Innovative Nursing Non-Pharmacological Interventions for Febrile Children: Warm Water Foot Immersion and Vinegar Compresses: A Comparative Study

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Received: 21 Oct. 2025; Accepted: 15 Dec. 2025

Abstract- Fever is a common indication of disease among children and is considered harmful by many parents, occurring when the body temperature rises above the normal range. The normal range of body temperature varies with a child's age, measurement method, and time of day. To compare the effects of warm-water foot immersion versus vinegar compresses on reducing body temperature in febrile children. A quasi-experimental non-equivalent control group pre-test—post-test design was employed in this study, involving 180 children at Karbala Teaching Hospital for Children. Participants were selected through purposive sampling and divided into three groups. Participants in the control group (n=60) received only standard hospital care; participants in the WWFI group (n=60) received a warm foot bath for 15 minutes; and participants in the vinegar compress group (n=60) received cider apple vinegar compresses for 15 minutes. Axillary body temperature was measured by using a mercury thermometer before and after the intervention. Using SPSS version 26, the data were analyzed. Employing descriptive statistics and the Mann-Whitney U test for group comparisons. The control group shows only a modest decline in body temperature over time, starting at a mean of 38.91±0.53° C and gently decreasing to 38.17±0.50° C by 60 minutes (P=0.145). In contrast, both interventions significantly lowered body temperature in children with fever (P=0.001). WWFI produced a statistically significant reduction in mean body temperature from 38.88±0.42° C at baseline to 36.85±1.32° C at the 60‑minute mark, and the vinegar compresses demonstrated a significant, steep decline from a baseline mean of 39.05±0.54° C to 36.87±0.28° C after 60 minutes. Statistical analysis showed a significant difference in effectiveness between the two interventions (P<0.001), with vinegar compresses being more efficacious. However, WWFI and vinegar compresses are both supportive non-pharmacological interventions among febrile children. But vinegar compresses were more effective than WWFI in reducing body temperature. As a non-pharmacological intervention, vinegar compresses should be involved in the fever management protocol for children, and additional studies with a large sample size and another age group in a different setting are also recommended.

Acta Med Iran 2026;64(1):28-37.

https://doi.org/10.18502/acta.v64i1.21037

Keywords: Nursing; Febrile children; Warm water foot immersion; Vinegar compresses; Comparative study

Introduction

Fever is the most common symptom associated with childhood illness (1,2). Being defined as a rise in body temperature that exceeds the normal daily variation, triggered by the hypothalamus in response to the release of regulatory proteins called cytokines, which are released during immunological and inflammatory reactions to infection (3). Fever is generally considered to be present if the oral temperature is over 37.7° C, rectal temperature above 37.5-38.3° C, axillary temperature, and the tympanic membrane temperature

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above 37.2° C (4). It accounts for about 70% of presenting complaints to the pediatric and general medicine outpatient departments (5). Despite being a self-limiting illness, fever makes parents uncomfortable and is the source of their distress and anxiety. These factors, when combined, raise health care costs and lead to unnecessary antibiotic use. Furthermore, parents frequently make unnecessary phone calls, visit doctors, and use emergency services disproportionately, which may result in unneeded laboratory tests or even the unnecessary administration of medications to children (6-8).

Additionally, although fever is a natural physiological reaction to an infection, its management remains a crucial aspect of pediatric care. Traditionally, antipyretic medications such as acetaminophen and ibuprofen are widely used; however, concerns about their adverse effects and misuse have raised interest in complementary and non-pharmacological interventions (9). The constant advancement in various fields worldwide, especially in healthcare, requires healthcare providers to have extensive knowledge, skills, and critical thinking to support the health of individuals throughout their life journey (10,11). Healthcare providers are recommended to use complementary therapies that are safe, side-effect-free, cost-effective, and easy to administer. In contrast, they are not intended to replace pharmacological therapies (12,13).

There are numerous non-pharmacological interventions available; one of the most effective is hydrotherapy, which is the most effective way to reduce body temperature (14). There are a variety of forms of hydrotherapies (use of water) that include cold sponge, tepid sponge, and warm water foot immersion that are found to be effective in temperature control and widely used among parents and health care professionals (15-17). Warm-water foot immersion (WWFI) is among the most effective hydrotherapies (18). It causes the congested blood to flow towards distant parts of the body, where it is brought to the dilated vessels of the foot and leg. The capillaries, blood vessels in the feet, start to expand and improved circulation, neutralizing acid, killing bacteria and relieving pain, fatigue and fever after application of WWFI for 15 to 20 minutes and the improvement in the blood circulation resets the hypothalamic set points by heat transfer from higher heat area to lower heat area (19). The mechanism of WWFI began by initiating skin vasodilatation and inducing sweat through increasing peripheral temperatures. Skin vasodilatation results in small amounts of dry heat loss and is primarily responsible for internal heat transfer, that is, transferring the heat from the core (internal organs) to the skin. The sweating causes heat loss and cooling through evaporation. Peripheral blood is cooled before it returns to the deeper internal tissues and organs (20,21).

Similarly, another non-pharmacological intervention that is suggested to be effective in reducing body temperature among febrile children is apple cider vinegar compresses, the components of vinegar that include: potassium, enzymes, vitamins A, B, C and E, minerals, and anti-oxidants also contains beta carotene, bioflavonoids, calcium, magnesium, potassium, phosphorus, copper, iron, sulfur, fluorine, silicon, boron and pectin. It naturally balances the pH of the skin and the whole body (22). Compresses containing apple cider vinegar. Additionally, vinegar is considered a tonic for the skin, helping maintain its suppleness and natural moisture content. Additionally, apple cider vinegar compresses enhance the capillaries' blood circulation system, which nourishes the skin and supplies oxygen, helping to reduce body temperature. Vinegar is also a tonic restorative for the skin, maintaining its elasticity, regulating moisture levels, and supporting skin cell regeneration to ensure optimal evaporation (23).

The study determined the effect of WWFI and vinegar compresses on body temperature reduction in febrile children. There is no study that has determined the effect of using WWFI and vinegar compresses and measured the extent of reduction in body temperature in Iraq. In addition, this study will compare these variables to determine which non-pharmacological intervention was most effective in reducing fever. Hence, the study aims to compare the effects of WWFI and vinegar compresses on fever reduction.

Materials and Methods

Study design and setting

A quasi-experimental non-equivalent control-group pre-test—post-test design was employed in this study to evaluate the effectiveness of WWFI and vinegar compresses on body temperature in febrile children attending the emergency department (ED) at Karbala Teaching Hospital for Children.

Sample and sampling

A non-probability purposive sample consists of 180 children aged between 2 and 7 years admitted with fever and allocated into three groups (60) in each group. A sample of the study was selected according to the following:

Inclusion criteria

-Children whose axillary body temperature is more than 37.5c0.

-Administer intravenous antipyretic (paracetamol).

Exclusion criteria

-Children with abnormal skin conditions such as burns, rashes, ulcers, lesions, open wounds, abscesses, or boils in the feet.

- Children with paralysis are partly or entirely unable to move the affected parts of the body and experience loss of sensation.

-Unconscious child.

Sample size calculation

A total of 180 children were included in the data analysis. The study sample was allocated into three groups (60 children in each group (see Figure 1). The minimum sample size in this study was 180 participants, calculated using a 95% confidence level and a 0.05 margin of error (24).

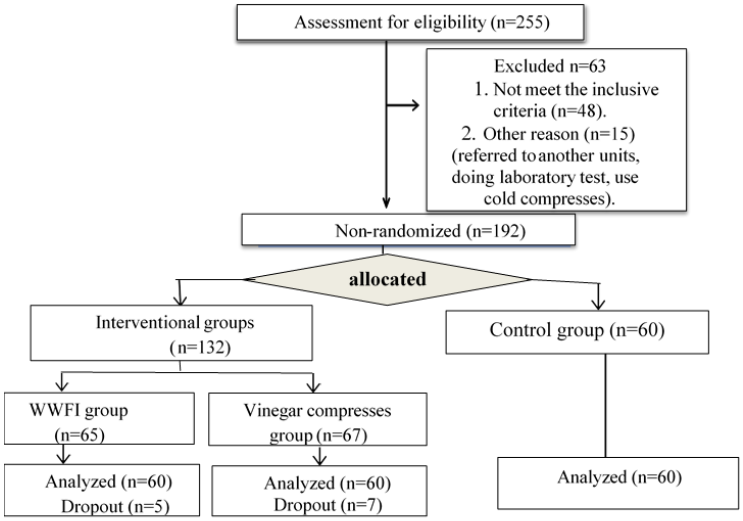

Figure 1. Flowchart of sample recruiting

Intervention protocol

Regarding professional research conduct, the researcher explained the study's aims and duration to reassure participants. Following that, verbal and written consents were obtained from the child's caregivers, who were randomly allocated into three groups (n=180) after being thoroughly examined and diagnosed with a fever by a hospital employee and confirmed by the researcher. However, the interventional protocol was established by the researcher after reviewing scientific literature and previous studies, as well as the researcher's experience. The goal of this interventional approach is to reduce body temperature in children with fever through the application of apple cider vinegar compresses and, on the other hand, through the application of WWFI. The temperature was axillary measured by using a mercury thermometer before the implementation of the intervention and administration of an antipyretic drug (paracetamol) to record as (pre-test) for both the two interventional groups and the control group.

WWFI group

Participants in this group received warm water foot bath therapy along with standard treatment by being placed in a sitting position either alone or with the assistance of caregivers, and his/her feet, including ankles, were socked in the foot bath device. A bath thermometer was used to adjust the water temperature to 38-40° C, and the child was completely covered with a blanket or sheet, leaving only their head and neck exposed. A warm water foot bath was applied for15 minutes, after that time, body temperature was measured at 15,30, 45, and 60 minutes and recorded as (post-test).

Vinegar compresses group

All participants in this group received cider apple vinegar compresses that were applied under the axillae, under the knee, and between the thighs, along with

standard treatment for 15 min. After that time, body temperature was also measured at the same previous regular intervals by using the same tool and recorded as (post-test).

Control group

The control group received only standard treatment to reduce fever in the hospital, such as antipyretic medication. The researcher did not provide any intervention to participants; instead, they received pre-test and post-test assessments of body temperature, administered every 15 minutes for 1 hour using the same tools used for the experimental groups, and these will be compared with the two experimental groups in the study.

Data collection instruments

Data was collected by using the following tools

Structured interviewing questionnaire

It was designed in English by the researchers based on a questionnaire constructed by El-Naggar and Kandulna (25,26). It is composed of two parts: The first part was related to the child's socio-demographic characteristics, such as age and sex. The second part focused on the child's clinical data, including the type and duration of fever, associated symptoms, and previous hospitalizations.

Child's vital signs chart

This tool was used pre-and post-application of WWFI and vinegar compresses to assess and monitor the child's body temperature.

Ethical consideration

The researchers have obtained ethical approval from the Research Ethics Committee at the University of Baghdad/College of Nursing, and Karbala Teaching Hospital has provided the official agreement for Children. Furthermore, written informed consent was obtained from the child's caregivers after thorough explanation of the study objectives, procedures, potential risks, and benefits. Additionally, each participant is given the right to withdraw from the study at any time.

Data analysis

Using the Statistical Package for Social Science (SPSS) version 26, the significance level was $P<0.05$. The mean and standard deviation for the WWFI group, the vinegar compresses group, and the control group were calculated. To compare differences between the intervention and control groups at pre-test and post-test measurements, the nonparametric Mann-Whitney U test was employed; to determine whether there are significant differences between three or more matched or related groups, Friedman's test was used.

Results

Table 1: Demonstrates that most of the children in the control, WWFI therapy, and vinegar compresses groups were within the age group (≥ 6) years old and accounted 43.3%, 50%, and 51.7%, respectively. Males represent a clear majority in all groups and accounted 61.7%, 58.3%, and 65% respectively. Regarding the types of fever, intermittent fever was more commonly observed than continuous fever in both the experimental and control groups, accounting for 65%, 58.3%, and 60% in the control, WWFI therapy, and vinegar compresses groups, respectively. Regarding the duration of fever, 43.3% of children in the control group, 38.3% in the WWFI therapy group, and 43.3% in the vinegar compress group had fever for 1-2 days. The associated symptoms report that feeling uncomfortable or tired is the most frequently reported symptom across all groups, accounting for 40%, 40%, and 36.7%, respectively. Vomiting and convulsions are less common, and combinations are even rarer. This table also showed a notable disparity: 80% of children in the control group had prior hospital admissions, compared with 65% in the WWFI therapy group and 73.3% in the vinegar compress group. Furthermore, this table revealed that there is no significant difference in the demographic and clinical variables across the three groups, except that previous hospitalization shows a highly significant difference among the groups ($\Lambda=6.690$, $P= .002$).

Table 2: focusing on the significant changes in temperature across the repeated time points within each group; in the control group, body temperature shows only a modest decline over time, starting at a mean of 38.91±0.53° C and gently decreasing to 38.17±0.50° C by 60 minutes. The Friedman test revealed no statistically significant change in temperature across time points ($\chi^2=6.84$, df=4, $P= .145$), accompanied by a very small effect size of .03. This suggests that, absent active intervention, fever resolution through a natural, passive course is minimal both statistically and clinically.

Table 1. Distribution of children according to their demographic characteristics and clinical data in each group

List	Characteristics in each group		Control		WWFI		Vinegar compresses		Variance test
			No	%	No	%	No	%	
		2 – less than 4	7	11.7	14	23.3	9	15	
		4 – less than 6	26	43.3	16	26.7	20	33.3	Λ= 2.704
1	Age (year)	≥ 6	27	45	30	50	31	51.7	P= .070
		Total	60	100	60	100	60	100	Sig= N.S
		M±SD	4.5 ± 1.5		4.6 ± 1.7		4.5 ± 1.5		
		Male	37	61.7	35	58.3	39	65	Λ= 1.075
2	Sex	Female	23	38.3	25	41.7	21	35	P= .343
		Total	60	100	60	100	60	100	Sig= N.S
		Intermittent	39	65	35	58.3	36	60	Λ= 1.306
3	Type of fever	Continuous	21	35	25	41.7	24	40	P= .274
		Total	60	100	60	100	60	100	Sig= N.S
		Last night	13	21.7	17	28.3	15	25	
		1 – 2 days	26	43.3	23	38.3	26	43.3	Λ= .357
4	Duration of fever	3 – 4 days	14	23.3	13	21.7	14	23.3	P= .700
		5 days or more	7	11.7	7	11.7	5	8.3	Sig= N.S
		Total	60	100	60	100	60	100	
		Vomiting	14	23.3	17	28.3	19	31.7	
		Convulsion	15	25	13	21.7	15	25	Λ= .134
5	Associated symptoms with fever	Uncomfortable/ tired	24	40	24	40	22	36.7	P= .875
		Combination	7	11.7	6	10	4	6.7	Sig= N.S
		Total	60	100	60	100	60	100	
		yes	48	80	39	65	44	73.3	Λ= 6.690
6	Previous hospitalization	No	12	20	21	35	16	26.7	P= .002
		Total	60	100	60	100	60	100	Sig= H.S

No: Number, %: Percentage, Λ= Levene's Test, *P*: Probability value, Sig: Significance, NS: Not significant, S: Significant, HS: High significant

Table 2. Significant differences in temperature (°C) across time points in control and intervention groups

Groups / Times points		Descriptive statistics				Friedman test				
		M	SD	Min	Max	Mean rank	χ^2	df	*P*	Effect size*
Control (N=60)	Pre-test	38.912	.5256	37.9	40.2	3.12	6.842	4	.145	.03
	Post (15 min)	38.825	.5395	37.6	40.0	3.08				
	Post (30 min)	38.543	.5027	37.4	39.7	2.95				
	Post (45 min)	38.362	.5178	37.4	39.5	2.90				
	Post (60 min)	38.167	.5007	37.2	39.5	2.95				
WWFI therapy (N=60)	Pre- test	38.882	.4184	38.3	39.8	4.91	231.082	4	.001	.96
	Post (15 min)	38.612	.4809	37.5	39.8	4.08				
	Post (30 min)	37.837	.4961	37.0	39.0	2.90				
	Post (45 min)	37.380	.4297	36.2	38.8	2.00				
	Post (60 min)	36.847	1.3234	27.2	37.8	1.11				
Vinegar compresses (N=60)	Pre- test	39.053	.5407	38.3	41.0	4.97	235.408	4	.001	.98
	Post (15 min)	38.543	.4496	37.5	40.0	3.98				
	Post (30 min)	37.915	1.2972	37.0	47.4	3.00				
	Post (45 min)	37.240	.2906	37.0	38.1	2.01				
	Post (60 min)	36.870	.2848	36.3	37.6	1.03				

M: Mean of total score, SD: Standard deviation, Min: Minimum, max: maximum, χ^2: Chi-square, df: Degree of Freedom, P: probability, * Kendall's W

Table 3 displays significant differences in clinical outcomes between WWFI and Vinegar Compresses; the findings indicate a statistically significant difference between the two methods (U=1317, Z=-2.594, *P*=.009). The mean rank for WWFI (68.55) exceeds that of Vinegar Compresses (52.45), signifying a generally lower temperature outcome in the WWFI group. The effect size is small to moderate (.27), indicating that vinegar compresses provided a more effective and quicker reduction in body temperature than WWFI.

Table 4 indicates that there are no significant associations or differences between demographic

characteristics and clinical data, and that the change in body temperature of children with fever is not affected by WWFI or vinegar compresses.

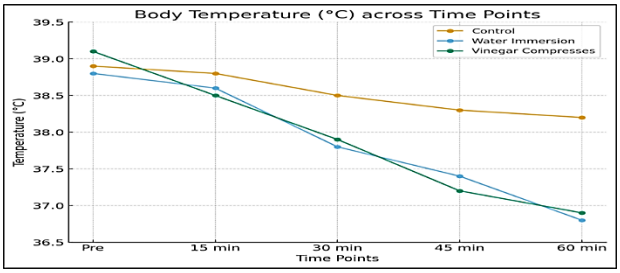

Figure 2. Body temperatures (° C) across different time points for the control, WWFI therapy, and vinegar compresses groups

Table 3. Significant difference in temperature reading based on the type of intervention among children with fever

Parameter	Intervention	N	Mean rank	Mann-whitney U	Z-score	*P*	Effect size*
Temperature	WWFI	60	68.55	1317.000	-2.594	.009	.27
	Vinegar Compresses	60	52.45				

N: Number, p: Probability, Sig.: Significance, HS: Highly Significant, N.S: Not Significant * Small ≈ 0.10, Medium ≈ 0.30, Large ≈ 0.50

Table 4. Associations and differences among demographic characteristics, clinical data, and body temperature of children with fever based on WWFI and vinegar compresses

Groups		WWFI		vinegar compresses	
Variables		Temperature		Temperature	
		Mean Rank	Test result	Mean Rank	Test result
Age (year)	2 – less than 4	36.329	r^s = .029	36.878	r^s = .152
	4 – less than 6	37.063	P = .825	36.945	P = .246
	≥6	36.973		36.819	
Sex	Male	36.689	*U*= 362.000	36.849	*U*= 1153.500
	Female	37.068	P = .249	36.910	P = .565
Types of fever	Intermittent	37.031	*U*= 412.000	36.842	*U*= 380.000
	Continuous	36.588	P = .697	36.913	P = .418
Duration of fever	Last night	36.524	*H*= 3.337	36.980	*H*= 3.433
	1 – 2 days	37.035	P = .343	36.858	P = .330
	3 – 4 days	36.985		36.786	
	5 days or more	36.757		36.840	
Associated symptoms	Vomiting	37.006	*H*= 3.923	36.816	*H*= 6.859
	Convulsion	36.454	P = .270	37.027	P = .077
	Uncomfortable/ tired	36.962		36.850	
	Combination	36.783		36.650	
Previous hospitalization	Yes	37.013	*U*= 373.000 P = .565	36.864	*U*= 342.500 P = .870
	No	36.538		36.887	

rs: Spearman Correlation coefficient, H: Kruskal–Wallis H, U: Mann–Whitney U, *P*: Probability value, *: Significant at *P*< .0 5

Discussion

Section I: Discussion of participants' demographic & clinical data

The first section is intended to present and discuss the demographic and clinical data for the study participants across the three groups (control, WWFI, and vinegar compresses). Table 1 was created to describe the demographics of a given sample, their corresponding frequencies, and the percentages.

In terms of age, the dominant age group in the control group, WWFI therapy, and vinegar compresses is 6 years or older. Making up 45%, 50%, and 51.7% of the participants of the three groups respectively. This result was consistent with a cross-sectional study that aimed to evaluate the length of stay (LoS) of all paediatric hospitalizations, exploring the frequency and characteristics of associated childhood conditions in

children under 16 years. Indicate that the most common age group admitted to the hospital was children younger than 12 years, accounting for 45.6% of total admissions [27]. Additionally, a comparative, prospective study was conducted to assess the effect of Shot Blocker and Its placebo on pain during intravenous cannulation in emergency departments. Three groups of participants were randomly allocated to: Shot Blocker group (n=79), Shot Blocker placebo group (n=75), and control group (n=74). It was demonstrated that (47.3%) in the control group, (45.3%) in the Shot Blocker placebo group, and (43.1%) in Shot Blocker within the age group between 6 and 8-year-old (28). While another study by (29), which was not consistent with our result, conducted a retrospective cohort study based on the electronic medical information of patients to assess fever among children and found that 31.6% of the study participants were between the ages of 3 and 5 years old, which differs from our study.

Regarding participants' sex, there is a higher proportion of males than females across all three groups. The majority of participants in the control group were males. Similarly, in the WWFI therapy group and vinegar compresses group, the percentages account 61.7%, 58.3%, and 65%, respectively. The findings of this study align with studies investigating differences in symptom reporting by child gender in sub-Saharan Africa. Researchers found that parents of girls reported fewer episodes of diarrhea and fever than those of boys (30). According to Rahman and Hossain (31), who conducted a survey study to determine the prevalence of fever, diarrhea, and upper respiratory tract infection (ARI) among children aged 6-59 months, 34.23% of the study participants were male, which was consistent with our study result. Another descriptive correlational study was conducted to compare the effects of the hospitalized and outpatient settings on the quality of sleep-in children with respiratory tract dysfunction at Dhi-Qar Health Directorate pediatric hospitals, involving 250 children. This study indicates that 64.0% of participants in hospitalization were male, and 58.4%. Of the participants in the outpatient group were male (32). On the other hand, a descriptive study was conducted to determine how well cold application reduces pain during chest tube removal in children. Report that (58.3%) of the participants in the study were female (33).

In terms of participants' clinical data, the study findings indicate that the intermittent fever is more commonly observed than continuous fever across all groups, with control: 65%, WWFI: 58.3%, and vinegar compress: 60%, the duration of fever reports that the 1-2 days category commands the highest share in each group: control: 43.3%, WWFI: 38.3%, vinegar compress:43.3%, and the associated symptoms reports that feeling uncomfortable or tired is the most reported symptom across groups: control: 40%, WWFI: 40%, vinegar compress: 36.7%. Vomiting and convulsions are less common, and combinations are even rarer. Additionally, there's a notable disparity: 80% of children in the control group had prior hospital admissions, compared to 65% in the WWFI group and 73.3% in the vinegar compress group. The findings of this study are consistent with a quasi-experimental study that investigated the effect of warm-water foot bath therapy on body temperature in febrile children. The majority of the study participants had fever for 2 days, comprising 40% in the control and 78%, 80% in the experimental group, respectively (34).

The findings of the current study regarding symptoms associated with fever and a history of previous hospitalization are largely consistent with those of a quasi-experimental, pre-test—post-test study conducted at the Children's Hospital affiliated with Ain Shams University to evaluate the effectiveness of foot bath therapy on body temperature and fatigue among febrile children. Showed that in relation to the symptoms that go along with fever, the majority of children feel tired. In both the study and control groups, over half of the participants experienced a headache, almost one-fourth had a skin rash, and more than one-third had convulsions. Additionally, the majority of participants in both groups had previously been admitted to the hospital, accounting for 48% and 54%, respectively [25]. Another study employed a quasi-experimental design to evaluate the effect of hot foot bath therapy on body temperature in patients with fever. The statistical tests related to the symptoms associated with fever indicate that 33.3% of the interventional group had vomiting, 10% have fatigue, and 6.7% had eye congestion. While 20% of the control group experienced vomiting, 13.3% experienced fatigue, and 6.7% experienced eye congestion (15).

Section II: Discussion of significant differences in body temperature across time points in control and interventional groups in the pre-test and post-test periods

Regarding the statistical analysis of body temperature for participants in the intervention and control groups, as indicated in Figure 2, it is suggested that participants in the intervention group experienced a significant reduction in body temperature after 60 min of applying the WWFI and cider apple vinegar compresses, as compared to participants in the control group. The

findings of this study showed a significant change in temperature (° C) across repeated time points within the interventional groups; the WWFI group showed a dramatic, statistically significant reduction in mean body temperature. Similarly, the vinegar compress group demonstrated a significant, steep temperature decline. In contrast, the control group shows only a modest decline over time. The results of the present study were confirmed by a quasi-experimental study conducted at Misr El-Hora General Hospital to evaluate the impact of warm foot bath therapy on body temperature in feverish children. The findings show that, after application, nearly three-quarters of the children in the experimental group had their body temperature return to normal, compared with more than one-third in the control group. The mean body temperature among children in the experimental group in the baseline was 38.7±.417 versus 38.6±.587 among children in the control group decreased to 37.4±.496 versus 37.8±.554 o C after application of warm water foot bath therapy, respectively, with statistically significant difference (35).

Additionally, a clinical trial was conducted to investigate the efficacy of warm-water footbath therapy on body temperature in patients with fever at a hospital in Bangalore. This study also found that the interventional group's mean temperature decreased from 101.030 F±1 to 100.120 F±1.18, and the mean temperature in the control group decreased from 100.940 F±0.83 to 100.850 F±1.06. The interventional group's mean temperature difference is 0.912, while the control group is 0.098 (36). The results of our this current study regarding the effect of cider apple vinegar compresses on temperate were consistent with quasi-experimental study with pre-test and post-test design that aim to determine the effect of warm compresses versus vinegar compresses on children's body temperature presented with acute fever, their study report that the average decreased in body temperature was1.41° C for the 18 respondents who received warm water vinegar compress and 0.87° C for the 18 respondents who receiving warm compress for 15 min. This indicates that the average decrease in body temperature following treatment with warm vinegar compresses and warm water compresses differs significantly, with a greater average decrease in body temperature with warm vinegar compresses than with warm water compresses (22).

Similarly, a quasi-experimental study was conducted to compare the effects of vinegar, cold water, and cold water plus vinegar compresses in the treatment of fever among 45 patients suspected of having typhoid fever; they were allocated into three groups, with 15 patients in each. Body temperature was measured orally at 1 and 2 hours using a mercury thermometer. The first group received pure white vinegar compresses, the second group received cold water compresses, and the third group received vinegar-soaked water compresses. The study findings demonstrate that vinegar compresses were more effective than cold water compresses and cold water plus vinegar compresses ($P \leq 0.001$) (37).

Section II: Discussion of the significant difference in temperature reading based on the type of intervention among children with fever

According to the results in Table 3, there was a significant difference in the effect of WWFI and cider apple vinegar compresses on body temperature (U=1317, Z=-2.594, P=.009). The mean rank for WWFI (68.55) exceeds that for cider apple vinegar compresses (52.45), indicating a generally lower temperature in the WWFI group. The effect size is small to moderate (.27), indicating that vinegar compresses provided a more effective and quicker reduction in body temperature than WWFI. From a point of view, the components of vinegar facilitate better heat conduction and evaporation by vasodilating peripheral blood vessels and altering the hypothalamic set point. The study results are consistent with two previous studies that found that vinegar compresses are an effective method for reducing elevated body temperature (fever) in children (37,22).

In contrast, this study was the first to compare these two non-pharmacological methods (WWFI and cider apple vinegar compresses) for managing elevated body temperature in febrile children. Despite numerous studies using vinegar as an anti-inflammatory and hypoglycemic agent, no other studies supported or compared the current results with them.

Section III: Discussion of the associations and differences between the effect of WWFI, cider apple vinegar compresses on body temperature level among children with fever and their demographic characteristics and clinical data

Based on the associations and differences between the methods of intervention, demographic characteristics and clinical data, table 4 shows anon-significant statistical association at P>0.05 between the effectiveness of the WWFI and cider apple vinegar compresses on body temperature level and the child's age, sex, types of fever, duration of fever, symptoms associated with fever, and history of previous

hospitalization. This result is consistent with a study that examined the effectiveness of foot bath therapy on body temperature in febrile patients. This study indicates that there is no statistically significant relationship between warm water foot bath therapy, age, sex, and duration of fever (P=0.264, 0.502, and 0.445, respectively (36). The results of our study align with a quasi-experimental non-equivalent control group study conducted to verify the impact of a single warm-water foot bath on body temperature in feverish children. The study found no statistical relationship between the child's age, sex, type, or duration of fever among the study group (34).

Limitations

There were some limitations during the course of the study that affected and interfered with data collection and intervention, as the study is new and the first of its kind in Iraq. The study was conducted at one hospital (Karbala Teaching Hospital for Children), which may have limited the applicability of the results to a broader range of inhabitants. The researcher also found a lack of articles on the effect of vinegar compresses on body temperature, which made comparisons difficult.

The study's results demonstrate that WWFI and cider apple vinegar compresses significantly reduce body temperature in feverish children. Although WWFI and cider vinegar compresses are both supportive care techniques for children with fever, vinegar compresses were more effective than WWFI. These techniques were found to be more useful for non-pharmacological interventions to reduce body temperature and prevent possible complications.

Recommendations

Healthcare providers, particularly nurses, should receive training in using non-pharmacological approaches, such as vinegar compresses and WWFI therapy, to manage fever in children. Parents or other family members should be educated that these non-pharmacological interventions can be done at home, as an easy and comfortable method to manage fever among children, do not demand any further cost or adverse side effects, and their benefits are great in preventing the progression of increased body temperature and reducing its complications, for example: febrile convulsion. Additional studies are recommended, with a larger sample size and a probability sampling method, to assess the effectiveness of vinegar compresses and to establish more accurate generalizations.

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