

Fever in Children: How Knowledge, Attitude and Belief among Healthcare Community can Affect Assessment.

Lesson learned from Developing Country

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Abstract

Background: The study was aimed to assess the knowledge of healthcare provider and the correlation of the healthcare providers' educational degree toward fever management in children.

Method: This study was conducted among healthcare-community using a questionnaire as the primary data. Descriptive statistical analyses were performed by using percentage and the correlation of their degree toward fever was analyzed by the chi-square test with statistically significant p values of < 0.05 .

Result: Questions 1-17 about basic science were answered correctly by more than 80%, except those regarding non-shivering thermogenesis in neonates showing that the residents and medical students group got better results than the specialists and medical doctors (61%; 68.8%; vs 84.7%; 83.3, respectively Chi-square, $p = 0.039$ ($p < 0.05$)). While questions 18-25 about fever management in children, around half of the subjects answered correctly following the recommendations.

Conclusion: The subjects' educational degree influenced their knowledge, attitudes, and beliefs regarding the fever management in children

Keywords: Attitudes, Belief, Fever, Healthcare Providers, Knowledge

1. INTRODUCTION

Human body temperature is regulated to certain degree, ranges around 36.2–37.5°C.[1] When the environment temperature decreases or elevates, the body will adjust and activate heat maintenance or heat loss. For example, in cold weather, the body will increase its temperature

to produce more heat to defend the body against cold weather.[2] Reversibly, in hot weather, the set point will be lowered to prevent overheating of the body. Among factors affecting loss of body heat are heat conduction from heat producing organs to tissues, skin, and environment either through radiation, conduction, convection, or evaporation.[3]

The elevated body temperature is called fever, which occurs due to temporary temperature set point elevation as a response to internal or external pyrogenic agents that will stimulate the anterior hypothalamus to increase temperature set point.[2] While beneficial, it may be dangerous if not managed quickly and properly. Fever is one of clinical feature that leads to infectious disease. Infectious diseases, which disproportionally affect children in developing country, remain high in number that in particular they have globally become the leading causes of death among children under five, including in Indonesia.[4] Complications of fever in pediatric patients include brain damage, seizures, and death.[5] Febrile seizure may cause calcification injury in brain tissue and consequently it may cause permanent brain injury as epileptic foci of the child in the future.[6] For this reason, it is highly important to define precise measurements for early detection and proper management. The aim of this study was to describe healthcare providers' knowledge, attitudes and beliefs regarding of fever management in children and to assess the correlation of the academical degree of healthcare providers toward fever in children. This study assessed health care provider's awareness of proper management either pharmacologically or supportive as well as their understanding in educating the parents for even earlier and proper management of fever in their children.

2. METHOD

This cross-sectional study was conducted from June 2019 to August 2019 among pediatric specialists, pediatric residents, medical doctors and medical students. Informed consent before enrolling into the study was obtained from all study participants. Each participant was given a set of completed self-administered questionnaires with true and false questions about fever (Table 1).

Data management and statistical analysis

All data analyzed were further anonymized. Descriptive data were expressed in percentage and statistical analyses were performed by IBM SPSS Statistic (version 23.0) software. The correlation between degree of health care provider was statistically analyzed by chi-square method with significancy level $p < 0.05$.

Ethic statement

Ethical clearance was obtained from the Research Ethics Committee of Faculty of Medicine Universitas Padjadjaran.

Table 1. Questionnaire items: 25 questions

1. The regulation of body temperature is part of homeostasis, its regulation through the negative feedback mechanism of the thermo-sensory system - the center of integration-thermo-effector. (True statement)
2. Dehydration is a non-thermal factor that affects the body's temperature regulation. Patient hydration conditions need to be considered in the management of fever. (True statement)
3. Non-shivering thermogenesis is the main mechanism in neonates when exposed to cold ambient temperatures. (True statement)
4. Neutral Thermal Environment at delivery depends on neonatal weight. The delivery room temperature for full-term neonates with an estimated normal body weight is around 25C. (True statement)
5. Body temperature measurements must be carried out for each patient, especially if it is more common in infant patients younger than 3 months. (True statement)
6. Pulmonary artery temperature measurement, although invasive, is the closest method of measuring core body temperature (core temperature). (True statement)
7. Rectal temperature measurement is considered a practical method, close to core body temperature, but should not be used to monitor body temperature during anesthesia to detect hypo and hyperthermia. (True statement)
8. In a state of shock, the pulmonary artery temperature has dropped but the rectal temperature is still normal. (True statement)
9. In daily practice is the patient's body temperature measured in the axilla using a digital thermometer. (True statement and the frequency of using this measurement)
10. In daily practice is the patient's body temperature measured in the forehead area using an infrared thermometer. (True statement and the frequency of using this measurement)
11. In daily practice is the patient's body temperature measured on the tympanic membrane using an infrared thermometer. (True statement and the frequency of using this measurement)
12. Fever is a danger sign of an infectious disease. (True statement)
13. In addition to infectious diseases, tooth eruption in infants and children is a cause of fever. (True statement)
14. High fever can cause brain damage. (True statement)
15. The risk of febrile seizures increases with high fever. (True statement)
16. Given antipyretics in children with febrile seizures who experience fever is an effort to reduce the risk of febrile seizures. (True statement)
17. When giving counseling to parents of patients, it is recommended the administration of antipyretic when the temperature is above 38-degree Celsius. (True statement)
18. In patients undergoing outpatient care, if fever is very high it is recommended that the drug paracetamol and ibuprofen given alternating. (False statement)
19. In addition to the administration of antipyretics, it is recommended that physical methods such as cold compresses or wiping with lukewarm water (tepid sponge) be taken to prevent fever quickly. (True statement)

20. In cases of high fever, in addition to the administration of antipyretics it is also recommended that physical methods of alcohol compresses are recommended. (False statement)
21. In children who are sleeping fever should be woken up to be given antipyretic drugs. (False statement)
22. Only paracetamol and ibuprofen are recommended as antipyretics in children. (True statement)
23. In patients with varicella who have a fever should be given ibuprofen to reduce fever and reduce pain that maybe happened. (False statement)
24. The intravenous dose of paracetamol is 15 mL/Bodyweight/times. (True statement)
25. Antipyretic administration before or immediately after immunization causes a low antibody titer formed. (True statement)

3. RESULTS

The 180 health care providers (HCPs) responding to the survey included 41 pediatricians (22%), 85 pediatric residents (47%), 48 (26%) general practices (GP) and 6 medical students (0.33%). Based on the 25 questions above, it showed that 6 questions had significant results of correlation between the academic degree of health professional and their knowledge, attitudes and beliefs (Table 2). More than 80% of correctly answered questions were obtained regarding basic science of human temperature, measurement of fever, and its complication in pediatric patients, stated in question 1-17, except those regarding non-shivering thermogenesis in neonates in only 61% of subjects, and only 46,3% correctly answered about neutral thermal environment depends on neonates' weight.

Tabel. 2 Items in the knowledge scale according to the percentage of correct answers

No	Specialist n=41 (%)	Resident n=85 (%)	GP n=48 (%)	Medical student n=6 (%)	P - value
1	92.7	72.9	89.6	100.0	0,214
2	97.6	92.9	93.8	100.0	0,685
3	61.0	84.7	68.8	83.3	0,039
4	46.3	78.8	58.3	50.0	0,406
5	92.7	89.4	89.6	100.0	0,581
6	92.7	80.0	91.7	83.3	0,235
7	87.8	87.1	75.0	83.3	0,164
8	85.4	81.2	79.2	83.3	0,447
9	95.1	84.7	91.7	100.0	0,512
10	92.7	55.3	97.9	83.3	0,031
11	80.5	44.7	85.4	83.3	0,031
12	85.4	43.5	68.8	83.3	0,304
13	87.8	36.5	81.3	100.0	0,590
14	85.4	56.5	91.7	83.3	0,713

15	100.0	49.4	91.7	100.0	0,241
16	97.6	55.3	100.0	100.0	0,659
17	95.1	89.4	97.9	83.3	0,374
18	46.3	22.4	62.5	50.0	0,295
19	56.1	38.8	64.6	66.7	0,458
20	48.8	10.6	33.3	16.7	0,295
21	61.0	32.9	50.0	16.7	0,049
22	87.8	70.6	62.5	33.3	0,006
23	41.5	36.5	39.6	0.0	0,215
24	48.8	28.2	35.4	16.7	0,032
25	53.7	5.9	54.2	16.7	0,178

Regarding treatment of fever in children (Question 18-25), only around half of healthcare providers answered in accordance with the existing recommendation, except for “only paracetamol and ibuprofen recommended as antipyretics in children”, in which 87,8% answered correctly. In the statement of alternating paracetamol and ibuprofen administration for high fever, only 46,3% answered correctly. The next question is regarding tepid sponging, who only 56,1% answered in accordance with the existing recommendation. When asked about alcohol compress, only 48,8% were correct. There were 61% of the subjects who correctly answered the statement to wake a child to administer antipyretic. Only 41,5% answered appropriately for the statement to administer ibuprofen in varicella patients with fever. With only less than half subjects, which is 48,8%, answered precisely regarding paracetamol dosage. There were 53,7% could answer the statement correctly about immunization causing lowered antibody titer. Neutral Thermal Environment in pregnancy is higher than pediatric specialists with 78,8% were correct. The number of subjects with correct answer on the statement “pulmonary artery temperature measurement while invasive, is the method closest to core temperature” were still lower than 80%. With the statement “in shock, pulmonary artery temperature is lowered but rectal temperature stays normal” only 80% answered correctly. The four lowest statements with correct answers were regarding the temperature measurement on tympanic membrane for 44,7% subjects, same as false statement that recommends alcohol compress. Fewer subjects answered correctly with the statement “varicella patients with fever, it is better to be administered ibuprofen to lower the fever and reduce possible pain” were for about 36,5% of the subjects. Lastly, the lowest number of subjects answered correctly on the statement regarding paracetamol dosage, of only 1 subject answered correctly (28,2%).

Among general practitioners, the number of subjects were somewhat similar to pediatric specialists, with questions number 1-17 could be answered correctly by more than 80% of subjects except question number 3 regarding non-shivering thermogenesis (68,8% of general practitioners) and question number 4 regarding Neutral Thermal Environment (NTE) that depends on neonates’ weight (58,3% of general practitioners). Although in case of general practitioners, the statement that rectal temperature measurement must not be used to monitor body temperature in anesthesia could only be answered correctly by 75% general

practitioners. To the statement in case of temperature difference of pulmonary artery and rectal in shock closely garnered 79,2% of subjects answered correctly, and fever is a warning sign of infection correctly answered by 68,8% of general practitioners, lower than those of pediatric specialists. Also similar to pediatric specialists, questions 18-25 regarding management of child with fever, the number of subjects with correct answers were relatively low. The three lowest questions correctly answered were the false statement recommended to give physical method of compress using alcohol for 33,3%, "In varicella patients with fever, it is better to be administered ibuprofen to lower the fever and reduce possible pain" 39,6% correctly answered, and "Intravenous paracetamol dosage is 15 mL/Kg BW/administration" with 35,4% correctly answered.

To the medical students, similar to the previous subjects, the question regarding basic science in questions 1-17 could be answered by most of them, except on Neutral Thermal Environment in pregnancy that depends on newborn's weight, although question regarding non shivering thermogenesis in neonates can be answered correctly (83,3%) unlike other subjects. Also, similar to the previous subjects, questions 18-25 regarding the management of children with fever, the number of subjects who could answer correctly were also low, with no subjects could correctly answer the statement about administration of ibuprofen in varicella patients with fever

4. DISCUSSION

This research demonstrated that 6 questions had significant results about the correlation between degree of health professionals and their knowledge, attitudes and beliefs. The significant results were about basic science, body temperature measurement and management of fever. Normal human body temperature ranges around $36.2 - 37.5^{\circ}\text{C}$ with oral measurement and higher 1°C with rectal measurement. Balance of body temperature is regulated within preoptic area in anterior hypothalamus with set point temperature $37,1^{\circ}\text{C}$. [3] Temperature equilibrium point in this case is defined as a limit that can be modified depending on the requirements of the body. In regulating heat, the body will retain balance between amount of produced heat and heat loss to attain equilibrium point of body temperature set by anterior hypothalamus. Among factors affecting loss of body heat are: how fast heat is conducted from core heat producing organs (liver, brain, heart, skeletal muscle, and brown adipocyte cells in infants) to neighboring tissues and how fast such heat transferred from the skin to nearby environment, either through radiation, conduction, convection, or evaporation. [7,8]

This research showed that among health care practitioners and medical students, most of them already understood basic science of body temperature physiology, with more than 80% pediatric specialists properly have had the knowledge, although only 61% answered correctly in regards to non-shivering thermogenesis in neonates, and only 46,3% correctly answered about neutral thermal environment that depends on neonates' weight. This finding also reflects both medical doctors and medical students, while pediatric residents differ somewhat depending on questions. It is implicated that recommendation regarding fever is not really

well known to health care providers, even to medical students. There are two modalities of heat production in neonates which are: (1) heat produced by cellular metabolism in core organs producing body heat and (2) additional heat production including non-shivering thermoregulation (NST) by brown adipocyte cells and shivering thermogenesis from movements of skeletal muscles.[9] However, because skeletal muscle in neonates are not yet mature to perform thermogenesis function, NST becomes the main modality to produce heat in neonates.[8,9]

In the statements regarding management, in questions 18-25, among pediatric specialists, residents, general practitioners, and medical students only half and fewer subjects could answer the statements correctly in accordance with fever guidelines.[10,11] For example, only 46,3% of pediatric specialists answered correctly against advising to alternate paracetamol and ibuprofen in high fever. The number is higher in pediatric residents in which 72,7% answered correctly, while 62,5% of general practitioners, and 50% of medical students answered correctly. Previous studies in Swiss demonstrate similar phenomena where health care providers management differed with existing recommendations, an alternating regimen of 2 drugs and physical antipyresis (tepid sponging) were indicated as common practice by 77% and 65% of pediatricians, respectively.[12] The previous report shows that the use of antipyretics according to discomfort was adopted only by 38.2% of participants, while 12.2% of them recommended alternate use of antipyretics.[13] Due to the nature of this study that evaluates knowledge through questionnaire instead of per case basis, there might be differences in actual practice compared to theory. These results have showed how important it is for every doctor to continue professional development (CPD). CPD is the period of education and training of doctors commencing after completion of basic medical education and postgraduate training, thereafter, extending throughout each doctor's professional working life.[14]

In questions 3 and 4, it can be seen that the specialists' answer results were lower than the results of the residents, general practitioners, and medical students. Only 61.0% and 46.3% of pediatric specialist answered correctly about non-shivering thermogenesis in neonates and neutral thermal environment for full-term neonates. This number was higher in pediatric residents in which 84.7% answered question 3 correctly and 78.8% answered question 4 correctly, while 68.8% of general practitioner answered question 3 correctly and 58.3% of them answered question 4 correctly, then 83.3% and 50.0% of medical students answered question 3 and 4 correctly. This might occur because the specialists probably seldom relearn about the basic science, thus it shows the importance of forgetting curve.[14] Therefore, every doctor should repeat the lessons regularly so that the lost memory or decreasing level of knowledge does not occur. Whereas in questions 10 and 11, the results of the residents' answer results were lower than the other subjects. Only 55.3% and 44.7% pediatric residents answered question 10 and 11 correctly. These results were more due to the fact that in practice, residents mostly use the axilla method with a digital thermometer. And it is known that indeed the digital thermometer and infrared thermometer have an accuracy level that is not much different.[15,16]

Meanwhile, the questions number 21, 22, and 24 showed that medical students got the lowest results. This is because the questions in these numbers emphasize practical knowledge which medical students usually have not studied in depth. Consequently, this shows the importance of CPD in order to increase their knowledge along with the higher level of education taken.[17] Similarly, recent literature reports suggest that improvements in educational interventions are needed in the case like this.[13] After graduating from medical school, all doctors need to undertake some lifelong training activities to maintain, update or develop their knowledge, skills and attitudes towards their professional practice. CPD refers to the continuous development of medical and non-medical competencies including professionalism, and interpersonal, managerial and communication skills.[14,17]

There is no single correct way to do CPD. Most of the learning in CPD is independent and based on their own learning needs. However, the onus is on physicians to demonstrate that they continue to maintain appropriate professional standards after training. Here, regulation becomes essential for re-validation, monitoring, and for providing the necessary impetus to mandate CPD. Doctors owe it to their patients to stay up to date with the latest developments in their field of practice. This is in the best interest of the patient and their professional duty. CPD fosters individual development, supports clinicians to challenge the evolution of scientific knowledge in medicine, and changes in patient requirements, systems that provide healthcare services, and regulatory agencies.[14] CPD is also an integral part of the process of improving the quality of health services that we provide to the community.

In Summary, the degree of education of healthcare providers influenced their competency in assessing and treating children with fever. The recommendation regarding the managements of fever seems to be adopted only by a minority of healthcare providers, therefore the knowledge among health care providers should be improved and updated continually. In addition, it is also very important for educational institution and professional medical society to provide continuing medical education for every healthcare providers so they can always re-learn basics sciences and what is new in medical world so the level of knowledge continues to increase and be maintained over time and the treatment provided will always standardized.

5. REFERENCE

- [1] Avner JR. Acute fever. *Pediatr Rev* 2009;30(1):5–13
- [2] Shinohara H, Hasegawa S, Tsunoda S, Hosogi H, Sakai Y. Principles of anatomy. In: Sakai Y, eds. *Laparoscopic Surgery for Colorectal Cancer*. Kyoto: Springer Japan KK; 2016:1–16
- [3] Walter EJ, Hanna-Jumma S, Carraretto M, Forni L. The pathophysiological basis and consequences of fever. *Crit Care* 2016;20(1):1–10
- [4] United Nations Children’s Fund. *Levels and Trends in Child Mortality Report 2018*. New York: United Nations Children’s Fund; 2018. Page 1–48
- [5] Chiappini E, Parretti A, Becherucci P, Pierattelli M, Bonsignori F, Galli L, et al. Parental and medical knowledge and management of fever in Italian pre-school children. *BMC Pediatr* 2012;12(97):1–10

- [6] Leung AKC, Hon KL, Leung TNH. Febrile seizures: an overview. *Drugs Context* 2018;7:1–12.
- [7] Marieb EN. *Essentials of Human Anatomy and Physiology*. 11th ed. Essex: Pearson Education; 2014:632
- [8] Champlain Maternal Newborn Regional Program (CMNRP). *Newborn Thermoregulation*. Ottawa: Champlain Maternal Newborn Regional Program (CMNRP); June 2013. Page 1–16
- [9] Asakura H. Fetal and neonatal thermoregulation. *J Nippon Med Sch* 2004;71(6):360–70
- [10] Chiappini E, Venturini E, Remaschi G, Principi N, Longhi R, Tovo PA, et al. 2016 update of the Italian Pediatric Society guidelines for management of fever in children. *J Pediatr* 2017;180(1):177–183
- [11] Fields E, Chard J, Murphy MS, Richardson M. Assessment and initial management of feverish illness in children younger than 5 years: summary of updated NICE guidance. *BMJ* 2013;346(2866):1–6
- [12] Lava SAG, Simonetti GD, Ramelli GP, Tschumi S, Bianchetti MG. Symptomatic management of fever by Swiss board-certified pediatricians: results from a cross-sectional, Web-based survey. *Clin Ther* 2012;34(1):250–6
- [13] Chiappini E, Cangelosi AM, Becherucci P, Pierattelli M, Galli L, de Martino M. Knowledge, attitudes and misconceptions of Italian healthcare professionals regarding fever management in children. *BMC Pediatr* 2018;18(1):1–6
- [14] Anshu, Singh T. Continuing professional development of doctors. *Natl Med J India* 2017;30(2):89–92
- [15] Berksoy E, Training T, Anil M, Teaching T, Bal A. Comparison of infrared tympanic, non-contact infrared skin, and axillary thermometer to rectal temperature measurements in a pediatric emergency observation unit. *Int J Clin Exp Med* 2018;11(2):567–73
- [16] Barbi E, Marzuillo P, Neri E, Naviglio S, Krauss B. Fever in children: pearls and pitfalls. *Children (Basel)* 2017;4(9): 1–19
- [17] World Federation for Medical Education (WFME). *Continuing Professional Development (CPD) of Medical Doctors*. Copenhagen: WFME Executive Council; 2003. Page 1–32