

Relationship between Fever Level and Leukocyte Levels in Children with Typhoid Fever

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Received: November 5, 2022

Received in Revised: December 4, 2022

Accepted: December 21, 2022

Abstract

Salmonella typhi spreads typhoid fever, a multisystem illness. The bacteria that cause typhoid fever may promote the generation of endotoxins that alter haematological assays, particularly those involving leukocytes. Exogenous pyrogens, such as bacteria or an immune reaction, produce fever. Pyrogen may be an interleukin-1-like protein. This chemical may stimulate the hypothalamus to create more prostaglandin E₂, causing fever. We also found lymphocytosis, monocytosis, eosinophilia, and thrombocytopenia. Endotoxin and endogenous mediators may reduce bone marrow, causing leucopenia. Recent research shows that the average leukocyte count is normal or slightly elevated, despite the idea that 25% of the population has leucopenia. This research examines whether fever and leukocyte counts are linked in hospitalized typhoid patients. This cross-sectional study was undertaken in the hospital's pediatrics and medical records departments. The sample included typhoid-hospitalized children. Forty persons were randomly recruited for this study. Chi-Square was used for univariate and multivariate analysis. ($p = 0.816$; OR = 1.181; 95% CI = 0.292-4.778). In typhoid-hospitalized youngsters, fever and leukocyte counts are unrelated.

Keywords: Typhoid Fever, Fever, Leukocyte Levels

Introduction

Typhoid fever is an acute systemic infectious illness caused by *Salmonella typhi*. In this disease, bacteria invade and multiply among the phagocytic mononuclear cells of the liver, spleen, intestinal lymph nodes, and Peyer's patches over an extended period of time, resulting in a high temperature and chronic bacteremia. The therapy has no negative effects on endothelial or cardiac tissues (Xia et al., 2016). Typhoid fever is a disease with its origins in Indonesia and which is most likely to be encountered in the country's major cities. The number of men and women infected with typhoid fever is almost equal. According to Teadt et al (2020) Adolescents and young adults have disproportionately high infection rates. Infection rates for typhoid in Indonesia remain high, with estimates ranging from 350 to 810 new cases per 100,000 persons. The morbidity rate for typhoid fever, which is now approximately 500 per 100,000 people in Indonesia, is also on the rise, according to studies performed in the country's basic hospitals. People waiting too long to seek treatment and the high expense of therapy itself may be responsible for between 0.6% and 5.0% of deaths. Despite widespread efforts to eradicate it, typhoid fever is still there and may cause recurrent outbreaks even in developed nations. Travel to less developed places is a common trigger for these diseases.

In the United States, males and females have similar typhoid infection rates. Chronic intestinal carriers are almost 3.65 times more likely to be female than male. Predominantly, these carriers are women over the age of 50. It has been reported that the incidence of typhoid was 75% higher among those under the age of 30. Less severe clinical symptoms are typical in children older than 5 years, and they typically develop after the age of 1 year. Symptoms of typhoid may

vary from being hardly perceptible (typhoid fever syndrome) to being so severe that they might kill you. The clinical picture might change in many ways at various times and places. Comparing the clinical image in the year 2000 to the clinical picture in the year 1960 in the same region may not be a fair comparison, and the same is true for emerging nations and developed ones. The majority of people with typhoid fever will experience a rise in body temperature as one of their symptoms.

The reason of the fever, which is frequently unknown at the onset of the illness and which afterwards varies periodically, might be any of many things. The morning will have normal or slightly below average levels, but the afternoon and evening will see much higher amounts (intermittent fever). The temperature is becoming steadily worse, and there is a wide array of other symptoms, including: frontal headaches (dizziness), muscular aches and pains, difficulty to sleep, loss of appetite, nausea, and vomiting. The fever is steadily rising. Fever becomes more intense and may last for a longer duration during the second week (continuous fever). If the patient recovers completely, their temperature will return to normal somewhere in the third week. When a region is inflamed, fluids, dissolved chemicals, and cells from the bloodstream go into the surrounding interstitial tissues. doing physical or mental damage to; killing. Actually, the inflammatory response is an ongoing process that consists of a sequence of actions that are perfectly timed with one another. The tissue being attacked must be alive in order for the immune system to mount an effective response. A healthy microcirculation is very important.

If the necrotic tissue area is large, however, the location of the inflammatory response will be on the tissue's perimeter rather than in the center. Here, non-living tissue meets tissue with a functioning circulatory system. Furthermore, although it may take some time for an inflammatory response to become obvious, in the case of specific injuries that result in the host's death instantly, there may be no outward indication of one. During the inflammatory reaction, cytokines are produced by leukocytes. Moshage (1997) As mediators of the acute phase response, these cytokines play an important role. Fever, a well-known physiological response, results from the activity of cytokines on the hypothalamic thermoregulatory area (Crowl et al., 1991). A condition known as leukocytosis arises when the bone marrow produces an abnormally high amount of cytokines, which in turn causes an abnormally high number of white blood cells (leukocytes) to circulate in the blood. The average core body temperature for a person is between 36.50 and 37.20 degrees Celsius. Extremely low temperatures (below minus 360 degrees) are extremely unusual. If the core body temperature is more than or equal to 37.20 degrees Celsius, a person is said to have a fever. A core body temperature below 350 degrees Celsius is indicative of hypothermia, whereas a core body temperature over 41.20 degrees Celsius is indicative of hyperpyrexia. As a general rule, oral and rectal temperature readings are more accurate than axillary readings. Rectal temperature is typically 0.50 degrees Celsius greater than oral cavity temperature under normal conditions. Antibody production and T-lymphocyte cell proliferation could rise by as much as 20 times in animals with fever compared to what happens at a normal body temperature of 370 degrees Celsius.

The human body has a defense mechanism that is very effective against infection, and a rise in core body temperature creates the optimal conditions for this mechanism to accomplish its work (Kjellstrom et al., 2009). Fever is caused by endogenous pyrogens, which may come from bacteria or be the consequence of an immune response that is unrelated to an infection (Watson, 1960). These pyrogens are what are known as exogenous. At this time, it is thought that pyrogen is a protein that is comparable to interleukin-1. The synthesis of the fever-causing chemical prostaglandin E2 in the hypothalamus is stimulated by this molecule, which may cause fever.

Because autonomic control has an influence on peripheral vasoconstriction, fever is generated when there is a decrease in the body's ability to dissipate heat.

Again, a patient may perceive a spike in fever due to increased metabolic activity, which increases heat production and, due to inadequate transport to the surface, raises the intensity of the patient's sensation of a high temperature. This may occur when a patient has an infection, for example. When we look at the total leukocyte count, we obtain a picture of leukopenia (three thousand to eight thousand per microliter), relative lymphocytosis, monocytosis, and eosinophilia, as well as significant thrombocytopenia. It is possible for leucopenia to occur as a consequence of endotoxin and endogenous mediator-induced suppression of the bone marrow. It is believed that twenty-five percent of the population has leucopenia; nevertheless, various research conducted during the last few years have shown that the typical leukocyte count is either normal or slightly raised. When thrombocytopenia hits, the creation of platelets slows while the rate at which they are destroyed quickens owing to an increase in RES cells. Anemia may be caused by a number of factors, the most significant of which are a shortage of red blood cells, undiagnosed bleeding, and a decrease in the body's ability to produce hemoglobin. According to studies carried, hematological exams, including leukocyte counts, revealed no link with the degree of fever in children who were afflicted with typhoid fever. The researchers are excited to carry out this investigation employing a comprehensive set of time periods, settings, and controls.

Methods

For the purpose of this research, secondary data in the form of medical record reports from children who had typhoid fever were used. The findings of this investigation are going to be processed by the Statistical Product and Service Solution (SPSS) application before being examined. Patients under the age of 18 who were diagnosed with typhoid fever and were hospitalized are included in the sample. Patients diagnosed with typhoid fever who fulfilled both the inclusion and the exclusion criteria were used as subjects. Purposive sampling, also known as sampling that is based on particular criteria and takes certain aspects into account, was used to gather the sample for this research project. Secondary data in the form of medical record reports of pediatric patients diagnosed with typhoid fever who were treated at the Children's Department were utilized as the instrument for this study.

Results and Discussion

Research has been conducted to investigate whether or not there is a connection between typhoid fever and the number of leukocytes found in youngsters. The data source for this research consisted of the hospital medical records of children who had been diagnosed with typhoid fever and who fulfilled the criteria for participation in the study. This investigation made use of medical records pertaining to children who were successfully treated for typhoid fever. A master table that is comprised of all of the information that has been collected and arranged in accordance with the inclusion criteria is generated with the assistance of Microsoft Excel. After that, SPSS (Statistical Package for the Social Sciences) for Windows version 21 was used to import and analyze the data. The findings were shown as either a frequency table or a cross table, depending on which format was chosen.

The following are the findings from study that was conducted using data on the association between the degree of fever and the number of leukocytes in typhoid fever patients aged 5-12 years who were hospitalized.

Table 1. Relationship between Fever Level and Leukocyte Levels

Level Fever	Normal	%	Tall	%	N	%	P Value ($\alpha = 0.05$)	P.OR
Subfebris	17	73,9%	6	26,1%	23	100%	0,816	1,181
Febris	12	70,6%	5	29,4%	17	100%		(0,292-4,778)
Total	29	72,5%	11	27,5%	40	100%		

In Table 1, it was shown that 17 typhoid patients had normal leukocyte levels, while 6 had high leukocyte levels. When the patients were feverish, 12 of the patients had normal leukocyte levels, while 5 had high leukocyte levels. The results of this test were then analyzed using the chi-square statistic. The chi-square test indicates that there is a possibility that the count value will be lower than five in as much as 25% of the cases. Because of this, we are unable to perform the chi-square test to analyze the data. Because of this, we decided to use the Fisher test to analyze the data. The results of the Fisher test showed that the threshold of significance was $p = 0.816$, which is more than 0.05. There is no connection between the level of fever and the number of leukocytes found in children who have typhoid fever. In addition, the odds ratio that we get is 1.181. (range: 0.292-4.778).

Distribution of Subjects by Gender

It is possible for there to be gender-based differences in the occurrence of some illnesses. Although it is true that every person, male or female, is capable of developing any given disease, there may be differences in the prevalence of certain diseases. This is due to a wide variety of factors, including individual differences in job and lifestyle, treatment knowledge and access, immune system strength and other physiological characteristics, genetic make-up, and environmental influences. Specifically, this is due to the fact that individuals' jobs and lifestyles vary. Even though there have been advancements in treatment, typhoid fever continues to be a serious medical problem in developing countries like Indonesia. This is due to the fact that the disease has the potential to cause severe bleeding as well as intestinal perforation, both of which have the potential to be fatal. This sickness is more likely to spread in areas with dense human populations, increasing dependence on urban infrastructure, less access to natural resources such as clean water, and overall bad living circumstances (Bunce et al., 2010). Rates have a tendency to be much higher in tropical locations in comparison to places with weather that is more moderate.

Forty youngsters were examined to determine whether or not they had typhoid fever; nevertheless, the ratio of males to girls was much higher than expected. According to the results of a wider epidemiological study that looked at the demographic characteristics of typhoid fever patients, the ratio of males to females who have the disease is much higher. The reason that males as opposed to girls are more likely to have typhoid fever may be due to the fact that, on average, men have participated in a greater number of extracurricular activities ever since they were little.

Distribution of Subjects by Clinical Symptoms

The hypothalamus, whose job it is to regulate the equilibrium between the body's heat production and heat loss, is the organ that is in charge of ensuring that the temperature of the body remains steady within a narrow band of acceptable variation. The hypothalamus is the part of the brain that is in charge of ensuring that the temperature of the human body remains at a steady 37.0 degrees Celsius when circumstances are normal (Cramer et al., 2022). In the event that there is a disparity between the pace at which the body generates heat and the rate at which it loses heat, this might result in a rise in set point that is too high. 23 people out of the

40 medical records that were used as the research instrument had a subfebrile fever (37.30 - 38.20C), and 17 people out of the 40 medical records had a fever (>38.20C) (42.5%). This is a response rate of 57.5 percent and 42.5 percent, respectively. The examination of these figures makes it abundantly evident that there are a much greater number of instances of subfebrile fever than there are of febrile fever. There is a possibility that the patient was treated with antipyretics or other drugs in an effort to bring their fever down before they were transferred to the hospital. It's possible that this will have an effect on the final result.

The findings of the research project indicated that there was a total of 29 people in the group who had laboratory results indicating normal leukocyte levels, while there were 11 people in the group who had laboratory results indicating excessive leukocyte levels. This was established as a result of the fact that there was a total of 29 people in the group who had normal leukocyte levels. It is assumed that this is because the amount of endotoxin that is now present in the body of the patient is still relatively low or has not yet reached the threshold that would be considered harmful. The final consequence of this is that the effect of the endotoxin cannot be determined by examining the leukocyte levels of the patient

Conclusion

Fever from typhoid may lead to significant bleeding and intestinal perforation, both of which have the potential to be fatal on their own. Typhoid fever can also cause organ failure and organ failure can lead to death. This illness has a greater potential to spread in regions that have both a large population density and poor living conditions. Tropical settings often have substantially greater rates of illness and death when contrasted with areas that have weather that is more moderate. The research instrument comprised of forty medical records, and out of those records, 23 people had a fever that was subfebrile (37.30 - 38.20C), and 17 people had a fever that was above 38.20C. (38.20 - 42.5C). During the course of medical care, the patient was most likely provided with antipyretics as well as other drugs in an effort to bring their fever down.

References

- Bunce, M., Rosendo, S., & Brown, K. (2010). Perceptions of climate change, multiple stressors and livelihoods on marginal African coasts. *Environment, Development and Sustainability*, 12(3), 407-440.
- Cramer, M. N., Gagnon, D., Laitano, O., & Crandall, C. G. (2022). Human temperature regulation under heat stress in health, disease, and injury. *Physiological reviews*, 102(4), 1907-1989.
- Crowl, R. M., Stoller, T. J., Conroy, R. R., & Stoner, C. R. (1991). Induction of phospholipase A2 gene expression in human hepatoma cells by mediators of the acute phase response. *Journal of Biological Chemistry*, 266(4), 2647-2651.
- Kjellstrom, T., Holmer, I., & Lemke, B. (2009). Workplace heat stress, health and productivity—an increasing challenge for low and middle-income countries during climate change. *Global health action*, 2(1), 2047.
- Moshage, H. (1997). Cytokines and the hepatic acute phase response. *The Journal of Pathology: A Journal of the Pathological Society of Great Britain and Ireland*, 181(3), 257-266.
- Teadt, S., Burns, J. C., Montgomery, T. M., & Darbes, L. (2020). African American adolescents and young adults, new media, and sexual health: scoping review. *JMIR mHealth and uHealth*, 8(10), e19459.

- Watson, D. W. (1960). Host-parasite factors in group A streptococcal infections: pyrogenic and other effects of immunologic distinct exotoxins related to scarlet fever toxins. *The Journal of Experimental Medicine*, 111(2), 255-284.
- Xia, N., Horke, S., Habermeier, A., Closs, E. I., Reifenberg, G., Gericke, A., ... & Li, H. (2016). Uncoupling of endothelial nitric oxide synthase in perivascular adipose tissue of diet-induced obese mice. *Arteriosclerosis, thrombosis, and vascular biology*, 36(1), 78-85.