

Effectiveness of Warm Water Footbath on Temperature and Fatigue among Children with Fever

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ABSTRACT

Contents: A fever can have various causes. Fever can be the only sign of a sick child. It may be combined with several problems.

Aim: Evaluate warm water footbath effectiveness on the temperature and fatigue level among children with fever.

Methods: Quasi-experimental pre/post, study, and control groups design was used. A non-probability purposive sample composed of 100 children, 50 in each study and control groups, their age ranged from 6-12 years with fever. The study was conducted in the Medical and Surgical wards, Emergency Unit (ER), Oncology and Hematology Units, and Pediatric Intensive Care Unit (PICU) at Children Hospital affiliated to Ain Shams University. Four tools were used. A Structured Interviewing Questionnaire. It is composed of two parts; the first part was concerned with the socio-demographic characteristics of children. The second part was concerned with the child's medical history. The second tool was the Child's Vital Signs Chart (pre & post). It was used to assess the child's vital signs, especially temperature. The third tool was Fatigue Scale Child (FS-C), and the fourth tool was Fatigue Scale Staff (FS-S) (pre & post) were used to assess the fatigue level among children pre- and post-applying warm water footbath from child perceptions and researcher's evaluation as a staff. The intervention was a warm water footbath applied for 20-30 minutes.

Results: The mean score level of children's age was 10±1.3 & 10±1.5 years for both the study and control groups, respectively. Nearly two-thirds of them (68% & 62%) were boys in the study and control groups, respectively. There were significant differences in the temperature and fatigue score among children with a fever between the study and control groups after the application of warm water footbath therapy. Also, statistically significant differences between the children mean scores of temperature and fatigue pre- and post-footbath in the study group children.

Conclusion: Warm water footbath is effective in reducing the temperature and fatigue level among children with fever. Recommendations: Warm water footbath should be involved in fever management protocol for children as a complementary therapy, and further studies with a large sample and another age group of children in another setting are also recommended.

Keywords: Warm water footbath, temperature, fatigue, children, fever

1. Introduction

Fever is a common health problem among children. Fever is a high temperature and occurs in children when the body temperature is over 37.5°C (99.5°F). Concerning the mortality of children in poor developing countries, it is alarming and calls for concerted efforts in fighting these health problems. National Health Interview Survey (NHIS 2019) reported that fever affects 25.7 million people, including 7.0 million among children before 15 years old, and it is a significant health and economic problem for children, their families, and society. Diseases that contribute to this mortality include cough, diarrhea, fever, and the overlap between these diseases, causing childhood morbidity and mortality (*World Health Organization 2014; Khatab et al., 2016*).

Fever is recognized as a symptom, not a disease, but it is a natural response of the body that helps in fighting foreign substances (*Thomas et al., 2009; Eldo 2015*). The heat-regulating center in the hypothalamus regulates body temperature. When the temperature rises, the child feels warm, increases oxygen consumption to meet the body's

metabolic needs, the heart rate, respiratory rate increases, and increases cellular metabolism. Simultaneously, increased metabolism uses energy that produces additional heat (*Thomas et al., 2009*).

Most of the childhood illness is accompanied by fever. Infection is a common cause of fever in children (*Sunar, 2017*). Viral and bacterial illnesses are common illnesses that cause fever. It can also happen with heat exhaustion, extreme sunburn, and other medical conditions. High fever may cause seizures for children. Therefore, complementary therapy as warm water footbath therapy has more useful (*Pereira & Sebastian 2018*).

Dilation of internal blood vessels and constriction of peripheral blood vessels occurs during fever. It weakens the child and makes him/her uncomfortable and anxious. Therefore, fever management is a concern to both healthcare providers as well as parents. Therefore, providing comfort to a child is an essential and most crucial nursing intervention (*Mandal et al., 2015 and Axelrod, 2015*).

There are several pharmacological and non-pharmacological measures to manage fever. Antipyretic is one of the pharmacological therapies to manage fever as

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paracetamol. The most common cause for the administration of antipyretics is to provide immediate comfort to the child. Nevertheless, paracetamol toxicity is a concern (Whittemore & Knafel, 2005; Pereira & Sebastian, 2018).

Along with pharmacological therapy, there are many non-pharmacological interventions such as tepid or cold sponging with various solution, external cooling, alcohol application of ice packs or cooling blankets, and warm water foot bath therapy that are found to be effective in controlling the temperature (Selvakumari 2017; Shahid et al., 2017). A previous study showed that ice packs placed on the neck, axilla, and groin are ineffective in treating hyperthermia. It may also result in rapid cooling and may cause shivering for children, which is a discomfort to them. There is a controversy regarding the uses of heat and cold therapies, whereas warm or cold water can help control the body temperature of a feverish child (Wilbert 2016; Pereira & Sebastian 2018).

The use of complementary or alternative medicine has increased in conventional healthcare settings and is being implemented in clinical settings to treat children's fever. There are many uses of complementary therapies to reduce temperature and relieving fatigue. It is becoming a significant part of modern-day health care, with millions taking treatment each year. The most used therapies are hydrotherapy, aromatherapy, relaxation technique, and massage (Khatab et al., 2016).

Under the National Health Policy, the healthcare system has been emphasized using complementary therapies and other treatments to provide comprehensive healthcare. Hydrothermal therapy is one such modality shown to be effective in treating fever. Hydrotherapy means the internal or external use of water in one of its forms (water, ice, or steam) for health promotion or treatment of different diseases with various temperatures, pressure, duration, and site. It is one alternative treatment modality used widely in ancient cultures, including Egypt, India, and China (Thomas et al., 2009; Khatab et al., 2016).

One of the hydrotherapy forms is a warm water footbath. It means immersion of the feet in water temperature from 40°C to 43°C for 15 to 20 minutes. Previous studies have pointed out that warm water footbath helps relieve fatigue, provide comfort, and reduce high temperature through sweating (Wood and Haber 2015).

An experimental study was conducted to assess the effect of warm water footbath to reduce fever. It reveals that there is a decrease in temperature after warm water therapy. The mean pre-test temperature of 101.06 °F was reduced to 98.85°F during post-test. The mean difference was 2.21°F. 72% of the participants were delighted (with warm water footbath therapy (Selvakumari 2017).

A warm-water footbath causes vasodilatation and induces heat dissipation. It increases the toxins' oxidation and increases the foot vessel expansion that resets the hypothalamic set points by heat transfer from higher to lower heat areas (Sullivan and Farrar 2011; Sanford et al., 2008). Therefore, blood volume is increased to the injured area, relieves pain, neutralizing acid and killing bacteria, and relieving aches and tiredness, provides a soothing and

healing effect, promotes muscle relaxation, and timely oxygen and nutrients to the brain that need to relieve fatigue (Genc & Conk 2008).

Warm water footbath application causes the congested blood to flow towards distant parts of the body and increases the phagocytes' ability to destroy the germs and detoxify the blood. The beneficial effect of increased blood flow to the tissue includes the facilitation of drainage and the "wash-out" effect. Thus, large quantities of bacterial poison can be eliminated (Khatab et al., 2016).

The pediatric nurse plays a vital role during children's care. Providing management knowledge for parents during fever is essential to prevent complications. However, nurses are considered one of the multidisciplinary team who plays a significant role in managing fever, decreasing temperature, and fatigue levels among children with fever to prevent complications like febrile seizures using new modality as using warm water footbath (Pereira & Sebastian 2018).

2. Significance of the Study

Children represent 40.1% of the Egyptian population and 10.7% of the population aged 6-12 years, and the overall prevalence of fever in children was 61% in the age of 6-12 years (Ministry of Health and Populations Egypt, 2017). Fever is a common health problem among children in Egypt, from one in six children aged five to ten years (Elakkuvana 2020).

Therefore, this study will be built on the science of complementary therapy that may be useful to nursing and other health care professionals for enhancing the quality of care, decreasing temperature and fatigue levels among children with fever. It is hoped that the current study results might found evidence-based data that can encourage applying nursing research into practice. Besides, it will create new trends for further research in the field of alternative therapy.

3. Aim of the study

It was to evaluate warm water footbath effectiveness on the temperature and fatigue level among children with fever through:

- Assessing the child's temperature and fatigue level before and after applying warm water footbath in both study and control groups.
- Comparing the changes in temperature and fatigue level among children with fever in both study and control groups after applying warm water footbath.

3.1. Research hypotheses

- H1: Application of a warm water footbath will reduce the temperature and fatigue level among children with fever compared to their pre-intervention.
- H2: application of a warm water footbath will reduce the temperature and fatigue level among children with fever compared to the control group.

3.2. Operational definitions

Warm water footbath

It is an immersion of children's feet and ankles in warm water at 40°C- 43°C for 20-30 minutes administered by the researchers and using a bath thermometer.

Effectiveness

It means a change occurring for direct action. It means warm water footbath to bring changes in temperature and fatigue among children with fever.

Fever

It is an unusually high body temperature. Fever is the child who is reached with axillary temperature 38°C and above.

Children

Hospitalized school-age children between six to twelve years with fever.

4. Subjects & Methods

4.1. Research design

A quasi-experimental pre and post, study and control group design were used to evaluate warm water footbath effectiveness on the temperature and fatigue level among children with fever. The quasi-experimental research resembles experimental research but is not true experimental research. Although the independent variable is manipulated, children are not randomly assigned to conditions (Wood & Haber 2015).

4.2. Research setting

Medical and Surgical Wards, Emergency Unit (ER), Hematology and Oncology Units, and Pediatric Intensive Care Unit (PICU) at Children Hospital. Whereas Pediatric Medical and Surgical Wards consist of 180 beds, 15 beds in PICU, and 20 beds in ER. These settings have the highest admission rate for children.

4.3. Subjects

The non-probability purposive sample composed of 100 children ranging from 6-12 years admitted with fever and allocated randomly in the study and control group (50 in each group). According to the Hospital Statistical Center, in the first six months of 2019, it was documented that there is an average of 90-100 child are admitted per month, of which 20-25 were children aged between 6-12 years (Ain Shams Children Hospital Statistical Center 2019).

So, the total number of children was ranged between 120-150 children. According to Krejcie and Morgan's (1970) statistical formula for determining the sample size, when the total number of cases 120, the sample size will 92, and if 150, the sample size will be 108. So, according to the average, the calculated sample size was 100 children. The study group received warm water footbath therapy and standard treatment, and the control group received standard treatment only. Research subjects were chosen according to the following:

Inclusion criteria

- Children whose axillary temperature was 38°C and above.

- Administered antipyretics.

Exclusion criteria

- Unconsciousness.
- Peripheral neuropathy.
- Children who cannot take a sitting position.
- Children who have any lesions or ulcers in the leg.

4.4. Tools of the study

Data was collected using the following three tools.

4.4.1. Structured Interviewing Questionnaire

It was designed in the simple Arabic language by the researchers. It consumed about 3-5 minutes for filling in by the researchers. It composed of two parts:

The first part was related to the child's socio-demographic characteristics such as age, gender, residence, previous hospitalization, hospital stay duration.

The second part was concerned with the child's medical data such as; diagnosis, vital signs, type and duration of fever, associated symptoms, and complaints like skin rash, seizure, and headache.

4.4.2. Child's Vital Signs Chart

This tool was used pre-and post-application of warm water footbath. The researchers used it to assess and follow up the child's vital signs, especially temperature.

4.4.3. Fatigue Scale Child (FS-C)

It was adopted from Hinds et al. (2010); Hockenberry et al. (2003) in the English language. It was used to measure fatigue in children between 7-12 years from their verbal perceptions. The scale contains 14 items that illustrate the fatigue intensity through a two-part instrument. The FS-C suggested that fatigue is conceptualized as three subjective dimensions: Lack of energy (4 statements), not able to function (5 statements), and altered mood (5 statements).

The lack of energy dimension's items includes: "I have been tired, my body has felt different, I have been tired in the morning and feeling too tired to spend time with his/her friends." Not able to function dimension's items includes "I have not been able to play, I have slept more at night, taking many naps, and I have not been able to run." The presence of altered mood dimension's items includes "I have been laying around, it is hard for me to keep my attention on things, it is hard for me to think quickly, emotional tiredness, anxious most of the time, and difficulty remembering what he/she just heard."

Scoring System

The items ask the child for a "yes" or "no" (to assess the frequency) response regarding their experience of any fatigue-related symptoms. If the statement is "true" for the child, they are then asked to rate how much the problem bothers the child on a five-point Likert scale. The scale ranged from "Not at all (1), a little (2), sometimes (3), quite a bit (4) to a lot (5) (to assess the intensity).

If the child has not experienced the problem and has answered with a "no" response to the question, the score is zero. The time consumed for filling in the FS-C was ranged

between 4-5 minutes.

Frequency scores ranged from 0 to 14. The FS-C intensity scores ranged from 14 to 70, i.e., 14 (no fatigue) and 70 (high fatigue). Higher scores represent high experienced fatigue.

4.4.4. Fatigue Scale-Staff (FS-S)

It was adopted from *Hinds et al. (2010); Hockenberry et al. (2003)* in the English language. It was used to measure fatigue in children from the researcher's perspectives as a staff. It consists of nine items, which explore the health professionals' perceptions about the fatigue intensity in children regarding their behavior and mood by circling one number for each item. e.g., the child can participate in daily care activities at the same level of effort, as usual, the child is not well-rested after a nap or a night's sleep, the child does not have the will or desire to participate in care efforts, hard getting out of bed, uncooperative, too tired to eat, dark circles under eyes, needed rest when walking, and no energy and mood changes. The time consumed for filling in the FS-S was ranged between 3-4 minutes. It uses a four-point Likert scale from not at all (1), sometimes (2), frequently (3), and almost always (4) with the higher the score, the higher the fatigue.

Scoring System

- 9 scores indicated no fatigue.
- 36 scores indicated high fatigue.

4.5. Procedures

The researchers reviewed the past, current regional, and international related literature covering all aspects of the study using articles, textbooks, scientific journals. This literature helped the researchers be acquainted with the research problem and guided them in developing the study tools.

Preparatory phase: The study tools' content validity was reviewed by a panel of five experts in the field, three from pediatric nursing and two from pediatric medicine. Their comments led to modifications of some items. FS-C and FS-S internal consistency and reliability were statistically evaluated by performing two separate assessments at two different times. These two data sets from the same researchers are then compared with each other. The test re-test method was used to assess the tool's reliability, and the correlation coefficient score for FS-C was 0.88 and 0.92 for FS-S by using Cronbach's Alpha method.

Official permission for data collection was obtained from the hospital managers in the previously mentioned setting by submitting an official letter issued from the Faculty of Nursing at Ain Shams University.

Ethical Considerations: Verbal consent from children and their parents (mothers) were obtained before the intervention. Clear and simple clarification of the study's nature and its expected outcomes were explained to children and their parents. Each sheet for children had code numbers to protect their confidentiality.

Exploratory phase: The pilot study was carried out on seven children, represent 10% of the study sample, to test the

feasibility of the research process and applicability of the study tools, the time required to fill it, its clarity, and validity. Children included in the pilot study were not involved in the study sample. The necessary modifications were done by adding or omission of unneeded or repeated items before data collection.

Fieldwork was performed from 1/10/2019 - 31/12/2019 to collect data by the researchers. The researchers were available for four days/week (Monday to Thursday) in the morning shift from 9 am - 2 pm. The numbers of children/week ranged from 7-9. The researchers have applied the warm water footbath every time for the child with fever. The study was applied through three phases as follows:

Assessment phase: During it, every participant child in the study was recruited individually to explain its nature and purpose. Medical data were gathered then the researchers obtained verbal consent from the child's parents/mothers, who agreed to participate in the study. The researchers assessed the child's axillary temperature by using the clinical thermometer. The child with axillary temperature 38°C in both groups (study and control groups) was included. The researchers then assessed the child's fatigue score using the FS-C as reported by the child and FS-S as perceived by the researchers as staff for both groups.

Intervention phase: In which intervention (warm water footbath) was applied to the study group during fever. Whereas a plastic basin was filled with warm water at a temperature of 40°C - 43°C measured by bath thermometer after that, the child's feet and ankles immersed in it for 20-30 minutes, and then the feet were dried using a towel whereas, the water temperature was maintained at 40°C through adding warm water when needed. This intervention was repeated approximately 2-3 times for the same child when the axillary temperature reached 38°C and above.

Evaluation phase: The child's axillary temperature was evaluated immediately after half an hour from intervention and then at 2, 4, 6 hours of intervention for both study and control groups.

According to FS-C and FS-S, the child's fatigue level was evaluated immediately after applying warm water footbath and then on the next day and third day after application.

4.6. Limitations of the study

The findings were difficult to generalize because of the small sample size, and the study was applied to a specific age group of children admitted in the hospitals.

4.7. Data analysis

Data were analyzed using a statistical package for the social science (SPSS) program, version 25. The demographic characteristics such as; age, gender, and residence were analyzed using descriptive statistics as frequency and percentage. Fatigue level was analyzed by using descriptive statistics as; mean, standard deviation. The effectiveness of warm water footbath among children with fever in both groups was analyzed using paired t-test,

repeated measures of one way and two ways ANOVA test (inferential statistics). $P > 0.05$ indicates no statistically significant difference, and ≤ 0.05 indicates a statistically significant difference.

5. Results

Regarding the socio-demographic characteristics of children, table 1 shows that the mean of children's age was 10 ± 1.3 and 10 ± 1.5 years, and nearly two-thirds of them (68%, 62%) were boys. Also, 60% and 54% were from an urban area in the study and control groups, respectively. Approximately half of the children (54%, 48%) and (36% & 36%) were previously hospitalized for a duration of hospital stay ranging from three to less than seven days in study and control groups.

Additionally, more than half (60%) of children were admitted to ER, and few of them (10%, 14%) in the hematology and oncology units in both study and control groups, respectively. As regards children diagnosis, this table also clarifies that slightly less than half (46% and 44%) of children diagnosed with rheumatic and typhoid fever, and less than one quarter (14%) their diagnosis was UTI, meanwhile few of them (10%) diagnosed with leukemia in study and control groups respectively, with a non-significant difference between both groups at the baseline assessment.

Regarding children vital signs, table 2 clarifies that the mean score level of the child's temperature was $39 \pm 1.3^\circ\text{C}$ and $39 \pm 1.7^\circ\text{C}$, respiratory rate was 40 ± 2.0 cycle/min, and 41 ± 2.0 cycle/min, and pulse was 100 ± 10.0 beat/min. and 100 ± 5.0 beat/min. In both the study and control group, respectively. This table shows that most children (88% and 90%) were uncomfortable/feel fatigued and tired concerning the fever associated symptoms. More than half of them (56%, 58%) had a headache. Nearly one-fourth of them (24%, 22%) had a skin rash, and more than one-third of them (40%, 44%) had convulsion/seizure in the study and control group, respectively. There were no statistically significant differences ($P > 0.05$) between the study and control groups.

On assessing the mean scores of children's temperature, table 3 confirms a statistically significant difference ($P < 0.05$) in children's body temperatures among study group children immediately, after 2, 4, 6 hours of intervention compared to their baseline assessment. In contrast, a non-

statistically significant difference ($P > 0.05$) was revealed between children in the control group immediately and at 2, 4, 6 hrs. of intervention compared to their baseline assessment.

Table 3 also shows a non-statistically significant difference between the study and control group at the baseline assessment, while statistically significant differences were revealed between both groups immediately, after 2,4,6 hours of assessment.

Table 4 represents the mean scores of fatigue levels as reported by children. This table clarifies no statistically significant differences ($P > 0.05$) at the baseline level between the study and control groups. In contrast, statistically significant differences were revealed immediately, the next day, and on the third day of assessment between both groups ($p = 0.001$).

Additionally, the study group children exhibit a statistically significant difference between their reported fatigue level immediately, the next day, and the third day of intervention compared to their baseline assessment. In contrast, the control group children had no statistically significant change throughout the intervention phases.

Table 5 illustrates the mean scores level of children fatigue assessed by the researchers. This table demonstrates no statistically significant differences ($P > 0.05$) at the baseline level between the study and control groups, while there are statistically significant differences between them immediately, the next day, and on the third day after intervention between both groups.

Moreover, the study group children exhibit a statistically significant difference between their fatigue level as assessed by the researchers immediately, the next day, and on the third day of intervention compared to their baseline assessment. In contrast, the control group children had no statistically significant change throughout the intervention phases, as reported by the researchers.

According to FS-C and FS-S, table 6 reveals the comparison of the mean scores levels of children fatigue. This table illustrates no statistically significant differences ($P > 0.05$) between children and researchers' assessment in both study and control groups.

Table (1): Comparison of children according to their socio-demographic in both study and control groups.

Socio-demographic variables	Study Group No. 50		Control Group No.50		X ²	P-value
	No.	%	No.	%		
Age in years						
6 - < 8.	15	30	17	34	0.035	0.645
8 - < 10.	20	40	20	40		
10 - ≤ 12	15	30	13	26		
Mean ±SD	10± 1.3		10± 1.5			
Gender						
Boys	34	68	31	62	0.215	0.871
Girls	16	32	19	38		
Residence						
Urban	30	60	27	54	0.334	0.875
Rural	20	40	23	46		
Previous hospitalization						
Yes	27	54	24	48	4.925	0.979
No	23	46	26	52		
Duration of hospital stay						
< 3 days	17	34	17	34	0.061	0.673
3- < 7 days	18	36	18	36		
≥ 7 days	15	30	15	30		
Mean ±SD	5± 1.0		5± 1.0			
Pediatric Hospital Units						
Emergency Room (ER)	30	60	30	60	0.215	0.782
Hematology and Oncology Units	5	10	7	14		
Medical and Surgical Wards	5	10	6	12		
Pediatric Intensive Care Unit (PICU)	10	20	7	14		
Diagnosis						
Pneumonia	8	16	8	16	4.925	0.771
Rheumatic fever	13	26	11	22		
Typhoid fever	10	20	11	22		
Gastroenteritis	7	14	8	16		
Leukemia	5	10	5	10		
Urinary tract Infections	7	14	7	14		

6. Discussion

Fever is a common symptom of illness among children due to numerous causes. Fever occurs due to heat loss mechanism is unable to maintain balance with excess heat production, resulting in an abnormal elevation in temperature (Vasundhara 2013). Warm water footbath therapy relaxes, calms tension, and increases nourishment to tissues. The nurse must consider the treatment modality that effectively treats the child, considering all the factors affecting thermoregulation (Paula 2016). Warm water footbath therapy is considered non-pharmacological, safe, and side effect free, cost-effective, and easy to administer (Sharma & Kumari 2019). As pharmacological measures have reported side effects, it is always better to use non-pharmacological measures to reduce fever and fatigue. Different studies were conducted to investigate the effectiveness of different non-pharmacological measures to reduce fever and relieve fatigue (Chiang et al., 2008). Hence, the current study aimed to evaluate warm water footbath effectiveness on the temperature and fatigue level among children with fever.

Two matched groups were recruited to achieve the aim of this study. The study shows a non-statistically significant difference between the study and control group at the beginning of the research regarding their socioeconomic and medical characteristics. Regarding children's socio-demographic characteristics, the present study results show that the mean level of children's age was 10±1.3 and 10±1.5 years. Approximately two-thirds of them were boys. More than half of them were from an urban area, and around half were previously hospitalized. Besides, more than one-third of the study and control groups had a hospital stay duration ranging from three to seven days.

Furthermore, more than half of the children were admitted to the ER. The present study results could be because children's parents had a higher awareness of fever's dangerous complications, and fever might cause seizure attacks that let parents hurry to the ER immediately. These results were consistent with Eldo (2015), who performed a quantitative study using quasi-experimental pre and post-test design with a control group to evaluate the effectiveness of warm water footbath therapy on reducing the level of temperature among 60 children with hyperthermia in Masonic Hospital at

Table 2: Comparison of children according to their vital signs and medical conditions in both study and control groups.

Medical data	Study Group		Control Group		X ²	P-value
	No.	%	No.	%		
Child's vital signs						
Axillary temperature						
38 - < 39°C	10	20	8	16	0.023	0.880
39 - < 40°C	20	40	21	42		
≥ 40°C	20	40	21	42		
Mean ±SD	39±1.3		39±1.7			
Respiratory rate						
20 - < 30 c/min.	8	16	7	14	0.064	0.690
30 - < 40 c/min.	17	34	18	36		
≥ 40 c/min.	25	50	25	50		
Mean ±SD	40±2.0		41±2.0			
Pulse rate						
70 - < 90 b/min.	7	14	6	12	0.054	0.645
90 - < 110 b/min.	18	36	20	40		
≥ 110 b/min.	25	50	24	48		
Mean ±SD	100±10.0		100±5.0			
Types of fever						
Intermittent	30	60	32	64	0.030	0.901
Continuous	20	40	18	36		
Duration of fever						
Last night	17	34	15	30	0.030	0.781
1-2 days	20	40	20	40		
3-4 days	10	20	10	20		
≥5 days	3	6	5	10		
Associated symptoms with fever*						
Skin rash	12	24	11	22	0.037	0.713
Headache.	28	56	29	58		
Uncomfortable/ feel fatigued or tired	44	88	45	90		
Convulsion/ Seizure	20	40	22	44		
Stiff neck and back pain	10	20	14	28		

* Number and percentage were not mutually exclusive.

Table (3): Comparison of mean scores of children's temperature (pre/post) between study and control groups.

Child's temperature assessment period	Study Group	Control Group	F- value	P-value
	Mean±SD	Mean±SD		
The baseline of the child's temp.	3.50±0.80	3.53±0.83	3.320	0.302
Immediately after application (after 30 minutes).	3.47±0.65	3.10±0.70	2.018	0.046
After 2 hours.	2.47±0.53	2.87±0.61	-2.470	0.012
After 4 hours.	1.77±0.50	2.75±0.71	-5.911	0.000
After 6 hours	1.35±0.40	2.70±0.70	-6.910	0.000
	F value	3.113		
	p-value	0.900		

*F= Variance analysis of repeated measurements, one way and two way ANOVA test

Table (4): Comparison of mean fatigue score (pre/post) reported by children between study and control groups.

Child's fatigue assessment period	Study Group	Control Group	F- value	P-value
	Mean±SD	Mean±SD		
Baseline fatigue level	65.73±3.18	63.90±5.80	10.421	0.0801
Immediately after application of warm water footbath (after 30 minutes)	59.53±3.20	62.81±5.70	2.512	0.0001
The next day after application of warm water footbath	34.03±5.58	63.60±6.67	11.523	0.0001
The third day after application of warm water footbath	14.01±5.51	50.88±6.59	12.323	0.0001
	F-Value	63.111		
	P-Value	0.800		

*F= Variance analysis of repeated measurements, one way, and two-way ANOVA test

Table (5): Comparison of mean fatigue scores (pre/post) of children assessed by the researchers between study and control groups.

Child's fatigue assessment period	Study Group	Control Group	F- value	P-value
	Mean±SD	Mean±SD		
Baseline fatigue level	32.73±3.18	30.90±5.80	12.421	0.0880
Immediately after application of warm water footbath (after 30 minutes)	23.53±3.20	28.81±5.70	2.712	0.0001
The next day after application of warm water footbath	15.03±5.58	27.60±6.67	11.123	0.0001
The third day after application of warm water footbath	10.01±5.51	29.88±6.59	12.223	0.0001
F -Value	20.133	33.111		
P -Value	.0001	0.800		

*P ≤ .05; F= Variance analysis of repeated measurements, one way and two way ANOVA test

Table (6): Comparison of mean scores level of children fatigue according to FS-C and FS-S post-intervention between study and control groups.

Items	Study Group	Control Group
	Mean±SD	Mean±SD
Fatigue Scores according to FS-C	33.133±3.121	61.211±3.123
Fatigue Scores according to FS-S	15.231±2.111	29.131±3.125
T-Test	23 .113	30.141
P-Value	0.901	0.701

Coimbatore and reported that, the majority 24 (80%) of the children belong to 4-9 years and 6 (20%) belong to the age group 10-14 years. Meanwhile, regarding their gender, 18 (60%) children were males, and 12 (40%) were females.

Additionally, *Khatab et al. (2016)* concluded that fever was highest in the age group of 6-8 years and among males' children with initial body temperature 37.5°C-38.5°C. *An et al. (2019)* reported that fever remains the most common concern prompting parents to present their child to the emergency department. Additionally, a randomized control trial was conducted in an accident and emergency department with 20 children aged four years to 12 years with fever equal to or greater than 38.9°C. The study concluded a significant reduction in body temperature in the post-test in the experimental group. This finding proved that the hot or warm water footbath therapy effectively reduced body temperature (*Wilbert 2016*).

Regarding children's diagnosis, this study also clarifies that slightly less than half of the children were diagnosed with rheumatic and typhoid fever, and less than one-quarter of them diagnosed with UTI. In contrast, few of them were diagnosed with pneumonia, gastroenteritis, or leukemia in the study and control groups, respectively. This result seems that school-age children are exposed to several attacks of the common cold and sore throat infection due to cold weather during their going to schools and overcrowding classes that accelerate the spread of infection and their buying food that had not safe under supervision from the front of schools. Additionally, they take their nutrition to neglect or forget to wash their hands after entering the toilet and omitting to drink sufficient water.

The current study findings were supported by the *World Health Organization (2014)*, who reported that fever is a normal response to different conditions, mainly due to infection. According to *Khalil (2017)*, fever may refer to a serious illness, but a fever is usually caused by a common infection, but not serious.

Regarding children vital signs before applying warm water footbath, the findings of the current study clarifies that the mean score level of child's axillary temperature was 39±1.3 and 39±1.7, respiratory rate was 40±2.0, and 41±2.0, and pulse rate was 100±10.0 and 100± 5.0 in both study and control groups respectively. This finding might be attributed to that all physiological parameters are interrelated with each other. When the child becomes ill or feverish, all physiological functions are affected and deteriorated. Also, fever may be caused primarily by a respiratory infection or rheumatic fever in the school-age group.

In this context, studies have presented that physiological manifestations during fever include increased oxygen consumption, heart rate, increased cardiac output, and serum levels of catecholamine (*Vinayaga 2016; Merck 2017*). Also, *Elakkuvana (2020)* founded that heart rate was significantly higher in critically ill children with a temperature greater than 37.80°C than in children with a temperature of less than 37.80°C.

The current study results show that most children were uncomfortable/feel fatigued and tired concerning the associated symptoms that the children have with fever. More than half of them had a headache, nearly one-fourth of them had a skin rash, and more than one-third of them had convulsion/seizure, in both study and control groups. There were no statistically significant differences (P > 0.05) between the study and control groups. From the researchers' point of view, fever is a symptom of serious illness that the child has and is accompanied by other manifestations like fatigue, malaise, vomiting, and abdominal pain.

The results of the current study were supported by *Wilbert (2016)*. He investigated the effectiveness of hot water foot bath therapy on temperature among patients with fever and mentioned that considering associated symptoms, in the intervention group, (10) 33.3% had vomiting, (3)10% have fatigue, and (2) 6.7% had eye congestion. In the control group, (6) 20% had vomiting, (4) 13.3% had fatigue, and (2) 6.7% (2) had eye congestion. The mean associated symptom

score was 40% in the intervention group and 50% in the control group.

On comparing the mean scores of children's temperature, this study confirms no statistically significant differences ($P > 0.05$) at the baseline level between the study and control groups. Additionally, the study group children exhibit a statistically significant difference between their temperature immediately, the next day, and the third day of intervention compared to their baseline assessment. In contrast, the control group children had no statistically significant change throughout the intervention phases. This finding pointed out that the warm water footbath therapy could improve the children's body temperature, as evidenced by the study group's improvement throughout the intervention phases and by comparing them with the control group children.

The present study results were confirmed by As well as *Mandal et al. (2015)* conducted a quasi-experimental study to evaluate the effectiveness of hot footbath therapy on physiological parameters of children with a fever at Calcutta National Medical College and Hospital, Kolkata. The study included thirty children with fever in the pediatric unit. Physiological parameters were assessed before providing therapy, 15 and 25 minutes after therapy. The result appeared to decrease physiological parameters after giving hot water footbath therapy in the intervention group, but physiological parameters are increased significantly in the control group.

Also, *Thomas et al. (2009)* conducted a comparative study ineffectiveness of warm water foot bath therapy and antipyretic drug versus only antipyretic drug in the management of fever among 150 children: A randomized controlled trial. The result pointed out that the reduction of body temperature in the warm water footbath therapy and the antipyretic group was faster than only the antipyretic group significantly. Therefore, warm water footbath therapy was effective for the reduction of the level of temperature among children. *Khalifa (2017)* conducted a study to evaluate the effect of warm water footbath therapy to decrease temperature among 60 children with fever through purposive sampling. The study revealed a difference in temperature reduction after warm water footbath therapy in the experimental and control groups. The study concluded that warm water therapy was highly influential in children with fever.

Pereira & Sebastian (2018) carried out a study to assess warm water footbath therapy's effectiveness on the level of temperature among children aged 6-12 years with fever. The study summarized that warm water footbath therapy effectively decreased temperature during fever in children, and it enhances the rapid reduction of increased body temperature along with standard care than paracetamol. Conversely, *Sunar (2017)* carried out an experimental study to assess the effect of hot water footbath in children with fever and reported a significant difference in the lowering of temperature after applying hot water footbath therapy in the study than the control group. The study also suggested that hot water footbath therapy is an alternative, complementary therapy that helps the parents and nurses in fever

management in an easy, cost-effective way without complication.

Concerning the mean scores level of children fatigue according to FS-C and FS-S, the present study results demonstrated no statistically significant differences ($P > 0.05$) at the baseline level between the study and control groups. Moreover, the study group children exhibit a statistically significant difference between their fatigue level as assessed by the researchers immediately, the next day, and on the third day of intervention compared to their baseline assessment. In contrast, the control group children had no statistically significant change throughout the intervention phases, as reported by the children and researchers, with a non-statistically significant difference between both scales' scores in the study and control groups.

Findings of the present study were supported by *Luk et al. (2008)*, who concluded that after administering warm water footbath at 40°C to 43°C for 10 to 30 minutes for children, it was founded that there had been a significant level of fatigue reduction. Children found themselves comfortable and had a high level of satisfaction towards the administration of footbaths. *Sanford et al. (2008)* conducted a longitudinal study to assess warm water footbath therapy's effectiveness on relieving fatigue and insomnia problems among 50 children on chemotherapy through purposive sampling. The study revealed a significant decrease in fatigue and improved sleep quality from the second session of chemotherapy. The study concluded that warm water footbath therapy was more effective for relieving fatigue and insomnia problems among children with chemotherapy.

The present study results supported both study hypotheses that applying warm water footbath application has reduced temperature and fatigue among children with fever compared to their pre-intervention level and compared to the control group.

Finally, a warm water footbath is excellent for reducing temperature and fatigue. The study findings provide statistical evidence that indicates that a warm water footbath can be used to reduce fever and fatigue. Therefore, with technological advances and ever-growing challenges, nurses should update their knowledge in the latest innovation and should take the initiative to implement a warm water footbath for children with fever to reduce temperature and fatigue levels.

7. Conclusion

The current study concluded significant differences in the temperature and fatigue levels among children with a fever between the study and control groups and between pre and post-test for study group children after applying warm water footbath. Therefore, warm water footbath therapy effectively reduces the temperature and fatigue level among children with fever.

8. Recommendations

- Warm water footbath therapy should be involved in fever management protocol for children.

- Further studies with a larger probability sample and another age group of children in another setting were recommended.
- Applying a comparative study between warm water footbath therapy and different types of hydrotherapy.
- Performing a comparative study between warm water footbath therapy and the use of antipyretics.
- Studying the effect of warm water footbath therapy on other physiological parameters like a child's oxygen saturation and weight gain.

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