



## **Effect of Ice Popsicles on Thirst, Xerostomia and Interdialytic Weight Gain for Children Undergoing Hemodialysis**

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### **ABSTRACT**

**Background:** Thirst and xerostomia are the most frustrating and commonly observed manifestations in children undergoing hemodialysis which can lead to significant excessive interdialytic weight gain. **Aim :** The study aimed to evaluate the effect of ice popsicles on thirst, xerostomia and interdialytic weight gain for children undergoing hemodialysis. **Subjects and Method:** A quasi-experimental research design was used to conduct the current study. **A convenient sample** of fifty-two children had an end-stage renal disease; undergoing hemodialysis for at least six months was participated from the pediatric hemodialysis unit at Minia University Children's Hospital. **Four data collection tools were utilized:** Bio-demographic characteristics of the studied children, Dialysis thirst inventory questionnaire, xerostomia inventory questionnaire and interdialytic weight gain assessment record. **Results:** Most of children had thirst and xerostomia before sucking ice popsicles decreased to less than one quarter in the first week and the minority at 4th week after sucking ice popsicles with statistically significant difference. On the other hand, the mean score of interdialytic weight gain decreased from  $1.89 \pm 0.63$  before sucking ice popsicles to  $1.28 \pm 0.49$  after 4th week of sucking ice popsicles with highly statistically significant difference at  $P \text{ value} \leq 0.001$ . **Conclusion:** Ice popsicles intervention had a positive effect on reduction of thirst and xerostomia and significantly decreases interdialytic weight gain for children undergoing hemodialysis. **Recommendations:** The application of ice popsicles intervention should be endorsed as a part of the routine care for managing thirst and xerostomia for hemodialysis children.

**Keywords:** Children; Hemodialysis; Ice Popsicles; Interdialytic Weight Gain; Thirst; Xerostomia

### **Introduction:**

Chronic Renal Failure (CRF) is a distressing disease with many long-term outcomes; it leads to an irreversible deterioration of kidney function that gradually develops to End-Stage Renal Disease

(ESRD). Currently, hemodialysis is the most regularly chosen renal replacement therapy. Hemodialysis (HD) is used in advanced and everlasting kidney failure in pediatric patients to render fluid imbalances and help control kidney

disease and promote the quality of life for CRF patients (Devarajan et al., 2022). Hemodialysis involves extracorporeal removal of waste products such as creatinine and urea, it also includes free water, and waste elimination using a membrane as a substitute in the kidney as a filter. Hemodialysis has a variety of complications such as growth disorder, paleness, frequent urinary tract infection, anorexia, mood disorders idiopathic vomiting and fatigue (Ye, et al.,2020).

Hemodialysis children usually experience experience hemodialysis 2-3 times a week with the duration of 3 to 5 hours of each hemodialysis session, meaning that; if the patient does not undergo hemodialysis in the days between two dialysis sessions the patient will undergoes problems with fluid retention. As a result of fluid restriction, it causes thirst which can use an increase in fluid intake that results in excess fluid problems causing various complications. As a result of limiting fluid intake the patient will experience thirsty and xerostomia (Utami & Widyarani, 2021).

Thirst is a subjective feeling that is characterized by the need to drink water and has an observable sign that affect patient's ability to function physically, mentally, and socially. A complicated mechanism made up of osmo, baro, mecano and thermo-receptors signals the need for water intake to specific areas of the brain, resulting in a subjective and painful feeling of thirst (Mohamed et al.,2023).

Thirst among hemodialysis patient caused by the restriction of fluid intake occurs when the salivary glands fail to provide enough fluids to

moisten the mouth. A sensation of thirst is brought on by dry mouth because it triggers nerve endings in the mouth, which are subsequently sent to the thirst center in the lateral hypothalamus next to the vasopressin-producing cells (Wasilah, 2022).

The study by Dehghanmerhr et al., (2018) cleared that; the most common side effects for pediatric hemodialysis patients are dry mouth and thirst. Between 68 and 86% of patient's experience thirst, which lowers their quality of life and causes them to feel uncomfortable and distressed.

Xerostomia is a subjective complaint (28 %to 67%) of dry mouth that is commonly reported in patients with end-stage kidney disease (ESKD), including those receiving chronic hemodialysis. Xerostomia may be caused by reduced salivary flow as a result of salivary gland atrophy and fibrosis as well as specific medications that are often taken by children receiving hemodialysis (Bossola,2019). Hemodialysis children were exposed to severe thirst distress frequently, and some studies have observed a positive relationship between thirst and an increased interdialytic weight gain (Hsu et al., 2022). Interdialytic weight gain (IDWG) is the consequences of salt and water intake between two hemodialysis sessions, and it is used as a criterion for fluid intake while the daily urine output is taking into consideration. Increased interdialytic weight in hemodialysis patients causes increased risk of death due to cardiovascular events and cerebrovascular diseases (Ozen et al., 2021).

Sucking the ice popsicles is one of alternative nursing approaches and effective intervention to decrease the thirst level among patients with

hemodialysis. One ice popsicle contains 10 ml of water, and the patients can suck it for about 5 minutes, sucking the popsicles provides a cold feeling which can freshen the patient's mouth; thus, the patients can hold their thirst longer. Other interventions performed to overcome thirst include gargles of boiled water, and chewing gum, many previous studies have revealed the effectiveness of sucking ice cubes (**Armiyati & Moustafa, 2019**) Also, the study by **Conchon et al. (2021)** who used ice popsicles and proved that; sucking ice popsicles was more efficient in alleviating thirst than 10 mL of water at room temperature as the ice popsicle which contains less water was required to calm thirstiness than with the room temperature water.

The nephrology nurse plays a pivotal role in providing information, support and care, understanding and medical counseling to the pediatric patients and his family throughout the whole illness (**Arnold-Chamney et al., 2019**). She also has an essential role in alleviating thirst and xerostomia among children receiving hemodialysis, through using an ice Popsicle as a non-pharmacologic strategy in a safe and efficient manner

### **Significance of the study**

Globally, more than 30 out of every 100,000 children experience chronic renal failure (CRF) annually, and this rate rises with age between 4 and 6 years (**Naritata et al., 2017**). As per the data from outpatient clinics and dialysis units at 11 universities in Egypt, 1018 patients were diagnosed with CRF, and 56.7% of them were aged between 1 and 19

years (**Shaban, 2021**). The estimated overall prevalence of children on dialysis is 264 per million (**Kamal et al., 2024**).

Hemodialysis children often experience thirst and dry mouth, leading to non-compliance due to excessive fluid intake and the inability to restrict fluids, resulting in high interdialytic weight. A higher risk of all-cause cardiovascular death and an increased occurrence of conditions such as ventricular hypertrophy, cardiac, and cerebrovascular disorders may be associated with high interdialytic weight gain (**Bossola et al; 2023**).

Thirst-quenching methods, like ice popsicles, are crucial for reducing thirst and xerostomia, which ultimately contributes to increased weight gain in children undergoing hemodialysis. The study by **Dasuki and Basok, (2019)** about the effect of sucking the ice on the thirst intensity of (CKD) patients undergoing hemodialysis reported that; Patients who suck on ice cubes show less intense thirst and a lower chance of having too much fluid in their bodies.

There is scarce study about the effect of ice popsicles on thirst, xerostomia and interdialytic weight gain among hemodialysis children in Egypt, Hopefully, the results of the current study will help reduce the suffering of these children. Eventually, the present study results will provide guidance and recommendations that should be reflected in pediatric nursing education and provide evidence-based data that can develop nursing practice and research in the field of nephrology nursing.

**Aim of the study**

The aim of current study was to evaluate the effect of ice popsicles on thirst, xerostomia and intradialytic weight gain for children undergoing hemodialysis.

**Research hypotheses:**

**H<sub>1</sub>:** Children who suck ice popsicles will exhibit lower thirst and xerostomia than before intervention

**H<sub>1</sub>:** Children who suck ice popsicles will exhibit a significant reduction in interdialytic weight gain than before intervention.

**Operational definition:****Ice Popsicles: -**

In the current study, ice Popsicles was considered ice cubes with stick was made with 10 ml of frozen distilled water in ice popsicles container.

**Subjects and Method****Research design**

One group (pre-posttest) quasi experimental research design was used to carry out this study. It is a form of experimental design similar to true experimental design but differs in that it manipulates an independent variable without randomly assigning participants to conditions or orders (**Grove & Gray, 2018**).

**Settings:**

This study was carried out at Pediatric hemodialysis unit of Minia University Children's Hospital which is affiliated to ministry of higher education and scientific research . The hemodialysis unit comprises of four rooms with a total capacity of sixteen beds.

**Sample:**

A convenient sample comprised all available children with end-stage renal failure who had been on hemodialysis at Pediatric hemodialysis unit of Minia University Children's Hospital for six months (52 of children).

**Data collection tool**

**Tool1: Bio-demographic characteristics of the studied children included the following parts: -**

**Part one: Personal data of children such as:** Child age, sex, child rank in the family and educational level

**Part two: Medical data for children: -**

**This part is covered information about:** Disease onset, start of hemodialysis session/year, hemodialysis frequency, and hemodialysis duration (4 items).

**Tool (II): Dialysis Thirst Inventory Questionnaire.**

The assessment tool for measuring thirst in children receiving hemodialysis was adapted from the study by **Bots et al. in 2004**. This tool consisted of 7 items, with each item utilizing a 5-point Likert scale ranging from 1 for never to 5 for very often. Responses to the seven items will be grouped as follows: Never thirsty=7 points, almost never thirsty=14 points, occasionally thirsty=21 points, fairly often thirsty=28 points, and very often thirsty=35 points.No and almost Never thirsty indicated "No thirst", while occasionally often and extremely thirsty indicated thirst (**Abdelsamie et al., 2022**).

### **Tool (III): Xerostomia inventory questionnaire**

**Thomson, et al. (1999)** developed a tool used to evaluate the severity of xerostomia in children. The tool consisted of 11 items, with each item rated on a 5-point Likert scale, ranging from "never" (rated as 1) to "very often" (rated as 5). The total xerostomia score was classified into four categories: No dry mouth (11 points), almost no dry mouth (22 points), occasionally dry mouth (33 points), and often dry mouth (55 points). No and almost no dry mouth indicates "No xerostomia", while occasionally often and extremely dry mouth indicate xerostomia (**Abdelsamie et al., 2022**).

### **Tool (IV): Interdialytic Weight Gain Assessment Record**

The researchers designed it after reviewing the pertinent research on the topic (Sacrias et al., 2016) in order to assess the children's weight between two sessions of hemodialysis by using the body weight scale and it included: Interdialytic weight gain = Proceeding post-dialytic weight- Current pre-dialytic weight

#### **Weight gain was categorized as the following:**

- Low interdialytic weight gain from 1 to less than 2 Kg
- Moderate interdialytic weight gain from 2 to less than 3kg
- High interdialytic weight gain equal or more than 3kg

### **Data collection Procedure**

The researchers conducted a direct personal interview with parents after that gathered the bio-demographic data of children from the child's

medical sheet using **Tool I**. The study sample included 52 children who followed the inclusion criteria, the children served first as a control group and after that, the same group of children serve as the study group. The data collection procedure was done over a period of six months, from the beginning of January to the end of July 2024.

### **At the first time children were served as a control group where no intervention ( no ice popsicles intervention)**

- Children were exposed to routine medical care from hospital only such as taking vital signs and receiving instructions about diet that rich in calcium and low phosphorus.
- The researchers assessed the child's thirst using tool (II) and also, the children's xerostomia was assessed before hemodialysis session using tool (III) in the first day as a pre-test.
- Post-dialytic weight was assessed using **Tool (IV)** after the first hemodialysis session using the following steps: First the researchers explained to the child and their parents that will use the digital scale to measure the child weight, Next, ensure the scale is on a stable surface and instruct the child to take off their coat and shoes. Then, turn on the scale and make sure it reads zero. Have the child stand in the center with their weight evenly balanced between both feet, facing forward with arms at their sides. Wait for the scale to stabilize, then record the weight to the nearest 0.1 kg and after weighing the child, the weight was recorded at the sheet as post-dialytic weight (**Grossman, 2017**).

**The same children were acted as a study group in which the ice popsicles intervention was applied for them:-**

The researchers taught mothers and their children about the preparation of ice popsicles at home and how to use it, they give the mothers popsicles containers and inform them that each container should contain 10 ml of natural drinking water and a stick should be inserted in the container and the container should be packed in the freezer for at least 5 hours.

- The researchers provided the instructions to the children and their mothers to suck the ice popsicle when they feel thirsty and at least five times per day for four consecutive weeks.
- The researchers followed the mothers and children by phone calling to check their compliance to preparation and usage of ice popsicles at home.
- The researcher assessed thirst and xerostomia post-session weekly at the end of 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and fourth week using tool (II) and (III) respectively.
- Pre-dialytic weight was measured before hemodialysis session using tool (IV), and interdialytic weight gain was determined by decreasing the child's pre-weight from the weight of the previous session (post-weight) four times per week, at the end of the first, second, third, and fourth weeks.



**Figure (1) Silicone ice Popsicle container**

**Figure1 Reprinted from <https://www.amazon.eg/> (2023)**

**Tool validity and reliability:**

Three experts in pediatric nursing and two specialists in pediatric nephrology evaluated the scales' reliability. The researchers translated the scales, statements and then reviewed them by the five experts. Tools were reviewed for topic coverage, item sequencing, clearness, relevance, applicability, format and length. Some adjustments have been made, like rewording specific sentences following experts' advice. The reliability of the thirst and xerostomia inventory questionnaire tools was tested using Cronbach's Alpha, resulting in values of 0.87 and 0.84, respectively.

**Ethical considerations:**

The Research Ethics Committee at the Faculty of Nursing, Minia University granted written approval code No (REC202461). The researchers received written approval from both the hospital director mentioned earlier and the dialysis unit director. The mothers of the children who took part in this study gave written formal consent. The researchers clarified the objective and characteristics of the study via face-to-face interviews, guaranteeing the confidentiality of the data for research purposes exclusively. The research followed ethical principles, ensuring anonymity and privacy through data coding, allowing the mother to opt out of the study without giving a reason.

**Pilot Study: -**

A pilot study was carried out on 10% of children receiving hemodialysis to assess the feasibility, objectivity, applicability, clarity, adequacy, and content validity, as well as identify any potential issues in the methodological approach or tools. The findings from the pilot study were utilized to explore the suggested statistical and data analysis methods, with the children who took part in the pilot study being incorporated into the overall sample for the present study.

**Statistical analysis:**

Data were collected, codified, classified, presented, scored, tabulated, and entered into the SPSS version (28). Descriptive statistics such as frequencies and percentages were used to present the data for qualitative variables, using Chi-square and Fisher's Exact Test. Mean and standard deviation were used to describe data for quantitative variables.

The non-parametric Friedman test was used to determine the significance level of more than two periods or stages, followed by post Hoc test for pairwise comparisons. The relationship between bio-sociodemographic data and thirst and xerostomia score was examined using Kruskal-Wallis and Mann-Whitney tests. A statistically significant result was determined if the P value was below 0.05.

**Results**

**Table (1)** displays the relevant personal data of the children involved in the present research. Regarding the age of children, over two thirds (67.3%) of them were male and aged between 7-10 years, with a mean age of  $10.5 \pm 2.7$  years. Additionally, 57.7% of them were classified as second children and 32.8% had four or more siblings. The over two thirds (65.3%) were enrolled in primary school, while 75.0% were from rural areas.

**Table (2)** illustrates medical data pertinent to hemodialysis children who involved in the current research. In relation to disease onset, this table presents that, 61.5 % of the studied children suffered from chronic renal failure from 4 years and more than half (52%) of them began to initiate first hemodialysis session from 5 years. This table shows that more two-thirds (65.4%) of children in the study had three hemodialysis sessions per week. During hemodialysis sessions, most participants (92.3%) reported that the session lasted four hours on average with a standard deviation of  $3.92 \pm 0.26$ .

Concerning thirst scale before and after sucking ice popsicles among studied children, table (3) highlighted that; more than two thirds (63.5%) of children felt very often thirsty before sucking ice

popsicles versus 40.4% of them felt fairly often thirsty in the first week after sucking with no statistically significance difference. On the opposite, more than one third of them (32.8%) of them labeled their thirst level as occasionally thirsty after 2 weeks from sucking ice popsicles with a significant difference p-value at 0.018\* while at 3<sup>rd</sup> and 4<sup>th</sup> week 61.5% and 78.9% respectively of them had never feel thirsty after sucking ice popsicles with a significant difference p-value ((0.049\* & 0.033\*). Regarding to total mean score of thirst scale score, the mean score was 28.98±6.30 decreased to 23.94±7.89, 17.19±8.14, 10.42±5.58, 8.73±3.90 at 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> week respectively after sucking ice popsicles with highly significant difference at P≤0.001.

Regarding xerostomia scale before and after sucking ice popsicles among studied children, table (4) pointed out that; more than half (51.9%) of children had very often dry mouth before sucking ice popsicles versus 40.4% of them felt fairly often dry mouth in the first week after sucking with statistically significance difference. On the opposite, more than one third of them (40.4%) of them labeled their xerostomia level as occasionally dry mouth after 2 weeks from sucking ice popsicles with statistically significance difference p-value at <0.001\*\* while at 3<sup>rd</sup> and 4<sup>th</sup> week 69.2% and 82.7% respectively of them had never dry mouth after sucking ice popsicles with significant differences p-value (0.03\* & 0.02\*). Regarding to total mean score of xerostomia scale score, mean score was

42.55±9.92 decreased to 33.94±10.38, 24.13±11.19, 16.44±9.82, 13.87±7.27 at 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> week respectively after sucking ice popsicles with highly significant difference at P≤0.001.

Table (5) demonstrates that; 55.8% of children had low interdialytic weight gain before sucking ice popsicles while 69.2%, 78.8%, 82.7%, 8.5% of them had low intradialytic weight gain at 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> week, respectively after sucking ice popsicles and the mean score of intradialytic weight gain decreased after sucking ice popsicles with highly significant difference at P≤0.001.

Figure (1) shows that; 94.2% of children had thirst before sucking ice popsicles compared to 88.4%, 94.2% respectively of children had no thirst at 3<sup>rd</sup> and 4<sup>th</sup> week after sucking ice popsicles with significant difference at P≤0.001.

Figure (2) shows that; 94.2% of children had xerostomia before sucking ice popsicles compared to 84.6% and 90.4% respectively of children had no xerostomia at 3<sup>rd</sup> and 4<sup>th</sup> week after sucking ice popsicles with significant differences at P≤0.001.

It is evident from table (6) that; there was no statistically significant relation between personal data and thirst degree among the studied children before and after sucking ice popsicles except for gender P. value at 0.05

It is evident from table (7) that; there was no relation between demographic characteristics and xerostomia degree among the studied children before and after sucking ice popsicles except gender P. value at 0.05.



**Table (1) Percentage distribution of the studied children regarding their personal data (n=52):**

Personal data	Studied children(52)	
	N	%
<b>Child's age:</b>		
7 - 10 years	35	<b>67.3</b>
11-14 years	10	19.2
15-18 years	7	13.5
<b>Age (Mean±SD)</b>	<b>10.53±2.71</b>	
<b>Gender:</b>		
Male	35	<b>67.3</b>
Female	17	32.7
<b>Child ranking in the family:</b>		
First	10	19.2
Second	30	<b>57.7</b>
Third	7	13.5
Fourth or more	5	9.6
<b>Child's education: -</b>		
Not enrolled in the school	4	7.7
Primary school	34	<b>65.3</b>
Preparatory school	11	21.2
Secondary school	3	5.8
<b>Sibling number</b>		
One	6	11.5
Two	14	26.9
Three	15	28.8
Four and more	17	<b>32.8</b>
<b>Place of residence:</b>		
Rural	39	<b>75.0</b>
Urban	13	25.0

**Table (2) Percentage Distribution of the Studied Children Regarding their Medical Data (n=52):**

Medical data	Studied children(52)	
	N	%
<b>Disease onset :</b>		
Less than 4 years	32	<b>61.5</b>
4< 7 years	11	21.2
7≤ 10 years	9	17.3
<b>Mean±SD</b>	<b>4.07±2.28</b>	
<b>Initiation of First hemodialysis sessions:</b>		
less than 1 year	10	19.2
1-5 yrs	27	<b>52</b>
More than 5 years	15	28.8
<b>Frequency of hemodialysis session:</b>		
One time per week	7	13.5
Two times per week	11	21.1
Three times per week	34	<b>65.4</b>
<b>Duration of hemodialysis session:</b>		
Three hours	4	7.7
Four hours	48	<b>92.3</b>
<b>Mean±SD</b>	<b>3.92±0.26</b>	

Table (3) Percentage Distribution of the Studied Children regarding Thirst Scale Items Before and After Sucking Ice Popsicles (n=52)

Degree of Thirst among Children (thirst scale items)	Before sucking ice popsicles		After Sucking Ice Popsicles							
			First Week		Second Week		Third week		Fourth week	
	No	%	No	%	No	%	No	%	No	%
Never thirsty	0	0	3	5.8	11	21.2	3 2	<b>61.5</b>	41	<b>78.9</b>
Almost never thirsty	3	5.8	8	15.4	12	23	1 4	27	8	15.4
Occasionally thirsty	4	7.7	6	11.5	17	<b>32.8</b>	3	5.8	2	3.8
Fairly often thirsty	1 2	23	21	<b>40.4</b>	6	11.5	2	3.8	1	1.9
Very often thirsty	3 3	<b>63.5</b>	14	26.9	6	11.5	1	1.9	0	0
Test $\chi^2$ Fisher(p-value)			27.89 (0.68)		19.78(0.01 8*)		18.86(0.049 *)		11.94 (0.033*)	
Min – max	11-35		7-35		7-35		7-29		7-26	
Mean $\pm$ SD	<b>28.98<math>\pm</math>6.30</b>		<b>23.94<math>\pm</math>7.89</b>		<b>17.19<math>\pm</math>8.14</b>		<b>10.42<math>\pm</math>5.58</b>		<b>8.73<math>\pm</math>3.90</b>	
Test(Fr)			0.385		1.413		2.327		2.702	
(p-value)			P1= 1		P2= <b>&lt;0.001**</b>		P3= <b>&lt;0.001*</b> *		P4= <b>&lt;0.001**</b>	

(Fr) Friedman post-hoc test,  $\chi^2$  Chi square test, Fisher's Exact Test(\*\*) Highly statistical significant difference at  $P \leq 0.001$  (\*) Statistical significant difference at  $P \leq 0.05$ 

Table (4) Percentage Distribution of the Studied Children regarding Xerostomia Scale Items before and after Sucking Ice Popsicles (n=52):

Degree of Xerostomia among Children(xerostomia scale Items(symptoms))	Before sucking ice popsicles		After Sucking Ice Popsicles							
			First Week		Second Week		Third week		Fourth week	
	No	%	No	%	No	%	No	%	No	%
No dry mouth	0	0	3	5.8	13	25.0	36	<b>69.2</b>	43	<b>82.7</b>
Almost dry mouth	3	5.8	6	11.5	21	<b>40.4</b>	8	15.4	4	7.7
Occasionally dry mouth	9	17.3	21	<b>40.4</b>	8	15.4	4	7.7	3	5.8
Fairly often dry mouth	13	25.0	13	25.0	7	13.4	3	5.8	1	1.9
Very often dry mouth	27	<b>51.9</b>	9	17.3	3	5.8	1	1.9	1	1.9
Test $\chi^2$ Fisher (p-value)			<b>63.5</b> <b>&lt;0.001**</b>		<b>37.53</b> <b>&lt;0.001**</b>		<b>22.23</b> <b>0.03*</b>		6.36 <b>0.02</b>	
Min – max	19-55		11-55		11-50		11-50		11-46	
Mean $\pm$ SD	<b>42.55<math>\pm</math>9.92</b>		<b>33.94<math>\pm</math>10.38</b>		<b>24.13<math>\pm</math>11.19</b>		<b>16.44<math>\pm</math>9.82</b>		<b>13.87<math>\pm</math>7.27</b>	
Test(Fr)			0.615		1.519		2.237		2.837	
(p-value)			P1= 0.472		P2= <b>&lt;0.001**</b>		P3= <b>&lt;0.001**</b>		P4= <b>&lt;0.001**</b>	

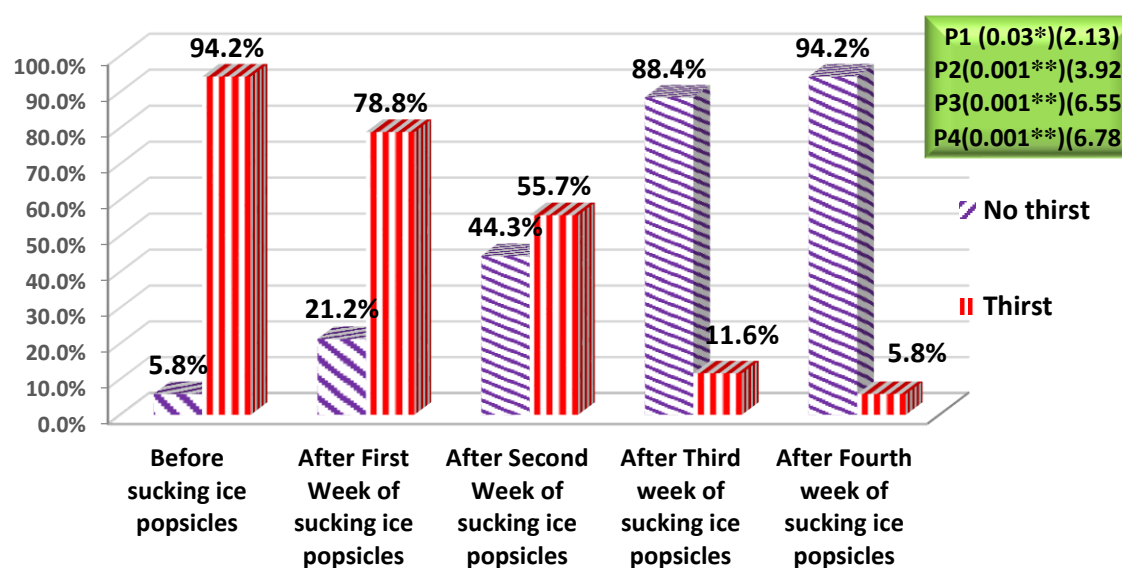
(Fr) Friedman post-hoc test,  $\chi^2$  Chi square test, Fisher's Exact Test(\*\*) Highly statistical significant difference at  $P \leq 0.001$  (\*) Statistical significant difference at  $P \leq 0.05$

**Table (5) Percentage Distribution of The Studied Children Regarding Interdialytic Weight Gain Levels Before and After Sucking Ice Popsicles (n=52):**

Intredialytic Weight Gain levels (Kg)	Before sucking ice popsicles		After Sucking Ice Popsicles							
			First Week		Second Week		Third week		Fourth week	
	No	%	No	%	No	%	No	%	No	%
Low Intredialytic Weight Gain	29	55.8	36	69.2	41	78.8	43	82.7	46	88.5
Moderate Intredialytic Weight Gain	16	30.8	12	23.1	9	17.4	8	15.4	5	9.6
High Intredialytic Weight Gain	7	13.4	4	7.7	2	3.8	1	1.9	1	1.9
Min-max	1-3.20		0.5-3		0.5-3		0.5-3		0.5-3	
Mean±SD	1.89±0.63		1.67±0.63		1.42±0.57		1.40±0.51		1.28±0.49	
Test(Fr)			0.740		1.192		1.317		1.606	
(p-value)			0.170		P2= 0.001**		P3=<0.001**		P4=<0.001**	

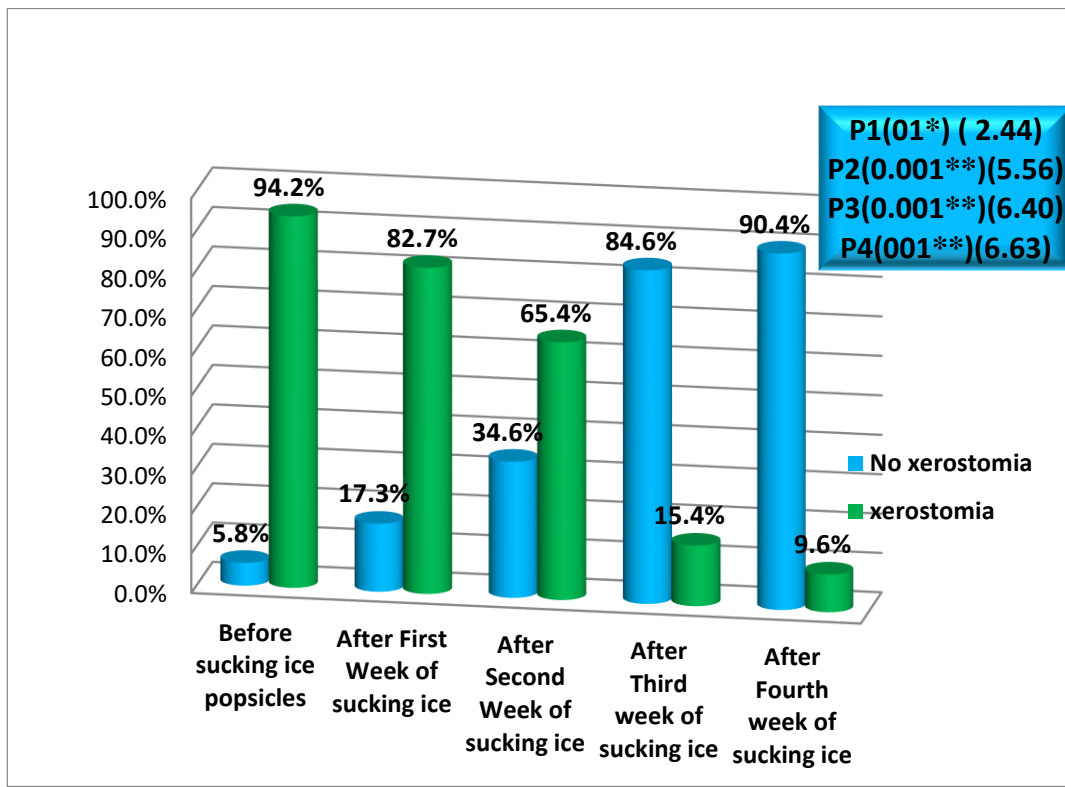
(Fr) Friedman post-hoc test ,  $\chi^2$  Chi seque test , Fisher's Exact Test

(\*\*) Highly statistical significant difference at  $P \leq 0.001$  (\*) Statistical significant difference at  $P \leq 0.05$



(Fr) Friedman post-hoc test

**Figure (1) Percentage Distribution of the Studied Children as Regards Thirst Degree Before and After Sucking Ice Popsicles (n=52)**



( Fr) Friedman post-hoc test

**Figure (2) Percentage Distribution of Children Regarding Xerostomia Degree Before and After Sucking Ice Popsicles (n=52)**

**Table (6) Relation between Personal Data and Thirst Degree among Studied Children Before and After Sucking Ice Popsicles(n=52):**

Personal data	Before sucking ice				After 1 <sup>st</sup> week				After 2 <sup>nd</sup> week				After 3 <sup>rd</sup> week				After 4 <sup>th</sup> week			
	No thirst		Thirst		No thirst		Thirst		No thirst		Thirst		No thirst		Thirst		No thirst		Thirst	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
<b>Age</b>																				
7 - 10 years	2	5.7	33	94.3	8	22.9	27	77.1	15	42.9	20	57.1	30	85.7	5	14.3	32	91.4	3	8.6
11-14 years	0.0	0.0	10	100	2	20	8	80	6	60	4	40	9	90	1	10	10	100	0.0	0.0
15-18 years	1	14.3	6	85.7	1	14.3	6	85.7	2	28.6	5	71.4	7	100	0.0	0.0	7	100	0.0	0.0
<b>Kruskal Wallis (p-value)</b>	1.51 (0.46)				0.26 (0.87)				1.69 (0.42)				1.17 (0.55)				1.51(0.46)			
<b>Gender</b>																				
Male	2	5.7	33	94.3	9	25.7	26	74.3	18	51.4	17	48.6	33	94.3	2	5.7	34	97.1	1	2.9
Female	1	5.9	16	94.1	2	11.8	15	88.2	5	29.4	12	70.6	13	76.5	4	23.5	15	88.2	2	11.8
<b>Mann-Whitney (p-value)</b>	0.02(0.98)				1.14(0.25)				1.48(0.13)				<b>1.86(0.05*)</b>				1.28(0.20)			
<b>Place of residence</b>																				
Rural	2	5.1	37	94.9	10	25.6	29	74.4	20	51.3	19	48.7	36	92.3	3	7.7	37	94.9	2	5.1
Urban	1	7.7	12	92.3	1	7.7	12	92.3	3	23.1	10	76.9	10	76.9	3	23.1	12	92.3	1	7.7
<b>Mann-Whitney (p-value)</b>	0.34(0.73)				1.35(0.17)				1.75(0.07)				1.48(0.13)				0.11(0.73)			
<b>Child education</b>																				
Don't read and write	0.0	0.0	4	100	1	25	3	75	2	50	2	50	3	75	1	25	4	100	0.0	0.0
Primary school	2	5.9	32	94.1	8	23.5	26	76.5	15	44.1	19	55.9	30	88.2	4	11.8	31	91.2	3	8.8
Preparatory school	1	9.1	10	90.9	2	18.2	9	81.8	5	45.5	6	54.5	10	90.9	1	9.1	11	100	0.0	0.0
Secondary school	0.0	0.0	3	100	0.0	0.0	3	100	1	33.3	2	66.7	3	100	0.0	0.0	3	100	0.0	0.0
<b>Kruskal Wallis(p-value)</b>	0.64(0.88)				0.99(0.80)				0.20(0.97)				1.145(0.76)				1.653(0.64)			

Table (7) Relation between Personal Data and Xerostomia Degree among the Studied Children Before and After Sucking Ice Popsicles(n=52)

Personal data of children	Before sucking ice				After 1 <sup>st</sup> week				After 2 <sup>nd</sup> week				After 3 <sup>rd</sup> week				After 4 <sup>th</sup> week			
	No Xerostomia		Xerostomia		No Xerostomia		Xerostomia		No Xerostomia		Xerostomia		No Xerostomia		Xerostomia		No Xerostomia		Xerostomia	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
<b>Age</b>																				
7 -10 years	2	5.7	33	94.3	6	17.1	29	82.9	23	65.7	12	34.3	29	82.9	6	17.1	32	91.4	3	8.6
11-14 years	1	10	9	90	3	30	7	70	7	70	3	30	9	90	1	10	9	90	1	10
15-18 years	0.0	0.0	7	100	0.0	0.0	7	100	4	57.1	3	42.9	6	85.7	1	14.3	6	85.7	1	14.3
<b>Kruskal Wallis (p-value)</b>	0.74 (0.69)				2.54 (0.28)				0.37 (0.82)				0.30(0.86)				0.21( 0.89)			
<b>Gender</b>																				
Male	3	8.6	32	91.4	8	22.9	27	77.1	26	74.3	9	25.7	30	85.7	5	14.3	31	88.6	4	11.4
Female	0.0	0.0	17	100	1	5.9	16	94.1	8	47.1	9	52.9	14	82.4	3	17.6	16	94.1	1	5.9
<b>Mann-Whitney( p-value)</b>	1.23(0.21)				1.50(0.13)				<b>1.91(0.05*)</b>				0.31(0.75)				0.63( 0.52 )			
<b>Place of residence</b>																				
Rural	3	7.7	36	92.3	8	20.5	31	79.5	27	69.2	12	30.8	34	87.2	5	12.8	35	89.7	4	10.3
Urban	0.0	0.0	13	100	1	7.7	12	92.3	7	53.8	6	46.2	10	76.9	3	23.1	12	92.3	1	7.7
<b>Mann-Whitney( p-value)</b>	1.02(0.30)				1.04(0.29)				1.0(0.31)				0.87(0.37)				0.26(0.78)			
<b>Child education</b>																				
Don't read and write	0.0	0.0	4	100	1	25	3	75	4	100	0.0	0.0	4	100	0.0	0.0	4	100	0.0	0.0
Primary school	2	5.9	32	94.1	6	17.6	28	82.4	22	64.7	12	35.3	28	82.4	6	17.6	31	91.2	3	8.8
Preparatory school	1	9.1	10	90.9	2	18.2	9	81.8	7	63.6	4	36.4	9	81.8	2	18.2	9	81.8	2	18.2
Secondary school	0.0	0.0	3	100	0.0	0.0	3	100	1	33.3	2	66.7	3	100	0.0	0.0	3	100	0.0	0.0
<b>Kruskal Wallis Test(p-value)</b>	0.64(0.88)				0.78(0.85)				3.43(0.32)				1.44(0.69)				1.66(0.64)			

## Discussion:

Xerostomia along with thirst are the most frustrating and frequently noted manifestations in children going through hemodialysis; it is a subjective intense experience, responsible for changes in the biopsychosocial functioning, in sensations and event in the cognition of the individual. In addition, a higher fluid intake as a result of thirst and xerostomia can lead to significant excessive interdialytic weigh gain. Non-traditional therapy such as ice popsicles is more secure than pharmacotherapy, it is relatively safe and does not cause side effects and has become a viable option to increases the flow of saliva and reduce thirst and xerostomia in children undergoing hemodialysis (Yemina et al., 2023). Therefore, the aim of the current study was to evaluate the effect of ice popsicles on thirst, xerostomia, and interdialytic weight gain for children undergoing hemodialysis.

In the present study, analysis of the data related to demographic characteristics of children demonstrated that, over two-thirds of children age ranged from seven to ten years and the mean age was  $10.5 \pm 2.7$  years.

**From the researchers point of view** this might be related to the most common age for chronic kidney disease among children is 5-12 years.

In the same context, Abdelsamie et al. (2022) who studied comparing the impact of acupressure and ice popsicles on thirst in children receiving hemodialysis discovered that; about two third of children their age ranged from seven to ten years

and the mean of children' age who receiving hemodialysis was  $10.05 \pm 1.76$  years. Meanwhile the result disagreed with Attia and Hassan (2017), who studied the effect of cryotherapy on children receiving hemodialysis in terms of pain management, revealed that; the ages of the children varied from 12 to 16 years, with a mean age of  $11.72 \pm 1.74$  years.

Based on the gender of the children studied, the results of the current research indicated that more than two thirds of children were male. This finding echoed the results of a study by El Said et al. (2017), in their study which aimed to examine the effect of cryotherapy on pain intensity at puncture sites of arteriovenous fistula among children undergoing hemodialysis showed that; more than half of children were boys. However, this finding is not consistent with Elhalafawy et al. (2020) entitled cryotherapy versus aromatherapy and their effect on pain of arteriovenous fistula puncture for children undergoing hemodialysis, who found that; 60% of the children in the cryotherapy group and two-thirds in the aromatherapy group were females, respectively.

It was discovered that more than half of children were the second child in their families and about one third of them had four or more sibling. This result was similar to the study by Attia and Hassan, (2017), who found that, less than half of the children were either the first or second child in their families, and they had three to four siblings., on the contrary Ebrahim et al. (2019) who investigated the effect cryotherapy and balloon inflation technique on pain of arteriovenous fistula

cannulation among children undergoing hemodialysis, showed that; less than half of children were the oldest child. In relation to children's education, less than two-thirds of children were enrolled in primary school., while the minority didn't read and write or in secondary school.

From the researcher's point of view, this may be due to almost two thirds of the children in the study were younger than seven to ten years old.

Yet these findings disagreed with the result of the study carried out by **Abdelsamie et al. (2022)** who found that; the majority of children were in primary school.

In terms of residence, three-quarters of the children were from rural areas. This finding aligns with the research conducted by **Elhalafawy et al. (2020)**, which indicated that a majority of children and over two-thirds were also from rural areas across each group. Conversely, **Ebrahim et al. (2019)** reported that more than half of the children studied came from urban areas.

Regarding the medical data of children, it was found that; approximately two-thirds of the children suffered from chronic renal failure for four years ago and the mean years was  $4.07 \pm 2.28$ , more than half of them began to initiate first hemodialysis session for five years ago, less than two third of those examined children attended three sessions each week with the majority reporting that the duration of their hemodialysis sessions was four hours, resulting in a mean duration of  $3.92 \pm 0.26$ . These findings align with the study conducted by **Abdelsamie et al. (2022)**, which indicated that the

children studied had been experiencing chronic renal failure for four years, and the majority received three sessions per week.

On the contrary, **El Said et al. (2017)** discovered that nearly half of the children had been on hemodialysis for one to less than three years. Most of the children underwent three dialysis sessions per week, with each session lasting three hours, which was the case for more than half of them. Similarly, **Ebrahim et al. (2019)** found that; the disease duration and AV fistula were less than five years, with a mean duration of  $2.98 \pm 2.81$  years in over two-thirds of the children. Furthermore, the majority of the children had three dialysis sessions per week, and 86.7% experienced sessions that lasted three hours.

Thirst is a widespread and distressing symptom that faces children undergoing hemodialysis. It is caused by insufficient fluids or an increase in the concentration of osmolites like salt (**Bossola et al., 2023**). The findings of the present study highlighted that the highest percentage of children undergoing hemodialysis experienced frequent thirst and none of them had never feel thirst before ice popsicles intervention. Also, the findings of the current study demonstrated a significant reduction in thirst intensity during the second, third, and fourth weeks after the ice popsicle intervention. This reduction can be explained by the impaired renal function observed in children undergoing hemodialysis, which results in increased sodium and water retention. Additionally, the loss of tubular function leads to greater urinary excretion, contributing to dehydration; this dehydration raises cellular



osmolality, subsequently increasing thirst intensity (Ostermann et al., 2023; Yemina et al., 2023).

This finding may be explained by the fact that decrease thirst intensity by the pre-absorptive satiety process that occurs through inhibition of the vasopressin hormone secretion which maintains the body water balance (Cuzzo et al., 2023). Also, could be due to the ice application stimulates the specific thermo- receptors in the mouth and activates the thirst brain areas to increase its nerve discharge which in turn relieves thirst (Seada et al., 2020). The current study results may be due to the study by Ananta, et al., (2023) who studied the innovation intervention using ice cube on the level of thirsting in patients with hypervolemia in hemodialysis unit concluded that; The ice will melt and hydrate the patient's mucosal membranes, preventing dry mouth. When the melted ice is swallowed, it will also moisten the esophagus and notify the hypothalamus that the patient's fluid needs are being satisfied, which will lessen thirst.

In congruence with the result of this study, Abdelsamie et al. (2022) noted that; very small proportion of children reported feeling thirsty often in the second and third weeks after sucking the ice popsicles. Additionally, Nakaya et al. (2021) in a quasi-experimental, pre- and post-test study conducted to analyze the effects of the ice popsicle on osmolality, vasopressin, the degree of thirst, and the discomfort associated with thirst concluded that; there was a decrease in thirst intensity and discomfort after consuming 20 ml ice popsicles. Moreover, Nurhayati, et al. (2022). Who investigated the effectiveness of chewing gum and sucking ice cubes in reducing thirst in chronic

kidney failure patients undergoing hemodialysis concluded that; the ice cubes alleviate thirst discomfort and enhance adherence in patients with chronic kidney disease undergoing hemodialysis.

Concerning the thirst degree, the present study revealed that the vast majority of children experienced thirst before ice popsicles and then decreased after ice popsicles intervention to more than three quarter, more than half during the first and second weeks, respectively, and the majority experienced no thirst in the third and fourth weeks after consuming ice popsicles, with a statistically significant difference. *These findings accepted the first hypothesis.*

The current study results were congruent with Abdelsamie et al. (2022) who mentioned that; there was a statistically significant difference in the thirst degree after popsicles intervention. As well as a study by Isrofah et al. (2019) about the sipping ice and its effect on reduce thirst feeling in chronic kidney disease patients who have hemodialysis indicated that; thirst levels decreased after participants received the intervention of sipping ice cubes. As a result, the researchers concluded that there were notable differences between participants' thirst levels before and after the ice intervention. The findings offer clinical and scientific backing, demonstrating compelling evidence for an inventive approach for managing thirst by utilizing ice cubes, which proves highly effective in alleviating thirst in hemodialysis patients. Also, the study by (Gungor et al., 2024). Concluded that; Spraying ice water can stimulate the throat of patients to increase saliva production and decrease the frequency of their thirst (Gungor et al., 2024).

On the other hand, the result of **Wasilah (2022)** was incongruent with the present study as they carried out a study about the thirst management among patients with hemodialysis by sucking ice cubes and they concluded that; ice chips decreased the amount of fluid consumed by hemodialysis patients but had no effect on the severity of their thirst.

Xerostomia is a frequent reported frustrated symptom for children undergoing hemodialysis (**Egbring et al., 2023**). The findings of the ongoing study showed that; more than half children indicated that they frequently experienced dry mouth prior to the intervention. On the opposite side after the ice popsicles intervention, more than two fifth of children labeled their xerostomia level as occasionally dry mouth after two weeks from while more than two third of children at the third week and the majority of them at the fourth week had never dry mouth after ice popsicles with statistically significant difference. This finding came on line with **Bruzda-Zwiech et al. (2018)** entitled the relationship between xerostomia, thirst, sodium gradient, and inter-dialytic weight gain in patients undergoing hemodialysis: a comparison between diabetic and non-diabetic patient who confirmed that; xerostomia is more severe in hemodialysis patients when assessed using the xerostomia inventory, this finding could be justified by the fluid restricted diet followed by those children. also, it could be related to the prescribed medications especially antihypertensive drugs which lead to hyposalivation and are considered xerostomatizing.

The current study results were in the same line

with the finding of the study by **Abdelsamie et al. (2022)** who showed that; nearly two third of children reported that they often had dry mouth before intervention and the percentage of xerostomia among studied children was significantly reduced to zero at second, third and fourth weeks after applying the intervention. Ice is a more effective and preferred strategy than water of normal body temperature, basically, it could relieve the mouth dryness by producing greater saliva to lubricate the mouth cavity (**Lian et al., 2024**).

Regarding the xerostomia degree, the present study indicated that; the majority of children had xerostomia before the ice popsicles and then reduced significantly after two weeks from sucking ice popsicles and the majority of children had no xerostomia at the third and the fourth week after the ice popsicles intervention with statistically significant difference. *These findings accepted the first hypothesis*

Current study results were consistent with the study by **Dagar et al. (2021)** about thirst intervention bundle and its effectiveness on thirst intensity, xerostomia and interdialytic weight gain among patients with CKD undergoing hemodialysis concluded that; there was a significant decrease in mean Xerostomia Inventory Score of experimental group both within the group over time ( $p < 0.001$ ) and across the two groups with time ( $p < 0.001$ ) at 0.05 level.

It is essential for the majority of children undergoing hemodialysis to adhere to a fluid restriction in order to avoid fluid overload and IDWG (**Petrosino & Dush, 2021**). Thirst and

xerostomia are interrelated symptoms; they are powerful stimuli to increase water consumption, which could result in an increase in IDWG as a result of not adhering to fluid restriction protocols (Hammond et al., 2023). The findings of the present study indicated that over half of the children exhibited low IDWG gain before ice popsicles intervention. Such percentage increased to more than two third in the first week but without statistically significant difference and increased to the majority during the second, third, and fourth weeks of the study period following the consumption of the ice popsicles with highly statistically significant differences, this could be justified that; using ice could decrease the thirst and xerostomia and potentially increase their compliance to fluid restricted diet, subsequently, this will lead to decrease IDWG (Bossola et al., 2018). *These findings accepted the second hypothesis.*

The findings of the present study were congruent with those conducted by Abdelsamie et al. (2022), who revealed that; over fifty percent of children experienced low IDWG prior to the intervention involving ice popsicles, this percentage increased to a majority of the children during the third and fourth weeks of the study. The results of Sacrias et al. (2016) aligned with those of the current study, their research focused on the impact of a nursing intervention involving ice cubes on thirst and IDWG in patients with chronic kidney disease undergoing hemodialysis and found that; patients who consumed ice cubes experienced a notable reduction in thirst distress, enhanced adherence to a fluid-restricted diet, and

consequently, a decrease in IDWG.

The findings of the present study clearly indicated that; there was no correlation between the demographic characteristics of children and their levels of thirst and xerostomia, both prior to and following the consumption of ice popsicles, with the exception of gender. This observation may be attributed to the differences in body composition between males and females; typically, males possess a higher proportion of muscle tissue, whereas females generally have a greater fat content. Consequently, females tend to have lower body fluid levels than males, which may lead to a reduced thirst threshold in females compared to their male counterparts (Anderson & Garcia, 2017).

### Conclusion

The results of the current study concluded that; the intervention involving ice popsicles had a beneficial impact on reduction of thirst and xerostomia significantly decrease IDWG for children undergoing hemodialysis as evidenced by the majority and the most of children had no thirst at the third and fourth week after sucking ice popsicles compared to most of them had thirst before the intervention with statistically significant difference. On the others hand; a decrease in the overall mean score of IDWG was noted after sucking ice popsicles with statistically significant differences.

### Recommendations

Based on the findings of the study, the following recommendations are proposed :

1. Application of ice intervention ought to be incorporated into the standard care practices for managing thirst and xerostomia for hemodialysis children.
2. The findings of this research are anticipated to inform nursing interventions aimed at managing thirst and xerostomia, specifically by providing education and recommending the use of ice cubes for children receiving hemodialysis.
3. A comparable study may be conducted in various children' hemodialysis units and on a larger sample size to strengthen the findings

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