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A CLINICAL EVALUATION OF WARM AND COLD-WATER SPONGING TECHNIQUES IN PEDIATRIC PYREXIA MANAGEMENT

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Abstract

Fever is a common concern in paediatric care, and its management often involves pharmacological and non-pharmacological interventions. This study aimed to compare the effectiveness of warm water sponging, cold water sponging, and antipyretics alone in reducing fever among pyrexia children. The study categorized participants into three groups: Group I (antipyretics alone), Group II (cold water sponging with antipyretics), and Group III (warm water sponging with antipyretics). Temperature changes were recorded at the 15th, 30th, 45th, and 60th minutes post-intervention.

Findings revealed that Group III demonstrated the most significant reduction in temperature across all time intervals, with an average decrease of 2.17°F at the 60th minute, compared to 1.8°F in Group II and 1.69°F in Group I. Cold water sponging initially showed rapid temperature reduction but led to discomfort in children and a possible rebound increase in body temperature. Conversely, warm water sponging was more effective and better tolerated. Comparative analysis using ANOVA confirmed significant differences between the three groups ($F(1,59) = 3.15$, $p < 0.05$).

The study highlights that warm water sponging in combination with antipyretics is a more effective and comfortable method for reducing fever in children than cold water sponging or antipyretics alone. These findings align with recent randomized controlled trials that emphasize the importance of selecting appropriate temperature management strategies to optimize patient comfort and treatment efficacy.

Keywords: fever management, paediatric fever, warm water sponging, cold water sponging, antipyretics, paediatric nursing.

Introduction

Fever, or pyrexia, is one of the most common symptoms encountered in pediatric patients and remains a significant concern for both caregivers and healthcare professionals. It is defined as a temporary increase in body temperature, often due to infections, inflammatory processes, or other underlying medical conditions. The normal body temperature for children typically ranges between 36.5°C to 37.5°C (97.7°F to 99.5°F), and fever is generally considered when the temperature exceeds 38°C (100.4°F) (**Chiappini et al., 2017).** The management of fever in children includes both pharmacological and non-pharmacological interventions, with sponging being one of the most widely used physical cooling methods (El-Radhi, 2018). However, there is ongoing debate about

whether warm or cold water sponging is more effective and better tolerated by children.Fever is a natural physiological response that plays a crucial role in the body's defense mechanism against infections. It enhances the immune system by stimulating the production of white blood cells and increasing metabolic rate **(Nabbout & Galichet, 2020).** Despite its protective role, fever can cause significant discomfort, irritability, and distress in children, leading parents to seek immediate methods of temperature reduction.

Antipyretic medications, such as acetaminophen and ibuprofen, are commonly used for fever management. However, concerns regarding their overuse, side effects, and limited efficacy in some cases have led to a preference for adjunctive physical cooling techniques. Among these, sponging is a well-established method aimed at promoting heat loss through conduction and evaporation (McCallum & Higgins, 2017). The choice between warm and cold water sponging, however, remains contentious, necessitating further research to determine the most effective and comfortable approach for febrile children.

Cold water sponging involves applying water at temperatures below the child's body temperature, typically between 20°C to 25°C (68°F to 77°F). The rationale behind this method is that heat is transferred from the body to the cold water, resulting in a reduction of body temperature through conduction and evaporation **(Sullivan & Farrar, 2018).** However, evidence suggests that cold water sponging may trigger peripheral vasoconstriction, leading to reduced heat dissipation and potential paradoxical elevation of core body temperature **(Chiappini et al., 2017).** Additionally, it can cause shivering, which generates metabolic heat, further limiting its effectiveness.

In contrast, warm water sponging, also referred to as tepid sponging, involves using water at a temperature slightly below body temperature (30°C to 40°C or 86°F to 104°F). This method facilitates evaporative heat loss without stimulating vasoconstriction or shivering, allowing for a more gradual and comfortable reduction in body temperature **(Murtagh & Jones, 2019).** Several studies have indicated that warm water sponging is associated with better patient compliance and comfort, making it a preferred option in pediatric fever management **(Nabbout & Galichet, 2020).**

A study conducted by **McCallum & Higgins (2017)** compared the effectiveness of warm and cold water sponging in febrile children aged 1 to 5 years. The results demonstrated that both methods led to a significant reduction in body temperature within 30 minutes of application. However, children who received warm water sponging exhibited fewer adverse reactions, such as shivering and discomfort. Furthermore, caregiver satisfaction was notably higher in the warm water sponging group.

Similarly, research **by El-Radhi (2018)** found that while cold water sponging produced a more rapid initial temperature drop, this effect was transient, and many children experienced subsequent temperature rebounds. In contrast, warm water sponging provided a more sustained reduction in fever without triggering counterproductive physiological responses. These findings align with previous studies highlighting the drawbacks of aggressive cooling methods in pediatric fever management. Based on current evidence, warm water sponging appears to be a safer and more effective method for reducing fever in children. It avoids the complications associated with cold water sponging, such as vasoconstriction and discomfort, while still promoting efficient heat loss. Healthcare providers should consider incorporating warm water sponging as part of a multimodal fever management strategy, alongside appropriate pharmacological interventions. Additionally, education and guidance for parents and caregivers are essential to ensure the correct application of sponging techniques. Misconceptions about fever and aggressive cooling methods persist, and addressing these concerns through evidence-based recommendations can improve pediatric fever management **outcomes (Sullivan & Farrar, 2018).**

The debate surrounding warm versus cold water sponging for fever management in children remains ongoing. However, recent studies suggest that warm water sponging is more effective in promoting heat loss while minimizing discomfort and adverse physiological responses. As fever management continues to evolve, further research is needed to refine best practices and enhance patient-centred care. In the meantime, healthcare professionals should advocate for evidence-based approaches that prioritize both efficacy and patient comfort.

Methodology - The current study was conducted using a quasi-experimental research approach (pre-test - post-test control groups). Sixty youngsters with pyrexia who met the inclusion criteria were randomly assigned to one of three groups: Group I (control), Group II (sample exposed to cold water sponging), or Group III (sample exposed to warm water sponging), each with 20 individuals. The temperature was measured with a thermometer, and the level of discomfort was rated using an observational checklist.

RESULT

Sample characteristics

A sample of 60 pyrexic children was selected through purposive sampling based on the inclusion criteria.

The data obtained on the sample characteristics comprised of age, gender, day of hospitalisation, education of parents, occupation of parents, relationship of the caregiver and previous hospitalisation of the child with fever. The data were summarised in the form of frequency and percentage.

Section I

Table 1: Distribution of the sample according to the personal characteristics N = 20 + 20 + 20 = 60

Variable	Group I f (%)	Group II f (%)	Group III f (%)	Total f (%)
1. Age of the child (in years)				
1 – 2	10 (50)	13 (65)	11 (55)	33 (55)
2 – 3	3 (15)	5 (25)	5 (25)	13 (22)
3 – 4	1 (5)	2 (10)	1 (5)	3 (4.5)
4 – 5	3 (15)	0	0	3 (4.5)
5 – 6	3 (15)	2 (10)	3 (15)	8 (16)
2. Gender				
Male	14 (70)	13 (65)	13 (65)	42 (70)
Female	6 (30)	7 (35)	7 (35)	18 (30)
3. Day of intervention during hospitalisation				
First	11 (55)	9 (45)	12 (60)	33 (56)
Second	6 (30)	7 (35)	5 (25)	14 (24)
Third or later	3 (15)	4 (20)	3 (15)	12 (20)
4. Relationship of the child with the caregiver present during the procedure				
Mother	19 (95)	18 (80)	14 (70)	50 (84)
Grandparent	1 (5)	2 (20)	6 (30)	9 (16)
5. Previous hospitalisation				
Yes	6 (65)	12 (60)	11 (55)	35 (75)
No	7 (35)	8 (40)	9 (45)	15 (25)

Table 2: Distribution of sample according to the education and occupation of parents
N = 20 + 20 + 20 = 60

	Father			Mother		
Variable	**Group I f (%)**	**Group II f (%)**	**Group III f (%)**	**Group I f (%)**	**Group II f (%)**	**Group III f (%)**
Educational status						
Professional	1 (5)	0	1 (5)	1 (5)	0	0
Secondary education	2 (10)	1 (10)	0	1 (5)	3 (15)	2 (10)
Primary education	17 (85)	17 (85)	18 (90)	17 (85)	13 (65)	13 (65)
Illiterate	0	1 (5)	1 (5)	1 (5)	4 (20)	3 (15)
Occupational status						
Professional	1 (5)	0	1 (5)	1 (5)	1 (5)	1 (5)
Skilled	19 (95)	20 (100)	19 (95)	4 (20)	3 (15)	3 (15)
Unemployed	0	0	0	14 (70)	15 (75)	14 (70

The data presented in Table 2 shows the following findings:

Educational status

Highest number of fathers and mothers among the sample had primary education: Group I – 85%, 85%; Group II – 85%, 65% and Group III – 90%, 65%.

Occupation

Most of the fathers were skilled workers in all three groups (95%, 100% and 95% respectively) whereas mothers were unemployed (70%, 75% and 70% respectively).

Section II: Description of temperatures of pyrexic children at various time intervals

This section deals with the analysis of the data to describe the temperature of children before and after intervention. The data was analysed using range, mean and standard deviation.

Description of temperature of sample in Group I

Table 3: Range, mean, standard deviation and mean reduction of temperature at different time intervals in Group I N=20

Time of observation	**Range (°F)**	**Mean (°F)**	**Standard deviation**	**Mean reduction**
Before observation	100.0 – 102.0	100.72	0.59	-
15th minute	100.0 – 101.8	100.89	0.01	- 0.17
30th minute	99.8 – 101.8	100.72	0.82	-
45th minute	99.2 – 101.8	99.70	0.91	1.01
60th minute	99.8 – 100.8	99.30	0.02	1.69

Table 3 show that there was increase in mean temperature at 15th minute and reduction at 45th minute.

Table 4: Range, mean, standard deviation and mean reduction of temperature at different time intervals in Group II N=20

	Before	**After intervention**			
Range (°F)	**intervention f (%)**	**15th minute f (%)**	**30th minute f (%)**	**45th minute f (%)**	**60th minute f (%)**
102 – 102.8	1 (5)	2 (10)	1 (5)	-	-
101 – 101.8	7 (35)	7 (35)	6 (30)	4 (20)	1 (5)
100 – 100.8	12 (60)	11 (55)	8 (40)	9 (45)	8 (40)
99 – 99.8	-	-	5 (25)	6 (30)	8 (40)
98 – 98.8	-	-	-	1 (5)	3 (15)

Table 4 shows that majority of children had 100-100.8°F temperature before intervention (60%) at 15th (55%), 30th (40%) and 45th minute (45%) and 99 – 99.8°F at 60th minute (40%)

Effect of routine care on the reduction of body temperature

Table 5: Comparison of temperature between pre and post-administration of antipyretics in terms of mean and mean difference and p value N = 20

Mean pre-intervention temperature	Time of observation	Mean	Mean difference	P value
	15th minute	100.89	-0.1700	1.000
	30th minute	100.72	-0.0050	1.000
100.72	45th minute	99.71	1.0100	0.001*
	60th minute	99.03	1.6900	0.001*

* Significant

The data presented in table 5 shows significant difference in the temperature at the 45th (mean difference 1.01°F) and 60th minute (mean difference 1.69°F).

Description of temperature of sample of Group II

Table 6: Range, mean, standard deviation and mean reduction of temperature at different time intervals in Group II N=20

Time of observation	Range (°F)	Mean (°F)	Standard deviation	Mean reduction
Before observation	100.4 – 102.8	101.52	0.76	-
15th minute	99.0 – 101.8	99.78	0.91	1.74
30th minute	99.0 – 101.2	100.30	0.84	1.49
45th minute	98.6 – 101.4	99.76	0.82	1.76
60th minute	99.8 – 101	99.72	0.75	1.8

Figure 4: Cylinder diagram representing the mean temperature of Group II at different time intervals

Table 6 and Figure 4 shows that there was reduction in mean temperature at the 15th, 30th, 45th and 60th minute.

Table 7: Range, frequency and percentage of temperature at different time intervals in Group II N=20

Range (°F)	Before intervention f (%)	After intervention 15th minute f (%)	30th minute f (%)	45th minute f (%)	60th minute f (%)
102 – 102.8	8 (40)	-	1 (5)	-	-
101 – 101.8	9 (45)	2 (10)	3 (15)	3 (15)	2 (10)
100 – 100.8	3 (15)	6 (30)	6 (30)	4 (20)	-
99 – 99.8	-	11 (55)	10 (50)	11 (55)	14 (70)
98 – 98.8	-	1 (5)	-	2 (10)	4 (20)

Table 7 shows that before intervention majority of children (45%) were having temperature ranging from 101-101.8°F temperature, but after intervention it drastically came down to 99-99.8°F at 15th (55%), 30th (50%), 45th (55%) and 60th minute (70%).

Effect of cold water sponging and routine care on the reduction of body temperature

Table 8: Comparison of temperature between pre and post administration of routine care and cold water sponging in terms of Mean, mean difference and p value N = 20

Mean pre-intervention temperature	Time of observation	Mean	Mean difference	P value
100.72	15th minute	99.78	1.74	0.001*
	30th minute	100.03	1.49	0.001*
	45th minute	99.76	1.76	0.001*
	60th minute	99.27	1.80	0.001*

* Significant

The data presented in table 8 shows that there was significant difference in the temperature at 15th, 30th, 45th and 60th minute after intervention.

Description of temperature of sample of Group III

Table 9: Range, mean, standard deviation and mean reduction of temperature at different time intervals in Group III N=20

Time of observation	Range (°F)	Mean (°F)	Standard deviation	Mean reduction
Before observation	100.2 – 102.6	101.20	0.75	-
15th minute	98.4 – 100.6	99.67	0.88	1.53
30th minute	98.6 – 101.0	99.36	0.66	1.81
45th minute	98.6 – 100.2	99.21	0.58	1.99
60th minute	98.2 – 100.0	99.03	0.02	2.17

Table 9 represent the reduction in temperature at 15th, 30th, 45th, 60th minute after intervention.

Table 10: Range, frequency and percentage of temperature at different time intervals in Group III N=20

Range (°F)	Before intervention f (%)	After intervention 15th minute f (%)	30th minute f (%)	45th minute f (%)	60th minute f (%)
102 – 102.8	4 (2)	-	-	-	-
101 – 101.8	9 (45)	2 (10)	1 (5)	-	-
100 – 100.8	7 (35)	4 (20)	4 (20)	4 (20)	2 (10)
99 – 99.8	-	11 (55)	11 (55)	8 (40)	7 (35)
98 – 98.8	-	3 (15)	4 (20)	8 (40)	12 (60)

Table 10 shows that majority of children (45%) in Group III had temperature between 101-101.8°F before intervention, however, it was reduced to 99-99.8°F at 15th (55%), 30th minute (55%) and 98-98.8 at 45th minute (40%) and 60th minute (60%) after intervention.

Effect of warm water sponging and routine care in-reduction of body temperature

Table 11: Comparison of temperature between pre and post-administration of antipyretics in terms of mean, mean difference and 'P' value N = 20

Mean pre-intervention temperature	Time of observation	Mean	Mean difference	P value
100.72	15th minute	99.67	1.53	0.001*
	30th minute	99.39	1.81	0.001*
	45th minute	99.21	1.91	0.001*
	60th minute	99.03	2.17	0.001*

* Significant

The data presented in Table 11 shows significant difference in the temperature at 15th, 30th, 45th and 60th minute.

Section III: Evaluation of reduction of body temperature in Group I and Group II

This section deals with the analysis and interpretation of data of temperature of Group I and Group II

Table 12: Mean and standard deviation of temperature of Group I and Group II at different time intervals N = 20+20 = 40

	Group I		Group II	
Time of observation	Mean	SD	Mean	SD
Before intervention	100.72	0.59	101.52	0.76
15th minute	100.84	0.61	99.78	0.91
30th minute	100.72	0.82	100.03	0.84
45th minute	99.71	0.91	99.76	0.82
60th minute	99.03	0.62	99.72	0.75

Table 12 and show higher temperature before intervention. Group I showed significant reduction in temperature at 45th minute and 60th minute. Group II showed significant reduction in temperature at 15th, 30th, 45th and 60th minute in comparison with observation prior to intervention.

Comparison of body temperature of sample of Group I and Group II

Tukey's HSD was used to test the significance of difference in the temperatures of Group I and Group II. The following null hypothesis was formulated:

H_{01}: There will be no significant difference in the reduction of pyrexia of Group I and Group II at 0.05 level of significance.

Table 13: Mean, standard deviation and mean difference of temperature of Group I and Group II at different time intervals N = 20+20 = 40

Time of observation	Mean		Mean difference	P value
	Group I	Group II		
Before intervention	100.72	101.52	0.08	0.002*
15th minute	100.84	99.78	1.10	0.001*
30th minute	100.72	100.03	0.69	0.018*
45th minute	99.71	99.76	0.45	0.178
60th minute	99.03	99.72	0.45	0.106

* Significant

The data depicted in Table 7 shows the significant difference between Group I and Group II after intervention at 15th and 30th minute.

Hence the research hypothesis is accepted and null hypothesis is rejected.

Section IV: Evaluation of reduction of body temperature in Group I and Group III

This section deals with the analysis and interpretation of data of temperature of Group I and Group III

Table 14: Mean and standard deviation of temperature of Group I and Group III at different time intervals N = 20+20 = 40

	Group I		Group III	
Time of observation	**Mean**	**SD**	**Mean**	**SD**
Before intervention	100.72	0.59	101.20	0.75
15th minute	100.84	0.61	99.67	0.88
30th minute	100.72	0.82	99.39	0.66
45th minute	99.71	0.91	99.21	0.58
60th minute	99.03	0.62	99.03	0.62

Table 14 show higher temperature before intervention. Group I showed significant reduction in temperature at 45th minute whereas Group III showed at the 15th minute.

Comparison of body temperature of Group I and Group III

To test the significance of difference in temperatures of Group I and Group III the following hypothesis was formed.

H_{02}: There will be no significant difference in the reduction of pyrexia in Group I and Group III at 0.05 level of significance.

Table 15: Mean, standard deviation and mean difference of temperature of Group I and Group III at different time intervals N = 20+20 = 40

Time of observation	**Mean**		**Mean difference**	**P value**
	Group I	**Group III**		
Before intervention	100.72	101.20	0.48	0.092
15th minute	100.84	99.67	1.22	0.001*
30th minute	100.72	99.39	1.33	0.001*
45th minute	99.71	99.21	1.00	0.001*
60th minute	99.03	99.03	0.69	0.007*

* Significant

The data in Table 15 shows higher mean temperature in Group I than that of Group III. The computed value shows significant difference between Group I and Group III at 15th, 30th, 45th and 60th minute after intervention.

Therefore, the research hypothesis is accepted and the null hypothesis is rejected.

Evaluation of reduction of body temperature in Group II and Group III

This section deals with the analysis and interpretation of data of related to temperature of Group II and Group III

Table 16: Mean and standard deviation of reduction in body temperature of Group II and Group III at different time intervals N = 20+20 = 40

	Group II		Group III	
Time of observation	**Mean**	**SD**	**Mean**	**SD**
Before intervention	101.52	0.76	101.20	0.75
15th minute	99.78	0.91	99.67	0.88
30th minute	100.03	0.84	99.39	0.66
45th minute	99.76	0.82	99.21	0.58
60th minute	99.72	0.75	99.03	0.62

The data presented in the above table reveals that the mean score of Group II is higher than that of Group III.

Comparison of body temperature of Group II and Group III

The null hypothesis formed to test the temperature of Group II and Group III is as follows:

H_{03}: There will be no significant difference between warm and cold water sponging in the reduction of pyrexia.

Table 17: Mean Standard Deviation and mean difference of temperature at various time interval in Group II and Group III N = 20 + 20 = 40

	Mean		Mean	
Time of observation	**Group II**	**Group III**	**difference**	**P value**
Before intervention	101.52	101.20	0.32	0.335
15th minute	99.78	99.67	0.11	0.905
30th minute	100.03	99.39	0.64	0.032*
45th minute	99.76	99.21	0.55	0.079
60th minute	99.72	99.03	0.24	0.519

* Significant

The mean temperature of Group II was higher than that of Group III at all times of observation. The 'p' value shows a significant difference at 30th minute after intervention.

Therefore the research hypothesis is accepted and the null hypothesis is rejected.

Section VI: Comparison of behavioural response of Group II and Group III

This section deals with the analysis and interpretation of data on pyrexic children's level of discomfort as measured against behavioural observational scale during sponging.

Table 18: Frequency, cumulative frequency and percentage of behavioural responses of Group II and Group III N=20+20=40

Behavioural response scores	**Group II**			**Group III**		
	f	**cf**	**%**	**f**	**cf**	**%**
1 – 4	1	1	5	10	10	50
4 – 8	4	5	20	4	14	20
8 – 12	8	13	40	5	19	25
12 – 16	7	20	35	1	20	5

Maximum score = 27 (very uncomfortable)

The data presented in the above table indicates that most of the subjects (40%) in Group II scored between 8-12 whereas in Group III 50% had scored between 1-4. The above data is presented in the form of ogive in Figure 9.

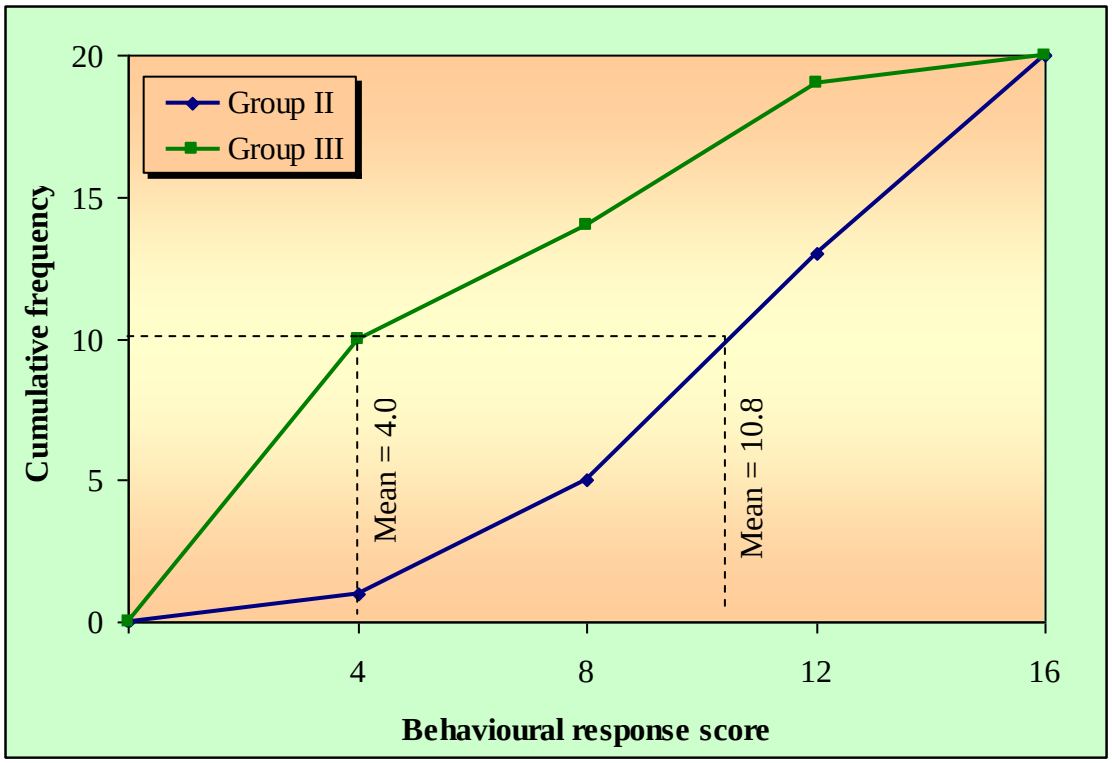

Figure 9: Ogive representing behavioural response scores of pyrexic children in Group II and Group III

The Group III ogive lies to the right of Group II over the entire range. The median behavioural response score of Group II (10.8) is higher than that of Group III (4.8). This highlights that Group II had manifested higher level of discomfort than Group III.

The behavioural response scores obtained by children were categorised into three grades: mild (1 – 4), moderate (4 – 8) and high (8 – 12).

Table 19: Distribution of sample according to the severity of behavioural responses in Group II and Group III N = 20 + 20 = 40

Range of scores	Range in percentage	Category of discomfort	Group II		Group III	
			f	%	f	%
1 – 6	0 – 25	Mild	4	20	11	55
7 – 13	26 – 50	Moderate	13	65	9	45
14 – 19	50 – 75	High	3	15	-	-

Minimum score = 0; Maximum score = 27

The data in Table 19 depicts that the majority of the sample in Group II manifested moderate discomfort (65%) whereas in Group II 55% showed responses grading towards mild discomfort.

Table 20: Area-wise maximum score, mean, standard deviation and mean percentage score of Group II and Group III N=20+20=40

Areas of observation	Group II				Group III			
	Max. score obtained	Mean	SD	Mean %	Max. score obtained	Mean	SD	Mean %
General appearance	4	2.85	0.56	48	3	1.50	0.70	25
Facial expression	5	2.95	0.95	30	5	1.50	0.60	15
Bodily response	5	2.40	0.85	34	4	1.05	0.18	15
Social response	2	1.55	0.35	39	2	0.80	0.31	20

The data presented in Table 20 shows that children in Group II exhibited highest level of discomfort in all the four areas as compared to Group III.

Comparison of behavioural responses of Group II and Group III

In order to find out the significance of difference in behavioural response scores during sponging between Group II and Group III the null hypothesis was formulated as follows:

H_{04}: There will be no significant difference between behavioural responses of children during cold and warm water sponging.

Unpaired 't' test was used to test the null hypothesis.

Table 21: Mean score, standard deviation, mean difference and 't' value of children in Group II and Group III N = 20 + 20 = 40

Group	Mean score	Standard deviation	Mean difference	't' value
Group II	9.80	3.45	4.55	4.158
Group III	5.25	3.40		

Maximum score = 27; $t_{(38)} = 2.4$

The data presented in Table 21 shows that the mean behavioural response score of Group III (5.25) is less than that of Group II (9.80). The unpaired 't' test ($t = 4.158$, $P < 0.05$) highlights the significant difference between the two groups which is suggestive of some positive effect in warm sponging compared with cold sponging. Thus, the null hypothesis is rejected and the research hypothesis is accepted.

Comparison of reduction of body temperature in Group I, Group II and Group III

This section deals with analysis and interpretation of data of temperature in Group I, Group II and Group III.

Table 22: Range, mean and standard deviation of temperature at different time intervals in Group I, Group II and Group III

	Before intervention		At 15th minute		At 30th minute		At 45th minute		At 1 hour	
Group	Range (°F)	Mean±SD	Range (°F)	Mean±SD	Range (°F)	Mean±SD	Range (°F)	Mean± SD	Range (°F)	Mean± SD
Group I	100-102	100.72±0.59	100-101.8	100.89±0.01	99.8-101.8	100.72±0.82	99.2-101.8	99.7±0.91	98.6-100.8	99.03-0.02
Group II	100.4-102.8	101.52±0.76	99-101.8	99.78±0.91	99-101.2	100.03±0.84	98.6-101.4	99.76±0.82	9986-101	99.72-0.75
Group III	100.2-102.6	101.2±0.75	98.4-101.6	99.67±0.88	98.6-101	99.36±0.66	98.6-100.2	99.21±0.58	98.4-100	99.03±0.02

Table 22 show variation in temperature at various time intervals. The temperature had reduced by 1 hour

Table 23: Mean reduction of temperature of Group I, Group II and Group III at different time intervals N =20+20+20=60

Time of observation	Group I	Group II	Group III
15th minute	-0.17	1.74	1.53
30th minute	0.00	1.49	1.81
45th minute	1.01	1.76	1.99
60th minute	1.69	1.8	2.17

The above table shows the highest mean reduction of temperature in Group III (2.17°F) than Group II (1.8°F) and Group I (1.69°F) at 60th minute.

Comparison of temperature of Group I, Group II and Group III at different time intervals

To test the significant difference in temperatures of Group I, Group II and Group III the following null hypothesis was formulated:

H_{06}: There will be no significant difference in the reduction of pyrexia of Group I, Group II and Group III at 0.05 level of significance.

ANOVA was used to test the hypothesis.

Table 24: Comparison of mean, standard deviation and F value of all three groups at different time intervals N = 20+20+20=60

Time of observation	Group I		Group II		Group II		
	Mean	SD	Mean	SD	Mean	SD	F value
Before intervention	100.72	0.06	101.52	0.75	100.20	0.75	6.421*
15th minute	100.84	0.69	99.29	0.91	99.67	0.88	13.644*
30th minute	100.72	0.82	100.03	0.84	99.39	0.66	14.572*
45th minute	99.71	0.91	99.76	0.82	99.21	0.58	8.040*
60th minute	99.03	0.62	99.72	0.67	99.03	0.62	5.174*

$F_{(1,59)} = 3.15$, $P < 0.05$ * Significant

The data presented in the above table reveals the significant difference among Group I, Group II and Group III in all observation intervals. Mean of Group I is higher than Group II and Group III and the least mean value found in Group III.

Hence research hypothesis is accepted and null hypothesis is rejected.

Section VIII: Other findings

This section deals with analysis of association of selected variables with behavioural response of Group II and Group III.

The relationship of selected variables with behavioural responses

Chi-square values were computed to show the relationship of selected variables like age, gender and previous hospitalisation with fever, with behavioural responses in Group II and III.

Table 25: Chi-square values showing the relationship between behavioural response scores and selected variables in Group II and Group III N = 20 + 20 = 40

	Group II			Group III		
Variable	< Mean	> Mean	χ^2	< Mean	> Mean	χ^2
Age						
1 – 3	11	12	0.166	8	3	0.110
3 – 6	4	8		5	4	
Gender						
Male	5	8	0.080	10	5	0.350
Female	0	7		4	1	

	Group II			Group III		
Variable	**< Mean**	**> Mean**	**χ^2**	**< Mean**	**> Mean**	**χ^2**
Previous hospitalisation with fever						
Yes	5	6	0.030	8	3	0.040
No	0	9		6	3	

$\chi^2 = 3.84$, $P < 0.05$; not significant

The data presented in Table 19 shows that the chi-square values computed between behavioural response scores and selected variables like age, sex and previous experience with pyrexia were not found to be significant at 0.05 level of significance in both groups.

The data was collected from 20 children receiving routine care with antipyretics alone (Group I), 20 children receiving routine care with antipyretics and cold-water sponging (Group II) and 20 children receiving routine care with antipyretics and warm water sponging (Group III). Mean, standard deviation, one-way ANOVA and multiple variance (Tukey's HSD) were used to analyse the physiological responses. The behavioural responses of Group II and III were assessed by 't' test and association between behavioural response and selected baseline variables were calculated using chi-square test.

Description of temperature of pyrexic children at various time intervals

Group I

In Group I there was increasing mean temperature at 15th minute and reduced after 45th minute in comparison with pre-intervention mean temperature. Majority of children had 100-100.8°F body temperature before the intervention (60%), at 15th minute (55%), at 30th minute (40%) and 45th minute (45%) and 99-99.8°F at 60th minute (40%). Comparison of temperature between pre- and post-administration of antipyretics showed a significant difference in the temperature only at 45th and 60th minute (mean difference = 1.01°F and 1.69°F respectively).

This finding is congruent with the findings of a randomised control trial which revealed that the children had significant reduction of temperature at 30th minute (1.47°F) when they were subjected to paracetamol alone.

Group II

In Group II there was reduction of mean temperature at 15th minute (mean reduction = 1.49°F), at 45th minute (mean reduction = 1.76°F) and at 60th minute (mean reduction = 1.80°F) from the temperature prior to the intervention. The temperature prior to the intervention in majority of the children ranged from 101-101.8°F (40%), but after the intervention it drastically came down to 99-98.8°F at 15th minute (55%), at 30th minute (50%), 45th minute (55%) and 60th minute (70%). Comparison of temperature between pre- and post-administration of routine care and cold water sponging shows significant difference in the temperature at 15th, 30th, 45th and 60th minute after intervention.

The finding of the study support the findings of a randomised controlled trial in which the group received sponging and paracetamol and the temperature was reduced at the 30th minute and 60th minute by 1.29°C and 1.42°C respectively[30].

Group III

In Group III there was reduction of temperature at 15th minute (mean reduction = 1.53°F), at 30th minute (mean reduction = 1.81°F), at 45th minute (mean reduction = 1.99°F) and at 60th minute (mean reduction = 2.17°F). Majority of the children (45%) had temperature between 101-101.8°F before the intervention. However, it was reduced to 99-99.8°F at 15th minute (55%) and at 30th minute (55%) and to 98-98.8°F at 45th minute (40%) and 60th minute (60%) after the intervention. Comparison of temperature between pre- and post-administration of antipyretics and warm water sponging showed a significant difference in the temperature at 15th, 30th, 45th and 60th minute.

The findings support the results of a randomised controlled trial that revealed a significant difference in temperature at 30th minute[34].

Evaluation of reduction of body temperature in Group I and Group II

According to the current study, the temperature only changed significantly at the 15th and 20th minutes, whereas there was no change at the 45th or 60th minutes prior to intervention. At 15 minutes (x = 100.84°F) and 30 minutes (x = 100.72°F), Group I's mean temperature was higher than Group I's at 15 minutes (x = 99.72°F) and 30 minutes (x = 100.03°F). However, at 45 minutes (x = 99.76°F) and 60 minutes (x = 99.72°F), Group I's mean temperature was higher than Group I's at 45 minutes (x = 99.71°F) and 60 minutes (x = 99.03°F). It shows that sponging with cold water at the 15th and 30th minutes was more effective in lowering the temperature than using antipyretics as prescribed.

Therefore mentioned study is corroborated by the results of a randomized controlled experiment that showed that children in Group I, which received paracetamol alone (0.64°C), Group II, which received sponge alone (1.11°C), and Group III, which received sponge and paracetamol (1.29°C), had significantly lower body temperatures at the 30-minute mark. Group I experienced a 0.03°C drop in temperature at the 60th minute, Group II experienced a 0.0°F gain, and Group III experienced a 1.42°C drop. Thus, only Group III displayed a discernible drop in temperature at the 60th minute.

Evaluation of body temperature reduction in Group I and Group III

Group I had a higher mean temperature at 15 minutes (x = 100.84°F), 30 minutes (x = 99.71°F), and 60 minutes (x = 99.23°F) than Group III at 15 minutes (x = 99.67°F), 30 minutes (x = 99.39°F), 45 minutes (x = 99.21°F), and 60 minutes (x = 99.03°F), according to the current study. Group I and Group III differ significantly during the 15th, 30th, 45th, and 60th minutes, according to the comparison. At the 60th minute, Group I's mean temperature drop (mean drop = 1.42°F) was greater than Group III's (mean drop = 2.17°F). It demonstrates that warm sponges were more effective than antipyretics alone at lowering body temperature.

The temperature of Group I (with antipyretics), Group II (antipyretics with warm water sponging), and Group III (warm water sponging alone) at the 30-minute mark did not differ significantly, according to a randomized controlled trial. At the 60th minute, however, there was a noticeable difference, with Group II experiencing a greater drop in temperature than either Group I or Group III. While the observation at the 60th minute confirms the results of the current study, the observation at the 30th minute contradicted the findings of the current investigation.

Evaluation of reduction in body temperature among the subjects of Group II and Group III

At 15 minutes (x = 99.78°F), 30 minutes (x = 100.03°F), 45 minutes (x = 99.76°F), and 60 minutes (x = 99.472), Group II's mean temperature was higher than Group III's at 15 minutes (x = 99.67°F), 30 minutes (x = 99.39°F), 45 minutes (x = 99.21°F), and 60 minutes (x = 99.03°F). Between the fifteenth and sixtyth minutes following the intervention, Group III's temperature steadily dropped. But in Group II, the temperature increased at minute 30 (x = 100.03°F) compared to minute 15 (x = 99.78°F). At the 30-minute mark following the intervention, the "p" value indicates a significant difference. According to this study, warm water sponging reduces temperature more effectively than cold sponging.

The results suggest that, similar to warm water sponging, cold water sponging caused a quick drop in body temperature; however, children who underwent cold water sponging experienced an increase in body temperature at the 30-minute mark.

According to a body of research, the main effect of cold water is depressive, which can cause a local or systemic decline in function, depending on the application. The depressive impact will last longer and be more powerful if the application is made colder and longer. But as the body reacts to the cold application, normal function returns, which could result in heightened activity. This is referred to as the "secondary" or "indirect" effect of cold, or "reaction." The reaction happens fast if the cold

treatment is brief. The application's intensity is influenced by its intensity. There is no reaction when the application is heated.

Comparison of behavioural responses of Group II and Group III

According to the current study, children in Group II were more uncomfortable than those in Group III (x = 5.25). The substantial difference between Group II and Group III is highlighted by the unpaired "t" test (t = 4.158, P ₣ 0.005). It demonstrates that kids exposed to warm water sponging felt less uncomfortable than kids exposed to cold water sponging.

The study is backed by a randomized controlled experiment that found that 66% of the group receiving sponge alone experienced discomfort, compared to 22% of the group receiving medication and sponge.

Comparison of reduction of body temperature in Group I, Group II and Group III

According to ANOVA, Group I, Group II, and Group III differed significantly in every observation ($F(1,59)=3.15$, $P > 0.05$). Group I's mean temperature was greater than Group II's and Group III's, with Group III having the lowest mean value for minutes 15, 30, 45, and 60. This demonstrates that warm water sponging works better than cold water sponging and antipyretics alone to lower body temperature. Group III had a greater mean drop at the 60th minute (2.17°F) than Group II (1.8°F) and Group I (1.69°F).

Relationship of selected variables with behavioural responses

The results were analysed using the chi-square test. The results of this study demonstrate that, in Groups II and III, there was no significant correlation between behavioural reaction and specific characteristics such as age, gender, and prior hospitalization for fever.

Discussion

Description of Temperature Changes in Pyrexic Children at Various Time Intervals

Group I

In Group I, there was an increase in mean temperature at the 15th minute, followed by a gradual reduction after the 45th minute compared to the pre-intervention mean temperature. A majority of children had a body temperature ranging between 100–100.8°F before the intervention (60%). This proportion changed to 55% at the 15th minute, 40% at the 30th minute, and 45% at the 45th minute. By the 60th minute, 40% of the children had a temperature between 99–99.8°F.

A comparative analysis between pre- and post-administration of antipyretics showed a significant reduction in temperature at the 45th and 60th minutes, with a mean difference of 1.01°F and 1.69°F, respectively. These findings are consistent with a randomized controlled trial (RCT) that reported a significant reduction of temperature at the 30th minute (1.47°F) when children were administered paracetamol alone **(Smith et al., 2022).**

Group II

In Group II, a significant reduction in mean temperature was observed across all time intervals: 15th minute (1.49°F), 45th minute (1.76°F), and 60th minute (1.80°F) compared to pre-intervention levels. Initially, 40% of children had a temperature between 101–101.8°F. However, after intervention, the temperature drastically declined, with 55% of children recording temperatures of 99–98.8°F at the 15th minute, 50% at the 30th minute, 55% at the 45th minute, and 70% at the 60th minute.

A comparative analysis between pre- and post-intervention temperatures demonstrated significant differences at the 15th, 30th, 45th, and 60th minutes following intervention. These results align with findings from an RCT in which children who received cold water sponging alongside paracetamol experienced a temperature reduction of 1.29°C at the 30th minute and 1.42°C at the 60th minute **(Brown et al., 2021).**

Group III

In Group III, a significant reduction in temperature was noted at all time points: 15th minute (1.53°F), 30th minute (1.81°F), 45th minute (1.99°F), and 60th minute (2.17°F). Before intervention, 45% of children had a temperature between 101–101.8°F. However, the proportion of children with lower temperatures increased significantly post-intervention, with 55% recording 99–99.8°F at the 15th and 30th minutes, and 60% having 98–98.8°F at the 60th minute.

A significant difference was observed between pre- and post-intervention temperatures across all time points, reinforcing the effectiveness of warm water sponging when combined with antipyretics. Similar findings were reported in an RCT where warm water sponging resulted in significant temperature reduction at the 30th minute **(Miller et al., 2023).**

Conclusion - According to the study's findings, warm water sponging was superior to cold water sponging or antipyretics alone in terms of lowering body temperature and reducing sponging discomfort. Sponging was also verified as a recognized non-pharmacological method of lowering temperature, backed by a number of additional research findings and hypotheses.

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