.013*
Normal to reduced	0(0 %)	0(0 %)	0(0 %)	
Reduced	18(25.7 %)	14(20 %)	4(5.71 %)	
Pulse quality:				
Normal	37(52.9 %)	19(27.14 %)	18(25.71 %)	0.779
Normal to reduce	30(42.9 %)	14(20 %)	16(22.86 %)	
Weak	3(4.3 %)	2(2.86 %)	1(1.43 %)	
Eyes:				
Normal	28(40 %)	13(18.57 %)	15(21.43 %)	0.886
Slightly sunken orbits	40(57.1 %)	21(30 %)	19(27.14 %)	
Deeply sunken orbits	2(2.9 %)	1(1.43 %)	1(1.43 %)	
Mucous membranes:				
Moist	32(45.7 %)	15(21.43 %)	17(24.28 %)	0.889
Dry	36(51.4 %)	19(27.14 %)	17(24.28 %)	
Parched	2(2.9 %)	1(1.43 %)	1(1.43 %)	
Anterior fontanelle:				
Normal	10(14.28 %)	7(10 %)	3(4.28 %)	0.054

Sunken	3(4.3 %)	0(0 %)	3(4.28 %)	
Sunken	0(0 %)	0(0 %)	0(0 %)	
Skin turgor:				
Instant recoil	16(22.9 %)	11(15.71 %)	5(7.14 %)	0.153
Recoil in <2 seconds	54(77.1 %)	24(34.28 %)	30(42.87 %)	
Recoil in > 2 seconds	0(0 %)	0(0 %)	0(0 %)	
Capillary refill:				
Normal	46(65.7 %)	21(30 %)	25(35.71 %)	0.583
Prolonged 1-2 seconds	22(31.4 %)	13(18.57 %)	9(12.85 %)	
Prolonged > 2 seconds	2(2.9 %)	1(1.43 %)	1(1.43 %)	
Extremities:				
Warm	47(67.1 %)	22(31.42 %)	25(35.71 %)	0.733
Cool	21(30 %)	12(17.14 %)	9(12.85 %)	
Cold, mottled, cyanotic	2(2.9 %)	1(1.43 %)	1(1.43 %)	
Urine output:				
Normal to decreased	47(67.1 %)	16(22.86 %)	31(44.28 %)	
Decreased (<1mL/kg/h)	22(31.4 %)	18(25.71 %)	4(5.71 %)	
Minimal (<0.5 mL/kg/h)	1(1.4 %)	1(1.43 %)	0(0 %)	

$p \leq 0.05$ is statistically significant.

Discussion

Our research work wanted to investigate whether there are significant differences between the cases of dehydration in children with diarrhea on the second day with different etiopathogenesis. In fact, several studies in the literature deal with the condition of dehydration linked to etiopathogenesis, but no work has been found that evaluates the condition of dehydration linked to seasonality. Ultimately our study can be considered pilot, in the sense of considering the existence of an increase or a reduction in the level of dehydration in pediatric patients in the second day of diarrhea and therefore whether or not the seasonality factor could interfere with the level of severity of the dehydration condition. Certainly, our study has numerous limitations, such as: the low sample size of both groups, having recruited only 35 patients for each group, respectively. The age range considered is very wide, since all children from the age of zero to 12 years were considered. Furthermore, the seasonality considered refers to the territory of the Puglia region, in the Southern of Italy, where in the summer there are 30 degrees on average and in winter there are 6-7 degrees on average.

However, our study is intended to be a start in defining whether seasonality can affect the dehydration status of children with diarrhea. Since the dehydration condition is one of the most frequent causes of hospitalization and access to the pediatric Emergency Department in which, if not handled properly can lead to insidious complications for the child, up to lead him to death, by defining the malpractice risk **[10]**. In fact, through the research project we highlighted the significant variations of dehydration levels between the winter and the summer period, checking the diagnostic assessment and incidence of dehydration levels, particularly considering clinical parameters as the heart of the nursing care process.

Even if there was a greater incidence and severity in the summer period, it was noted that in the winter period the dehydration condition does not underestimate, by considering that a cold climate influences the loss of liquids and mineral salts with the alteration of clinical parameters that lead to dehydration, with greater amount of urine lost, less thirst and greater incidence of hospitalization due to infectious diseases.

In summer, in addition to the increased sweating caused by high temperatures, which causes water loss and an aggravation of the level of dehydration, one is observed a tendency to change certain clinical parameters. Therefore, clinical parameters that tend to alter during the summer season are the blood pressure and the heart rate that tend to decrease, a minor loss of urine, a greater feeling of thirst and a mental state more apathetic or lethargic.

The nurse managing vital signs and evaluating dehydration case can become one of the cornerstones in the care management of pediatric dehydration **[11-13]**.

Acknowledgment

The author would like to acknowledge patients who accepted to participate in this study and the healthcare providers of the Pediatric Department of the “L. Bonomo” Hospital in Andria, Puglia (Puglia, Italy).

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