ADDIS ABABA UNIVERSITY
COLLEGE OF HEALTH SCIENCES
SCHOOL OF ALLIED HEALTH SCIENCES
DEPARTMENT OF NURSING AND MIDWIFERY

Experimental Study on Comparison of Body Temperature among 5Min and 10Min Glass Mercury Thermometers and Digital Thermometers in Under-5 Children with Febrile Illness at Axillary site in Axum Saint Mary Hospital, Central Zone of Tigray, Ethiopia

By
Hadgu Gerensea Gebre (BSc. Nursing)

A Thesis Submitted to School of Graduate Studies, Addis Ababa University, College of Health Sciences, School of Allied Health Sciences, Department of Nursing and Midwifery for Partial Fulfillment of Requirements of Master's Degree in Pediatric and Child Health Nursing.

May, 2014.
Addis Ababa, Ethiopia

ADDIS ABABA UNIVERSITY
COLLEGE OF HEALTH SCIENCES
SCHOOL OF ALLIED HEALTH SCIENCES
DEPARTMENT OF NURSING AND MIDWIFERY

Experimental Study on Comparison of Body Temperature among 5Min and 10Min Glass Mercury Thermometers and Digital Thermometers in Under-5 Children with Febrile Illness at Axillary site in Axum Saint Mary Hospital, Central Zone of Tigray, Ethiopia

By
Hadgu Gerensea Gebre (BSc. Nursing)

A Thesis Submitted to School of Graduate Studies, Addis Ababa University, College of Health Sciences, School of Allied Health Sciences, Department of Nursing and Midwifery for Partial Fulfillment of Requirements of Master's Degree in Pediatric and Child Health Nursing.

Advisor**:**
Assistant Prof. Rajalakshmi Murugan

May, 2014.
Addis Ababa, Ethiopia

ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

Experimental Study on Comparison of Body Temperature among 5Min and 10Min Glass Mercury and Digital Thermometers in Under-5 Children with Febrile Illness at Axillary site in Axum Saint Mary Hospital, Central Zone of Tigray, Ethiopia

By

Hadgu Gerensea Gebre (BSc. Nursing)

Department of Nursing and Midwifery, School of Allied Health Sciences, College of Health Sciences, Addis Ababa University

Approved by the Examining Board

_____

Chairman, Department of Graduate Committee _____

Dr…….

Advisor _____

_____

Examiner _____

_____

Examiner _____

ACKNOWLEDGMENT

My sincere and deepest gratitude goes to my advisor and instructor Assistant Prof. Rajalakshmi Murugan for her unreserved assistance in giving me timely comments and relevant guidance from the beginning of the research proposal to the write-up of the final thesis paper.

I am also very grateful and would like to extend my heartfelt thanks and appreciation to the study participants and data collectors for their full participation and supporting in data collection.

Finally, I would like to acknowledge Addis Ababa University, College of Health Sciences, School of Allied Health Sciences, Department of Nursing and Midwifery for giving me this great opportunity.

At last, but not the least I want to thank to all my friends who support me from topic selection up to submission of this thesis.

LIST OF ACRONYMS

AAU: Addis Ababa University

AGE: Acute Gastro-Enteritis

AGMT: Axillary Glass-Mercury Thermometer

ASTM: American Society of Testing and Materials

BSc: Bachelor of Science

DT: Digital Thermometer

ETB: Ethiopian Birr

FI: Febrile Illness

GMT: Glass- Mercury Thermometer

IRB: Institution Review Board

KM: Kilo Meter

MD: Mean Difference

Min: Minute

Prof.: Professor

MSc: Master of Science

^{O}**C**: Degree Celsius

^{O}**F**: Degree Fahrenheit

OPD: Out Patient Department

SD: Standard Deviation

St. Saint

URTI: Upper Respiratory Infection

VAE: Visual Acuity Examination

WHO: World Health Organization

TABLE OF CONTENT

Contents Page

LIST OF TABLES

LIST OF FIGURES

Description Page

LIST OF ANNEXESS

Description Page

ABSTRACT

Background: - Evaluation of body temperature is one of the oldest known diagnostic methods and still an important sign of health and disease. Since rectal and oral temperature measurement are uncomfortable, less hygienic and unacceptable in many cultures; axillary has been method of choice in many countries like Ethiopia. In children decisions concerning investigation and treatment may base on results of temperature alone. Although accuracy of axillary temperature measurement is affected by a number of factors, device dwell time and device type are common.

Objective: - is to compare body temperature among 5and10Min glass-mercury thermometer (GMT) and digital thermometer (DT).

Method: Experimental study design was used to compare body temperature among 5Min, 10Min GMT and DT. A total of 98 samples were taken. The GMT (5 and 10min) was taken at the same axilla where as DT on the opposite axilla, but randomization of right and left axilla was carried out within consecutive study subject and measurements were taken simultaneously. A statistical significance ($p<0.01$) and clinical significant ($0.2^{o}c$) were used. Correlation and Bland-Altman plot were used to observe the agreements of the recording.

Results: mean difference (MD) of 5 and10 GMT, 5min GMT and DT, and 10min GMT and DT were 0.13673 ±0.13112, -0.0082±0.15106 and 0.12857±0.10745 respectively. A statistically significant difference was noted in comparisons of mean temperatures of 10min GMT with 5min GMT and DT ($P<0.000$), but not in 5min GMT with DT ($P>0.01$). Clinically all were not significant ($MD<0.2^{o}c$).in all comparison the correlation analysis also shows strong positive correlation($r>0.75$) and all the MD were fall in the limit of agreement in Bland-Altman plot.

Conclusion and Recommendations: Even a statistical significant ($p<0.000$) difference was observed in 5min with 10min GMT, and 10min GMT with DT the strong correlation, their good agreement and clinical insignificant, some important disadvantages of GMT and advantage of DT makes DT good alternative to the traditional glass mercury thermometer. Their variation in temperature is not likely to change any clinical decision. So health professionals should use DT for measuring body temperature in under-5 febrile illness except for neonate. Moreover researchers should repeat the study using core temperature as gold standard for comparison.

Key Words: Body Temperature, Thermometers, Mean Difference, Dwelling Time, Comparison

CHAPTER-ONE

INTRODUCTION

1.1 Background and Statement of the Problem

Body temperature is a measure of the body's ability to generate and get rid of heat. The normal physiology is to keep body temperature within a narrow safe range in spite of large variations in environmental temperatures.(1) Maintenance of body temperature occurs through the integration of multiple body systems that interact to maintain a balance between heat loss and generation. Normal body temperature is around 37° C (98.6° F), but varies during the day. The lowest body temperature occurs in early morning hours (2 am to 4 am) and the highest temperature occurs in the late afternoon. Body temperature may also increase as a result of overdressing or strenuous exercise, especially in hot weather. (2)

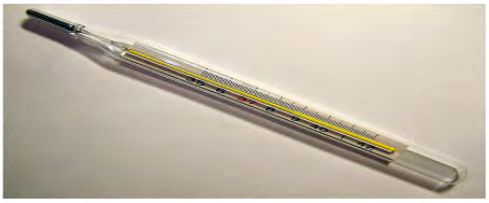
Fever is one of the body's normal defenses against attack from an infection or another disease. It is therefore a symptom, not a disease itself. A part of the brain that acts as the body's thermostat controls body temperature by balancing hot and cold signals throughout the body. Fever may actually play a role in fighting infections and shortening their course by turning on the body's immune system, thereby increasing the release and activity of white blood cells and other germ-killing substances. However, while some doctors recommend not treating fever, most do. This is because children are more likely to eat, drink and sleep if their body temperature is controlled. Not only reducing fever make they feel better, but also getting sick children to drink helps prevent dehydration. Although lack of fever does not rule out the presence of bacteria or other serious disease, high fever has a high correlation with serious illness. (3)

Febrile illness is defined as a disease characterized by an increase of body temperature more than 37.5^0C resulting from infectious process. Febrile Illnesses (FIs) due to different etiologic agents are the most common causes of morbidity and mortality in developing tropical and subtropical countries. (3)

Many of the infectious diseases assessed, classified and treated using the Integrated Management of Childhood Illnesses (IMCI) guidelines have fever as a secondary cause. For example, many children with upper respiratory tract infection, pneumonia or ear infection will have fever. Severe illnesses associated with danger signs are also associated with fever, such as sepsis septicemia and meningitis. The danger signs lead to appropriate referral for the illness. Fever is also associated with malaria, dysentery and diarrhea in children. In these patients, the cause of the fever is treated and fever is not used in decision making. While these conditions all cause fever, the management of the condition itself results in the management of the fever. (4)

A thermometer is a device that measures temperature or temperature gradient, using a variety of principles. For recording body temperature, several different types of thermometers are used, such as mercury thermometers, digital thermometer, liquid crystal forehead thermometer, and infrared tympanic thermometer.(1)

Digital thermometer



A clinical mercury-in-glass thermometer

Fig-1.1 Digital and Glass mercury thermometer

Body temperature in children can be measured at a number of anatomical sites using a range of different types of thermometers, including mouth, rectum and axilla.(5) Ideally, measurement should be reliable, non-invasive, non-traumatic, culturally acceptable, user-friendly and hygienic. Since rectal temperature measurements are relatively more time-consuming, invasive, uncomfortable, less hygienic and unacceptable in many cultures, and oral temperature is unhygienic and difficult in children, axillaries measurements have been the method of choice in many countries. (6-8)

Evaluation of body temperature is one of the oldest known diagnostic methods and is still an important sign of health and disease, both in everyday life and in medical care. The individual can describe feelings of illness and discomfort, but in conditions where individuals are unable to explain themselves e.g. children, the nurse has to interpret the clinical signs and rely on objective measurements. (9) Change in body temperature is one of the most important physical sign and symptom in both acute febrile illness as well as chronic illnesses in children. This is especially important in newborns, in which fever can be indicative of infection. It was shown that temperature out of the normal range is closely related to the survival of infants. (6-7, 10-11) Many decisions concerning the investigation and treatment of children may based on the results of temperature measurement alone.(12-13)

As the basic sciences develop, temperature measurement methods and devices were improved. For hundreds of years, both in clinics and home, GMT was the standard of human temperature measurements(14) and currently developing countries are used it commonly, (15) though no longer recommended.(11, 13, 16-19) DTs are widely used by healthcare professionals as an alternative to GMT as they are faster, easier to read and avoid the environmental concerns of mercury.(5, 19)

Although accuracy of axillary temperature measurement is affected by a number of factors, including ambient temperature, local blood flows, inappropriate placing of the probe and closure of the axillary cavity, device dwell time and device type are common which can led to false high readings which may lead to expensive and painful diagnostic studies and medical interventions or false low readings which may lead to greater morbidity and mortality. So that temperature measurement must be accurate and consistent, as decisions about therapeutic intervention is based upon it.(9, 20-24)

The accuracy of devices to record and grade temperature is uncertain. (1) Limited researches have been addressed whether the thermometer correctly identifies patients with hyperthermia or hypothermia. In general, these studies indicate that noninvasive temperature measurements are accurate in ruling out hyperthermia and hypothermia, but may fail to detect hyperthermia and hypothermia, depending on the thermometer used. Especially there is controversy in alternative approach of digital to mercury thermometers regarding accuracy and sensitivity. (25) So this study may feel the gap among health professionals.

1.2 Rationale and Significant of the Study

Temperature taking is the most frequently performed clinical observation and is predominantly a nursing task. Although the use of digital thermometer is gradually increasing, MGT is still most common device used in the pediatric setting, especially in developing countries (15) in spite of having long dwelling time, danger of breakage, potential harm and toxic vapor effects; difficulties in reading, and possible role in spread of hospital acquired infections. (11, 13, 16-19, 26) There is confusion about the proper length of time for waiting periods of MGT in axillary site. (27) Some studies highly recommend axillary MGT should wait 10Min rather than 5Min, which may be impractical, but other studies vice versa. Standard Nursing texts also vary between 5 and 10 Min which are not supported by current studies. (27)

It is important that the speed of application and ease of use does not prejudice a nurse's decision in choice of the thermometers and accuracy must be foremost consideration. Current nursing studies on temperature measurement are conducted to understand the efficacy of the various types of equipment available to measure temperature, (28-29) but they are insufficient and contradictory. (30) Especially, there is debate between MGT and DT regarding to their accuracy in measuring true body temperature and their ability to detect fever and hypothermia. Researches on those devices are scarce besides the manufacturer's data sheets. Even the little documented studies have large discrepancy and health professionals are in debate. Due to inconsistencies in both research methods and clinical practice (31-32) nurses are challenging in selecting the measurement method that is most appropriate for a patient and provides the most accurate and precise approximation of core temperature. (33)

The false low and false high result related to accuracy of thermometer device and dwelling time may lead to misdiagnosis and treatment. If DTs are to become the standard device used in the clinical setting, they must be subjected to rigorous investigations to increase the knowledge of practitioner and thereby improve practice.

Febrile illnesses are the most common leading cause of morbidity and mortality in under-5 children which needs accurate measurement of body temperature. Ethiopia is one of the developing countries which use both GMT and DT in measuring body temperature with the uncertainty of the device and dwelling time in their capability of detecting hyperthermia and hypothermia. So it is important to know the standard time and accurate device to measure body temperature.

This study fills the gaps among health professionals and has some input on nursing body of knowledge. It will have contribution for decision makers and significant others to take possible measure on temperature measurement device. It will recommend possible solutions on accuracy of device and dwelling time of GMT. It may decrease misdiagnosis of febrile illness in under-5 children related to inaccuracy of body temperature measurement due to devices type and dwelling time. This study will also be used as a base line data for further research on comparison of temperature measuring devices related topics. It is designed to investigate whether DT is suitable alternative to MGT in children and compare dwelling time of 5Min and10Min MGT.

CHAPTER-TWO

LITERATURE REVIEW

2.1 5Min and 10Min Axillary Glass Mercury Thermometers

A study conducted by Cutter, highlights the inconsistencies in different studies' suggestions of how long to leave thermometers in different sites of the body. The confusion surrounding this area is reflected in his study as the majority of nurses were not leaving thermometers in site in accordance with the recommended time periods. Different authors recommend different 'optimum' times that a thermometer be left in site. (31, 34) Standard Nursing texts also have great discrepancy on how long to leave mercury thermometer on axillary. E.g. Potter and Perry (2007) and Fulbrook (1993) as 10 Min (35-36) and Ulusoy and Go¨rgu ¨lu ¨ (1996) as 5–10 Min, (37) but different studies put significance difference among these ranges. Not only nursing text books, current nursing clinical trial also has inconsistency on how long leave axillary GMT. (27)

Haddadin and Shamo'on (2007) from East Mediterranean study also state the stabilization time for axillary reading is 93% at 5Min, and 98% at 7 Min with a mean of 4.4 Min (SD 0.84). They conclude, the thermometer should be left in place for 5 Min, (38) which is similar with studies in India that recommend to keep the reading mercury thermometer for 3-5 Min in axilla. (39, 40)

Study from China indicates no statistically significant differences (P0.05) among 10 Min period, an 8 Min period and 6 Min period. The study concludes measurement of axillary temperature using mercury-in-glass thermometer for 6 Min period is accurate. (41) Similarly study from India shows the mean placement time for axillary temperature is 4.8 Min. (42)

But one study from Turkey determines that most of the thermometers (82.26%) stabilized in the 8 Min and some of them stabilized in the 9 Min. A statistically significant difference is noted between the two temperature averages measured in the seventh to 8 Min ($P<0.05$). Maximum readings measured by mercury-in-glass thermometer is stabilize in the 8 Min. (27) Study by Greylinget al. (2000) also found that a maximum temperature reading is reach after 3 Min in only 9% of the tested subjects, in 25% after 6 Min, and in 66% after 9 Min, and the 9 Min measurement had the highest sensitivity. (43)

Similarly other studies from Korea on 5 Min and 10 Min axillary mercury glass thermometer shows significant differences (P0.05). (38-40) Moreover, The temperatures taken in axillary in two hundred volunteers for 5 Min, 7 Min, 10 Min and 13 Min result increased profile of the temperature is observed. But between 10 Min and 13 Min, there is no significant different (P0.05), and they state “appropriate time for axillary temperature is10 Min”. (44)

Furthermore; from China, three clinical glass thermometers taking at 5, 10 and 15 Min on one group shows 10 Min were 0.27 ^{O}C higher than that of measured at 5 Min (P0.001). On the other group 10 Min were 0.38 ^{O}C higher than that of measured at 5 Min (P0.001). Body temperature values measured at 15 Min are 0.61 ^{O}C and 0.23 ^{O}C higher than that of measured at 5 Min and 10 Min (P0.001). Finally the study recommends the measuring time should be 15 Min if the condition is permitted and measuring for 10 Min may be more suitable to the clinical practice since 5 Min measuring time can not reflect the internal temperature correctly (45) Which is analogous with other study in Canada. (19)

Clinical trials conducted in China on 296 students using mercury thermometer at 3 Min, 4 Min, 5 Min, 6 Min, 7 Min, 8 Min, 9 Min and 10 Min are also show significance difference (P 0.001). They end with best time of axillary temperature measurement of 10 Min. (46) Systematic review by Craig, 2000 [1a] study demonstrates the longer placement time for axillary thermometers the increase accuracy of the temperature measurement (47) as Waterloo (2002) other study from China also found main problem with axillary temperature measurement is the long dwell time to reach equilibrium, with only 18% of axillary readings reaching maximum at 5 Min. (5)

2.2 Glass Mercury and Digital Thermometers

Temperature is one of the most common and important clinical sign. The gold standard for ambulatory patient, temperature recording has been done by the clinical mercury thermometer. Due concerns about the breakages and environmental hazards, new thermometers have come into view with the hope of replacing the clinical mercury thermometer. (16)

After considerable debate in the 1990s in United State of America (USA), Leick-Rude and Bloom, during routine accuracy testing in a study, reported that 25% of the glass/mercury thermometers tested differed from the reference thermometer by >0.2 degrees centigrade. This finding was consistent with the authors' review of prior work. Indeed, another recent study had rejected 28% of glass/mercury thermometers due to inaccuracy. (48)

Since the start of the American Society of Testing and Materials (ASTM) International Mercury initiative in 2006, ASTM technical committees have been struggling with the issue of substituting alternative temperature measurement devices for the traditional mercury-in-glass approach without affecting test method results. Among the devices being considered are the digital readouts. Some medical professionals still consider mercury to be the only accurate and consistent method of measuring temperature and blood pressure. Yet, as peer reviewed studies from the last decade demonstrate, this is not currently the case, and in fact our attitude toward the accuracy of mercury thermometers and sphygmomanometers was probably overly positive in years past as well. (49)

Study from America by Dollberget al (2001) shows DT in term and near-term infants had the highest correlation with the glass thermometer for axillary temperature. The study accepted the accuracy and precision of digital instrument with a difference of $+0.2^0$C. (50) Similarly both laboratory and clinical studies show that there is no significant difference in the average accuracy of the two types of thermometers. They stated, however, that temperature readings with digital thermometers had greater fluctuation. In clinical studies, they wrote, “between 9 and 23% of repeated measurements using an digital thermometer differ by0.5°C or more, while the corresponding range for mercury thermometers is 0-6%.” (32)

Moreover, study in Denmark by Jensen etal compared measurements with mercury thermometers to digital thermometers in a hospital setting reported that digital measurements were most accurate. (51) Besides, Shanks etal. Studied the accuracy of digital thermometers using 20 hospital in patients as subjects; they compared two brands of digital thermometers with the mercury thermometer. The researchers found no significant difference between the measurements of the three thermometers. (52)

Study from Malaysia on 2010 shows, DT agree best with GMT and appears to be the best alternative to the traditional and time tested GMT with best concordance (limits of agreement 0.48–0.59°C). (13)

A primarily clinical trial both in laboratory and clinical studies in Bosten America, also show that there is no significant difference in the average accuracy of mercury and digital thermometers. Taking clinical measurements using mercury thermometers have no clinical advantage over digital rather have disadvantage. (53) Similarly other study from USA, resulted with high correlation (0.748-1.0) between glass thermometer and digital thermometer temperature assessments. (28)

Even though study from Turkey shows the mean differences(þ0.02 C) between axillary GMT and DT were significant (p¼0.001,), there is no clinical differences (defined as a mean difference of 0.2 C) between mean axillary GMT and DT measurement (29) which is comparable with others finding i.e. digital thermometer had a high correlation with the GMT (r=0.94) . (24, 28, 54)

The study from surgical and medical ward of Nehru hospital, Chandigarh, a total of 200 patients of 600 readings with both clinical mercury and digital thermometers also shows that the difference between the temperature readings of the two thermometers is not clinically significant. Digital thermometers should be used in place of the clinical mercury thermometers as it is environmentally friendly. There was no difference in the temperature for 386 (64.3%) readings. For 127 (21.2%) readings there was 0.1 °F difference in the temperature. Except 2 readings, all readings were falling within the lines of limits of agreement i.e. ±1.96 SD. (16)

Similar study in 2008 on the accuracy of the various non-invasive thermometers i.e. digital, forehead strip, tympanic and mercury thermometers, found that the digital thermometer gave the best concordance with mercury thermometer. (18) which is similar with Imani.et and Chan MS, finding from Iran and USA. (55-56)

But, one study from Biomedical Instrumentation and Technology indicated that the improvements in safety, speed, and simplicity of use of the new clinical thermometers have been offset by a loss in accuracy and reliability. Latman state that "the current generation of electronic, digital clinical thermometers, in general, may not be sufficiently accurate or reliable to replace the traditional glass/mercury thermometers". (57)

Study from Thailand shows glass thermometers have been considered the gold standard method of temperature measurement in newborn infants. However, anal perforation, accidental breakage and mercury contamination are risks associated with this method, in addition to being time-consuming and exposing neonates to room temperature which can cause hypothermia. For these as well as other reasons, digital thermometry has been used instead of the traditional mercury-in-glass thermometer. But digital thermometry is not a perfect device to be used instead of the standard mercury-in-glass thermometer in all neonates. The study indicated that, for temperature measurement of relatively healthy infants who had an acceptable ranges of measured temperature of 0.2^0C, rectal digital thermometry could be an appropriate device instead of the mercury-in-glass thermometer in order to decrease disturbance time during measurement and decrease the work load of care givers. In sick or critically-ill patients, the mercury-in-glass thermometer should be the standard device. (58)

Furthermore, two DT readings under-recorded compared with mercury to the extent of -0.278^{o}C and -0.348^{o}C respectively. In both cases, there is a statistically significant difference. Further analysis shows that, the first DT for oral, 68% of subjects the reading is below that for mercury. In the second DT the comparable figure was 79%. The results indicate that overall the DT on average under-recorded temperature significantly ($p<0.05$), both at oral and axilla sites, compared to a GMT reading at the axilla. These mean differences are considered clinically, as well as statistically, significant. On the basis of the reading, the patient's temperature would appear normal, when in fact he or she had pyrexia that would require nursing intervention. (59)

Even the comparative study between mercury and digital thermometer done on Iran shows there is no statistical significant difference between measurement by mercury and digital thermometer (36.48±0.84 and 36.51±0.87), for detecting fever, DT had 85.4% and 95.7% sensitivity and specificity respectively. Regarding low sensitivity of DT, the study conclude, GMT is still suitable device to detect fever. (60)

2.3 Conceptual Frame-Work

The accuracy of body temperature depends on health professional knowledge and skill. Even though health professionals are skillful, unless the device used is standard or accepted by ASMT, the result obtained may not reflect true body temperature.

According to the literature review the main factors identified are socio-demographic factors like age, environmental factor (hot or cold), device type (Mercury or Digital), dwelling time of mercury (5Min or 10Min), site of measurement (axilla, rectal, oral etc), health professional knowledge and skill (placement technique) and health status are identified variables that can varies body temperature result.

Even though there is shortage of researches on the topic, the conceptual frame work was developed by the researcher after extensive literature review and consult with the experts. The determinant factors were addressed and the relation was shown as the figure below.

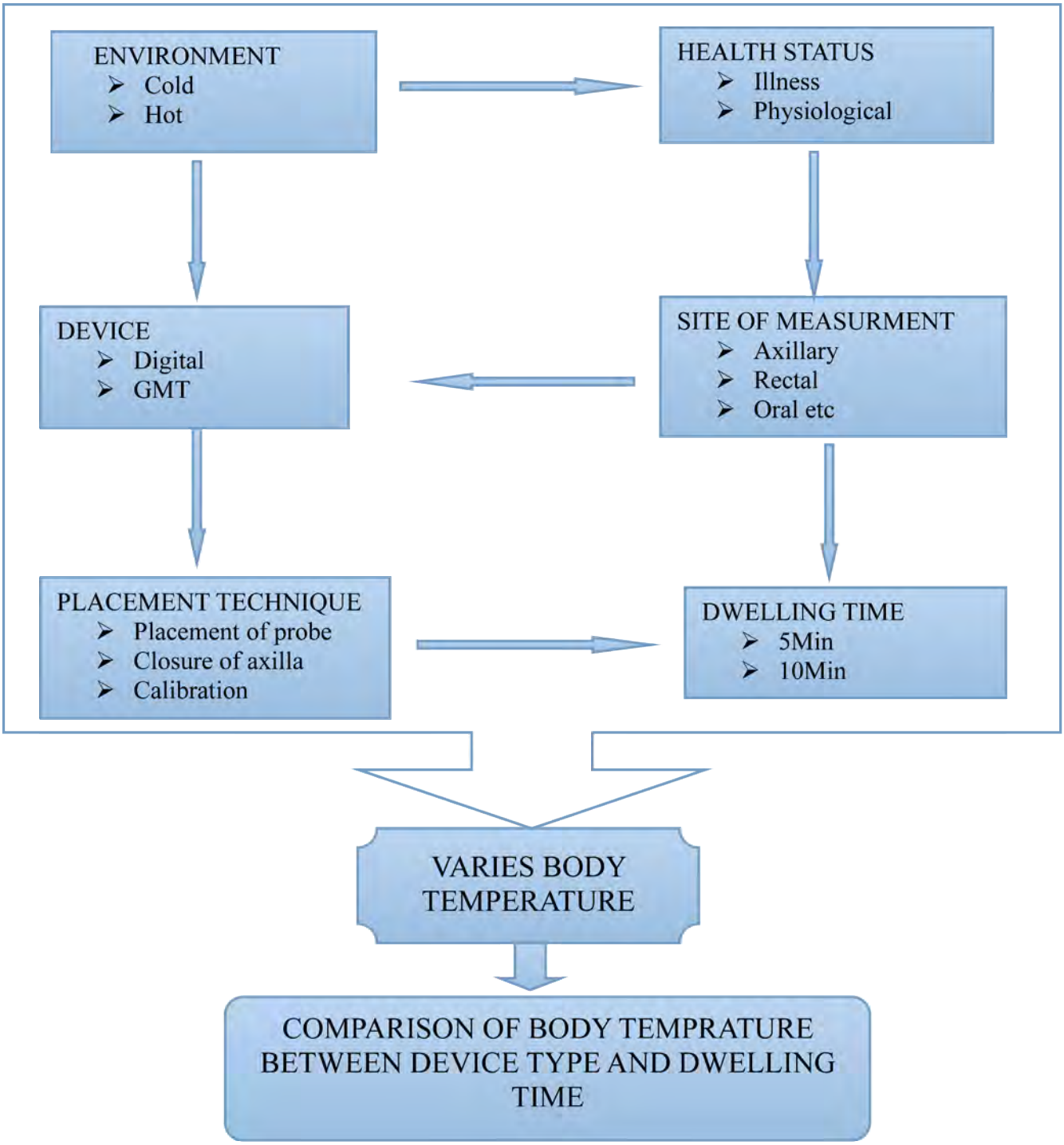


Fig-2.1 a Conceptual Frame-work for Determinants of Variation of Body Temperature Result

2.4 Research Questions

Can digital thermometer be used as alternative device with old standard GMT in Axillary site in under-5 Children?

Is there difference in body temperature result between 5Min and 10Min glass-mercury thermometers in Axillary site in Under-5 Children?

CHAPTER-THREE

OBJECTIVES

3.1 General Objective

To Compare Body Temperature among 5Min Glass-Mercury, 10Min Glass-Mercury and Digital Thermometers among Under-5 Children with Febrile Illness using Axillary Site in Axum Saint Mary hospital

3.2 Specific Objectives

To Compare Body Temperature between 5Min and 10Min Glass-Mercury Thermometers among Under-5 Children with Febrile Illness using Axillary Site in Axum Saint Mary hospital

To Compare Body Temperature between 5Min Glass-Mercury and Digital Thermometers among Under-5 Children with Febrile Illness using Axillary Site in Axum Saint Mary hospital

To Compare Body Temperature between 10Min Glass-Mercury and Digital Thermometers among Under-5 Children with Febrile Illness using Axillary Site in Axum Saint Mary hospital

3.3 Hypothesis

There is a significant temperature result difference among 5min GMT, 10min GMT and DT.

CHAPTER-FOUR
METHODOLOGY

4.1 Study Area

The study was carried out in Axum, city of northern Ethiopia, 1024 Km north of Addis Ababa and 241 Km far from Mekelle which is the capital city of Tigray region, located in the Central Zone of Tigray Region near the base of the Adwa mountains and surrounded by La'ilay Maychew woreda. Axum was the original capital of the kingdom of Axum and one of the oldest continuously inhabited places in Africa. According to Central Statistical Agency of Ethiopia (CSA), as of July 2012, the population of the town was 56,576. The census indicated that 30,293 of the population were females and 26,283 were males and governed as an urban woreda. It has an elevation of 2,131 meters (6,991 feet). The 2007 national census showed that the majority of the inhabitants practiced Ethiopian Orthodox Christianity, with 88.03% reporting that as their religion, while 10.89% of the populations were Muslim. Saint marry hospital is one of the 13 governmental hospitals found in Tigiray region which serve medical care for Axum's population and nearby. In Tigray region 16.9% of the population is under-5 yrs and Axum town have around 7,490 numbers of children less than five years according to reports from city administration in 2012. (61)

St. Marry hospital is one of the referral hospitals in the zone and FI is prevalent including ka-lazar, so that sample was found within the data collection period and at the time of my clinical experience, nurses working in the hospital and clinical students was debated regarding the devices even the controversy is as national. The qualified and trained health professionals may found in hospital than health center since accurate diagnosis of FI is needed. This is why the study focused on this area. Similarly as the generalizability is to the devices study area may not have effect.

According Köppen-Geiger climate classification system classifies its climate as subtropical highland. (61-62) Having no great variation of environmental temperature may increase the validity of the result.

Table-1 Climate data for Axum for 2014

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Year
Average high °C	25.9	27.2	28.6	29.4	28.8	27	22.5	22.3	24.8	26.3	26.8	25.7	26.28
(°F)	(78.6)	(81)	(83.5)	(84.9)	(83.8)	(81)	(72.5)	(72.1)	(76.6)	(79.3)	(80.2)	(78.3)	(79.32)
Daily Mean °C	**16.7**	**17.8**	**17.7**	**21**	**20.8**	**19.7**	**17.2**	**17.4**	**17.9**	**17.9**	**17.4**	**16.2**	**18.14**
(°F)	**(62.1)**	**(64)**	**(63.9)**	**(70)**	**(69.4)**	**(67.5)**	**(63)**	**(63.3)**	**(64.2)**	**(64.2)**	**(63.3)**	**(61.2)**	**(64.68)**
Average low °C	7.5	8.4	10.8	12.7	12.9	12.4	12	12.6	11.1	9.6	8	6.7	10.39
(°F)	(45.5)	(47.1)	(51.4)	(54.9)	(55.2)	(54.3)	(54)	(54.7)	(52)	(49.3)	(46)	(44.1)	(50.71)

Source: Climate-Data.org *(altitude: 2133M)*

Fig - 4.1 Map of Axum

4.2 Study Period

The Study was conducted from November/2013 to May /2014.

4.3 Study Design

Experimental Study design was used to compare body temperature among 5Min mercury, 10Min mercury and digital thermometers among under-5 children with FI using axillary site in Axum St. Marry hospital.

4.4 Source and Study Population

4.4.1 Source Population

The source population was all under-5 age children with FI visiting Axum St. Marry hospital for health care service.

4.4.2 Study Population

The study population was under-5 children with FI visiting Axum St. Marry hospital for health care service, particularly in under-5 OPD at the time of data collection.

4.5 Inclusion and Exclusion Criteria

4.5.1 Inclusion Criteria

Under-5 age children with FI

Children visiting Axum St. Mary hospital particularly under-5 OPD

4.5.2 Exclusion Criteria

Children under-5yrs of age with FI coming for follow up unless with new FI, children treated at ward and children under-5 with FI who have axillary ulcer, lethargy or unconscious, was excluded from the study as this have drawback for study subjects and the study. As sampling was convenience, irritable subjects were also excluded.

4.6 Sample Size Determination

A total of 96 samples was calculated using mean difference between 5Min and 10 Min(0.27) and S.D 0.54 and 0.42 at alpha of 0.01 with detection capability (power) of 90% (beta 0.1) and taking 1 as ratio of exposed to non exposed using open epi statistical software; since the sample need for digital and mercury is below 96. A total of 288 measurements was taken in both experimental and control group. Manually the study was also calculated using the following formula:

$$N = \frac{(r+1)(Z_{\alpha/2} + Z_{1-\beta})^2 \sigma^2}{rd^2}$$

$N = \frac{(1+1)(2.58+1.28)^2 * .4837^2}{1 * .27^2} = \frac{2 * 14.9 * 0.234}{1 * .073} = \frac{6.972}{0.073} = 95.5$ **~96**

Where r is the ratio of control to experimental which is 1:1 so r=1

δ Is the pooled standard deviation: 0.4837, d is mean difference: 0.27

$Z_{1-\beta}$ is normal deviated at 90%:1.28

$Z_{\alpha/2}$ is for 1% is 2.58 and N is sample size needed for each group.

4.7 Sampling Procedures

A convenient sampling procedure was used as the study was conduct on Under-5 Children who are difficult in co-operating to the procedure. Since axillary movement was expose the mercury thermometer to the environment, which is easily affected by environmental temperature, children who were irritable were conveniently excluded from the study. All under-5 children with FI visiting under-5 OPD of St. Marry hospital who fulfills the inclusion criteria was taking until the sample size fulfill.

4.8 Clinical Study Procedures

Both the data collectors and participants were blinded to the control and experimental groups. First GMT and DT was selected by lottery method for the right and left axilla then changed with in consecutive study subject. The 5 and10 Min GMT was in the same axilla with in the same time. The 5Min and 10Min GMT was the same thermometer except dwelling time difference.

The 5Min measurement GMT is the control group where as 10Min measurement of GMT and measurement of DT were experimental group. When comparing 10Min measurement of GMT and measurement of DT, the DT acts as control.

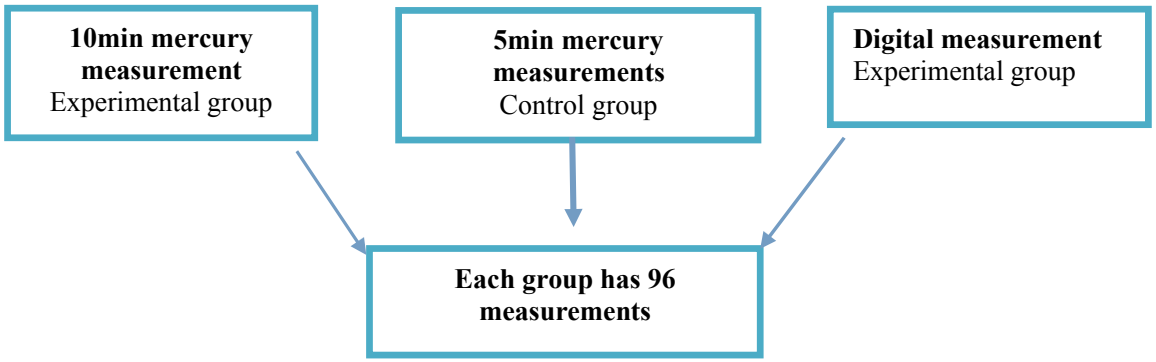


Figure-4.2 a Diagrammatic presentation of clinical study procedure for comparison of body temperature among under-5 children with febrile illness by axillary site in Axum St. Marry hospital Tigray, Ethiopia, 2014GC

4.9 Data Collection Procedures (Instrument, Personnel, Data Quality Control)

The study was continuously collect primary data through data collection tools which is developed after review of literature and consultation with the experts in nursing. For content validity the tool was reviewed by experts. The tools included: Part-I: Demographic preformed, Part-II: Recording Temperature result and observation checklist. The demographic preformed was filled before starting the procedure.

The research data was collected on the same season and daily environment temperature was recorded. Data collection time was from 2:00-6:00 o'clock morning and 7:30-11:30 o'clock afternoon on local time. Any measurement result below 5Min and 10Min recommended for 5Min and 10Min measurement respectively due to irritability or other, even only for 10Min was discard. Data collectors record their measurements independently to avoid bias in reading the GMT. Each method was performed only one time on each study subject.

All data collectors(BSc Nurses) was screened for test of visual acuity in both eye 6/6 and trained thoroughly with close supervision for 4 days in correct positioning, calibration, reading of thermometers and documenting based on WHO guideline of taking axillary temperature. As these was particularly relevant concerning consistency and accuracy of measurement. All the temperatures was measured on the Celsius (^{O}C) scale and timed with the same stop clock except for digital which have beep sound.

The validity of the mercury-in-glass thermometers was ensuring by checking calibration. The mercury-in-glass bulb thermometers was shaken before each recording to decrease its temperature reading below 35°C and only those thermometers with a deviation of 0.1°C was used during temperature measurement. If the thermometers were not calibrated, they were not meeting their potential to examine the research question and hypothesis. In an effort to avoid this threat to validity, calibration was addressed according to individual thermometer manufacturer instructions.

In addition, prior to data collection 5 mercury thermometers were left for 5Min in water bath three times. Of these the four thermometers that results the same value was used. Similar method was used for digital thermometers. Drying of axillary site was also construct validity for the study. This study was performing measurements following manufacturer information for each of the thermometry instruments, as described in the instruments and measurements section.

First, digital and GMT was randomly placed in bilateral axillas at the same time, and then they was exchange in the consecutive study subject. One GMT was used for 5Min and 10Min GMT to avoid instrumental bias. First GMT was calibrated below 35^{o}c then the GMT result of 5min was recorded after 5min. 10min GMT was taking by adding 5min without calibration of 5min GMT result. The data on temperature measurement was collected in two phase. Phase one was pre-test study conducted at Axum health center involving 10 children with FI to determine the selection methods of participants, the adequacy of parent's information sheet and consent form, and to check the thermometer functioning correctly. Phase two involves collecting the data in the study area.

4.10 Operational Definitions

Febrile Illness: A disease characterized by increase body temperature more than 37.5^{o}c resulting from infectious process like malaria, pneumonia, measles, otitis media, acute gastro-enteritis, upper respiratory tract infection, meningitis...

Clinical Significance of Temperature: The mean difference of temperature result between 5Min and 10Min mercury thermometer or mercury and digital is $\geq 0.2^{O}$C.

Body Temperature: It is the degree of heat maintained by the body or it is the balance between heat produced in the tissues and heat lost to the environment.

Body Temperature Result: Temperature results from axillary site using GMT or DT.

Normal Body Temperature: Axillary body temperature between is 36.5-37.5^{O}C using GMT or DT

Pyrexia: Axillary body temperature ranges 37.5 – 40^{O}C using GMT or DT

Hyper pyrexia: Axillary body temperature 40^{O}C and above using GMT or DT

Hypothermia: Axillary body temperature less than 36.5^{O}C

4.11 Variables

4.11.1 Dependent Variables

The dependent variable is body temperature result of GMT and DT.

4.11.2 Independent Variables

Demographic variables: Age, sex, religion,

Temperature variation variables: device type (GMT, GT), dwelling time of GMT (5Min and 10Min) are the study variables

Co-variant variables: Route (site) of measurement, Right and lift axilla, placement of probe, environment, local blood flow, closure of axilla, taking antipyretic medication, taking bath with in 30Min, time (morning, afternoon), and type of FI.

4.12 Scale of Measurements

For body temperature, degree celliuse scale of measurement was used in both GMT and DT. For time, in GMT, minute was scale of measurement; whereas beep sound was used in DT.

4.13 Data Analysis Procedures

First the data was interred and coded to epi info version 3.54 and exported to analysis in SPSS version 21 window7. Data analysis included descriptive statistics was used to describe participants' demographic characteristics, and temperature result (hypothermia, normal, pyrexia, and hyper pyrexia)(63) by percentage , mean, standard deviation and range. Correlation was determined by the Pearson correlation coefficient (to determine the strength of the correlation) while the extent of agreement was assessed with the Bland-Altman plot. To determine statistically significant difference a paired t-tests was used; $p<0.01$ was statistically significance. Not only statistical, clinical significance was also considered in the analysis. Even though the Standard clinical significance varies with different literatures most of them use a mean difference of 0.2 ^{O}C as not clinical significance. (36, 60, 64) This study was also used mean difference 0.2^{O}C between control and experiment group was clinical significant.

4.14 Data Quality Management

Visual acuity and training for data collectors about filling the socio-demographic information and taking the axillary temperature procedure was done to help for the quality of data. Drying axillary site and taking temperature at the same time was considered to have some input on the quality of data. Similarly, pilot study and exclusion of thermometers having difference was carried out prior to data collection.

Content validity was checked by experts and close supervision during data collection procedure and proper recording was also taken. Immediate checkup was carried out and any unfulfilled data was filled immediately. The study design also overcomes methodological difficulties encountered by previous experimental studies:

1. Use of randomization on right and left axillary for mercury and digital
2. Use of one axilla for 5Min and 10Min GMT
3. Addition of 5min for 10min GMT without calibration of 5min GMT result

4.15 Ethical Considerations

Institution Review Board (IRB) of Addis Ababa University, College of Health Science, School of Allied Health Sciences, Department of Nursing and Midwifery was review the protocol to insure full protection of the rights of study subjects. Following the approval by IRB, Official letter of co-operation was written to Axum St. Marry hospital from Department of Nursing and Midwifery of AAU. After getting permission from Axum St. Marry hospital, data collectors was inform to parents verbally and at least one parent was present during the data collection. Data was treated confidentially and identify subject by number only. Since it is axillary, it is safe and measurements were taken at OPD during assessment and also take 10Min for all measurement. So it has no treatment and investigation delay. As the sampling is convenience, irritable subjects were also not forced. Risk of skin irritation was informed with informed consent. Any breakage of GMT was disposed appropriate as it is environmental hazard. Probe was cleaned according to service manual instructions (WelchAllyn, Inc.) prior to use for individual study subject as this prevents risk of infection.

4.12. Dissemination of Results:

Results will be disseminated to Axum St. marry hospital and AAU, College of Health Science, School of Allied Health Sciences, Department of Nursing and Midwifery, through documentation. To researchers and students the result will be disseminated through presentations. If possible it will be accessible on internet for all through publication.

CHAPTER-FIVE

RESULT

5.1 Socio-Demographic

A total 100 study subjects were collected. Of these 2 were excluded from the analysis due to their incompleteness and unreadable in their temperature result. A total of 98 study subject were analyzed. 66(67.3) were collected in the morning. Of the 98, 53(54.1%) were female. 90(91.8) were orthodox. 34(34.7%) were aged from 1-3Yrs. For detail see Table 5.1.

TABLE 5.1 Frequency and percentage of socio-demographic characteristic of under-5children with febrile illness in under-5 OPD of Axum St. marry hospital, Tigray, Ethiopia from 22-29/8/ 2014G.C

S. No	Variables	Frequency	Percentage
1.	Age		
	0-28 days	4	4.1
	29days-1Yrs	30	30.6
	1-3Yrs	34	34.7
	3-5Yrs	30	30.6
2.	Sex		
	Male	45	45.9
	Female	53	54.1
3.	Religion		
	Orthodox	90	91.8
	Muslim	8	8.2
4.	Care giver		
	Mother	86	87.8
	Father	7	7.1
	Sister/brother	2	2
	Care servant	3	3.1

96 and 90 of the respondents were not taking bath and antipyretic within 30min prior to data collection respectively. 35 were diagnosis with pneumonia. For detail see Fig.5.1.

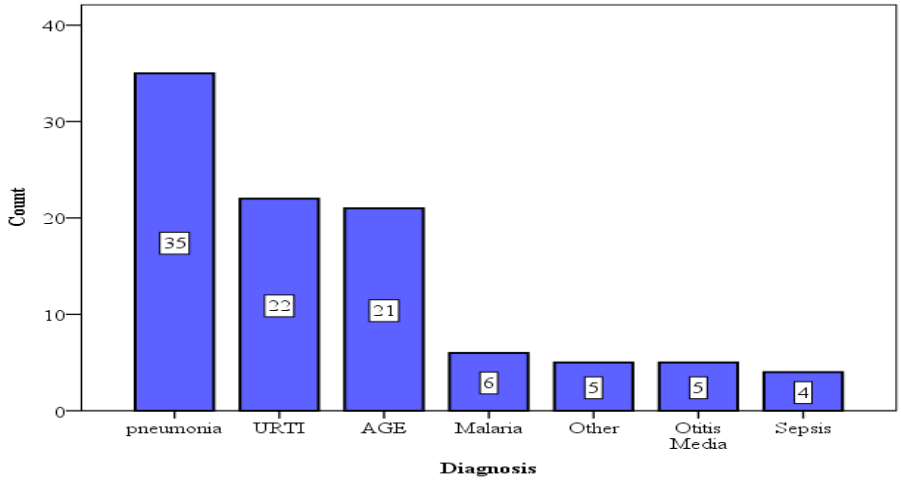


Fig. 5.1 count of diagnosis of under-5 children with febrile illness in under-5 OPD of Axum St. marry hospital, Tigray, Ethiopia from 22-29/ 8/2014G.C

5.2 Temperature Results

In this study one reading each with the 5min glass mercury thermometer, 10min glass mercury thermometer and digital thermometer were taken for each patient. The procedure was carried out for 98 subjects. This resulted in 98 5min mercury temperature readings, 98 10min mercury temperature readings and 98 digital temperature readings. The mean temperature of 5min mercury thermometer, 10min mercury thermometer and digital were 37.29±.77, 37.43±.77 and 37.3±.78 respectively. For detail seen Table 5.2.

TABLE 5.2 Mean, SD and Range of Temperature Result of 5Min GMT, 10Min GMT and DT among Under-5yrs of age Children with FI visiting Under-5 OPD in Axum St. Marry hospital, Tigray, Ethiopia from 22-29/8/ 2014G.C.

Thermometers	Observation	Mean ±SD	Median	Range	Minimum	Maximum
5Min Mercury	98	37.29±0.77	37.2	4	35.6	39.6
10Min Mercury	98	37.43±0.77	37.4	3.7	35.9	39.6
Digital	98	37.3±0.78	37.3	3.6	35.8	39.4

The maximum difference of the 5min mercury with 10 min mercury and DT readings was 0.6 and 0.7 respectively and the minimum difference was 0.10 °C. Only 19 and 36 have no difference with 10 min GMT and DT respectively. The maximum and minimum difference of 10 min mercury and DT were 0.4°C and 0.1°C respectively. 19 have no difference.

Only 14(14.3%), 7(7.2) and 13(13.3%) of the 98 paired measurements of each 5min GMT and 10min GMT, 5min GMT and DT and 10min GMT and DT have temperature difference greater than 0.2^{o}C respectively. For detail see table below.

TABLE-5.3 Difference of Temperature in ^{o}C and Frequency among 5Min GMT, 10Min GMT and DT among Under-5yrs of age Children with FI visiting Under-5 OPD in Axum St. Marry hospital, Tigray, Ethiopia from 22-29/8/ 2014G.C.

Comparisons	Difference of Temperature in ^{O}C	Frequency of Difference n (%)
5Min and 10Min Mercury	No	19(19.4)
	0.1	35(35.7)
	0.2	30(30.6)
	>0.2	14(14.3)
5Min Mercury and Digital	No	36(36.7)
	0.1	36(36.7)
	0.2	19(19.4)
	>0.2	7(7.2)
10Min Mercury and Digital	No	19(19.4)
	0.1	38(38.8)
	0.2	28(28.5)
	>0.2	13(13.3)

The frequency and percentage of grading fever for each thermometer are shown in Table 5.4

TABLE-5.4 Frequency of Grading Fever by Thermometers among Under-5yrs of age Children with FI visiting Under-5 OPD in Axum St. Marry hospital, Tigray, Ethiopia from 22-29/8/ 2014G.C.

Thermometers	Frequency (Percentage) of Grading of Fever			
	Hypothermia	Normal	Pyrexia	Hyper pyrexia
10Min Mercury	8(8.2)	44(44.9)	46(46.9)	0(0)
Digital	13(13.3)	44(44.9)	41(41.8)	0(0)
5Min Mercury	10(10.2)	45(45.9)	43(43.9)	0(0)

The mean difference of 10min and 5min GMT, 5min GMT and DT and 10min GMT and DT were 0.13673±0.13112, -0.0082±0.15106 and 0.12857±0.10745 respectively.

5.3 Statistical Results

A statistically significant difference was noted in comparisons of mean temperatures of 10min GMT with 5min GMT and DT (P<0.000), but there were no clinical differences (defined as a mean difference of 0.2 C). No statistical (P >0.596) and clinical significant difference (defined as a mean difference of 0.2 C) was observed between 5min GMT and DT. For detail see Table 5.5

TABLE-5.5 Statistical values among Comparison Groups (5Min and10Min GMT, 5Min GMT and DT and 10Min GMT and DT) among Under-5yrs of age Children with FI visiting Under-5 OPD in Axum St. Marry hospital, Tigray, Ethiopia from 22-29/8/ 2014GC.

Comparison Groups	Mean difference ±SD	t-cal	P-value	99% CI of the Mean difference	
				Lower	Upper
5Min and 10Min GMT	0.1367±0.13112	10.323	0.000	0.10193	0.17154
5Min GMT and DT	-0.0082±0.15106	-0.535	0.594	-0.04826	0.03193
10Min GMT and DT	0.12857±0.1075	11.845	0.000	0.10005	0.15709

Statistical analysis in relation to socio-demographic and other was done but no difference was observed clinically and statistically except for neonatal in which clinical significance (0.225) was observed though not statistically significant. Similarly 10min GMT was not statistically significant in this age group. This is most probably due to few observations. See the Table-5.6.

TABLE-5.6. Statistical values of comparison groups in relation to socio-demographic and other variables among Under-5yrs of age Children with FI visiting Under-5 OPD in Axum St. Marry hospital, Tigray, Ethiopia from 22-29/8/ 2014GC.

S.N	**Variables**	Observation	Mean difference and statistical values of thermometers with different variables					
			5 Min and10 Min GMT		5 Min GMT and Digital		10 Min GMT and Digital	
			MD±SD	P-value	MD±SD	P-value	MD±SD	P-value
1	Age							
	0-28days	4	-0.225±0.126	0.037	-0.125±0.21	0.31	0.1±0.16	0.308
	29days- 1yr	30	0.133±0.177	0.000	0.003±0.18	0.92	0.137±.1	0.000
	1-3Yrs	34	-0.12±0.12	0.000	0.006±0.14	0.80	0.13±0.11	0.000
	3-5Yrs	30	-0.15±0.086	0.000	-0.02±0.13	0.4	0.126±0.1	0.000
3.	Time of Measurement							
	Morning	67	-0.14±0.1	0.000	-0.013±0.13	0.47	0.12±0.11	0.000
	Afternoon	31	-0.135±0.18	0.000	0.003±0.18	0.92	0.14±1	0.000
5.	Taking antipyretic							
	Yes	8	-0.15±0.09	0.003	0.013±0.11	0.76	0.16±0.12	0.006
	No	90	-0.135±0.134	0.000	-0.01±0.15	0.54	0.13±0.1	0.000
6.	Axillary							
	Rt GMT and Lt DT	49			-0.01±0.14	0.6	0.134±0.1	0.000
	Lt GMT and Rt DT	49			-0.006±0.16	0.7	0.122±1	0.000

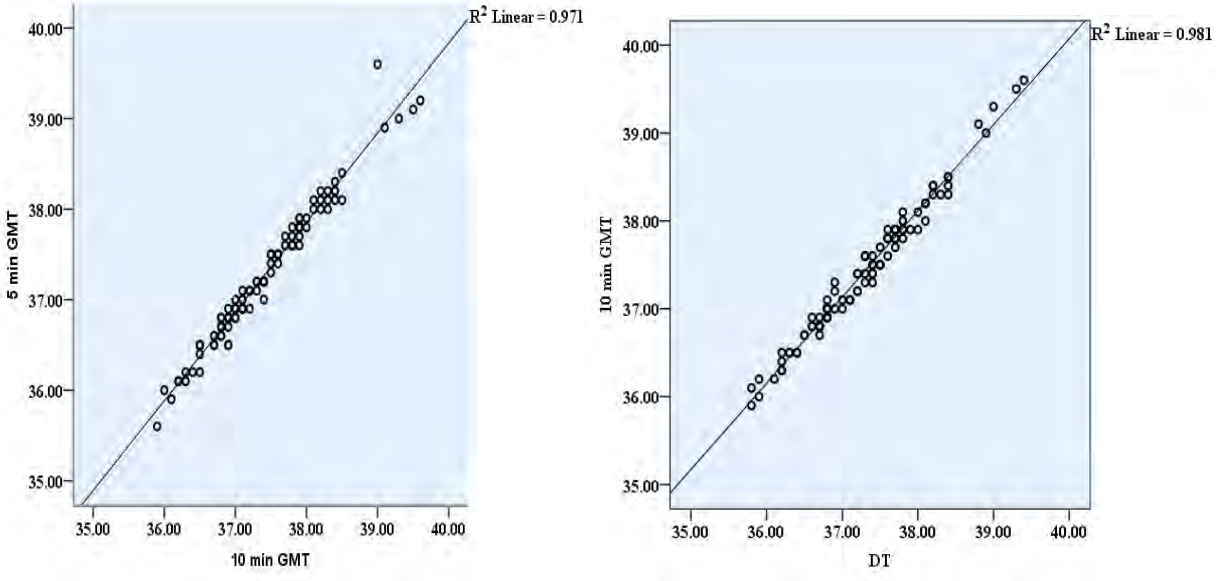
Correlation analysis:

In all the comparisons groups they have strong positive correlation. The Pearson correlation(r) of 5 Min and 10 min GMT was 0.99 which implies both as the result of 5GMT increases the result of 10 GMT also increase. Both have direct positive relation. For further see the table below.

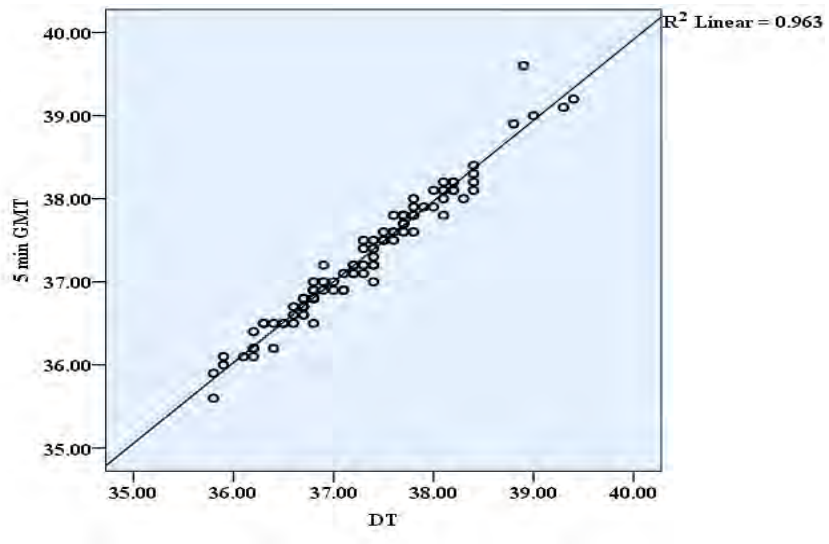
TABLE-5.7. Correlation ® among Comparison Groups (5Min with10Min GMT, 5Min GMT with DT and 10Min GMT with DT) among Under-5yrs of age Children with FI visiting Under-5 OPD in Axum St. Marry hospital, Tigray, Ethiopia in 2014GC.

Thermometers	5min GMT	10min GMT	DT
5min GMT	1		
10min GMT	0.99	1	
DT	0.98	0.99	1

The graphic representation of the correlation was shown in the figure below.



(a) (b)



(c)

Fig.5.2 (a) correlation of 5min GMT with 10min GMT, (b) Correlation of 10min GMT and DT, (c) Correlation of 5min GMT with DT

Band-Altman analysis

In order to determine the concordance between the glass- mercury thermometer and the digital thermometer, the Bland Altman method of analysis was used.

Fig.5.3. (a) depicts the Bland Altman plot of the 5min mercury temperature readings and the digital temperature readings. On the X- axis the mean of the mercury and the digital temperature are plotted and on Y - axis the difference between the temperature readings of 5min mercury and digital thermometer are plotted. In this plot a line of mean bias and the lines of 99% limits of agreements are present. Bias is the average of difference between the temperature by mercury thermometer and the digital thermometer. All of the readings were falling within the lines of limits of agreement i.e upper limit of 0.3816 and lower limit of -0.3979 and Only 1 readings were falling outside the lines of limit which is outlier since its mean difference is extreme. The limit of agreement is -0.00816. The negative sign shows digital was higher in mean than 5min mercury since digital is subtracted from 5min mercury. There is no difference is sensitivity among 5min GMT and DT as limit of agreement is nearest direct line (0.0).

Fig.5.3 (b) depicts the Bland Altman plot of the 10min mercury temperature readings and 5min mercury temperature readings. It shows all of the readings were falling within the lines of limits of agreement i.e upper limit of 0.475 and lower limit of -0.2016 and Only 1 readings were falling outside the lines of limit which is outlier observed in the above. The limit of agreement is 0.1367.

The positive sign and becoming all the mean difference above direct line (0.0) except the12 mean difference which are in the direct line (0.0) indicates 10min is sensitive than 5min GMT. A value of zero implies perfect concordance.

Similarly Fig.5.3 (c) All of the readings of 10min GMT and DT were falling within the lines of limits of agreement i.e upper limit of 0.4 and lower limit of -0.1487. For further see the figure below.

The horizontal line in the middle indicates the mean difference of two measurements, and two additional lines indicate 2.58 SD above and below the mean.

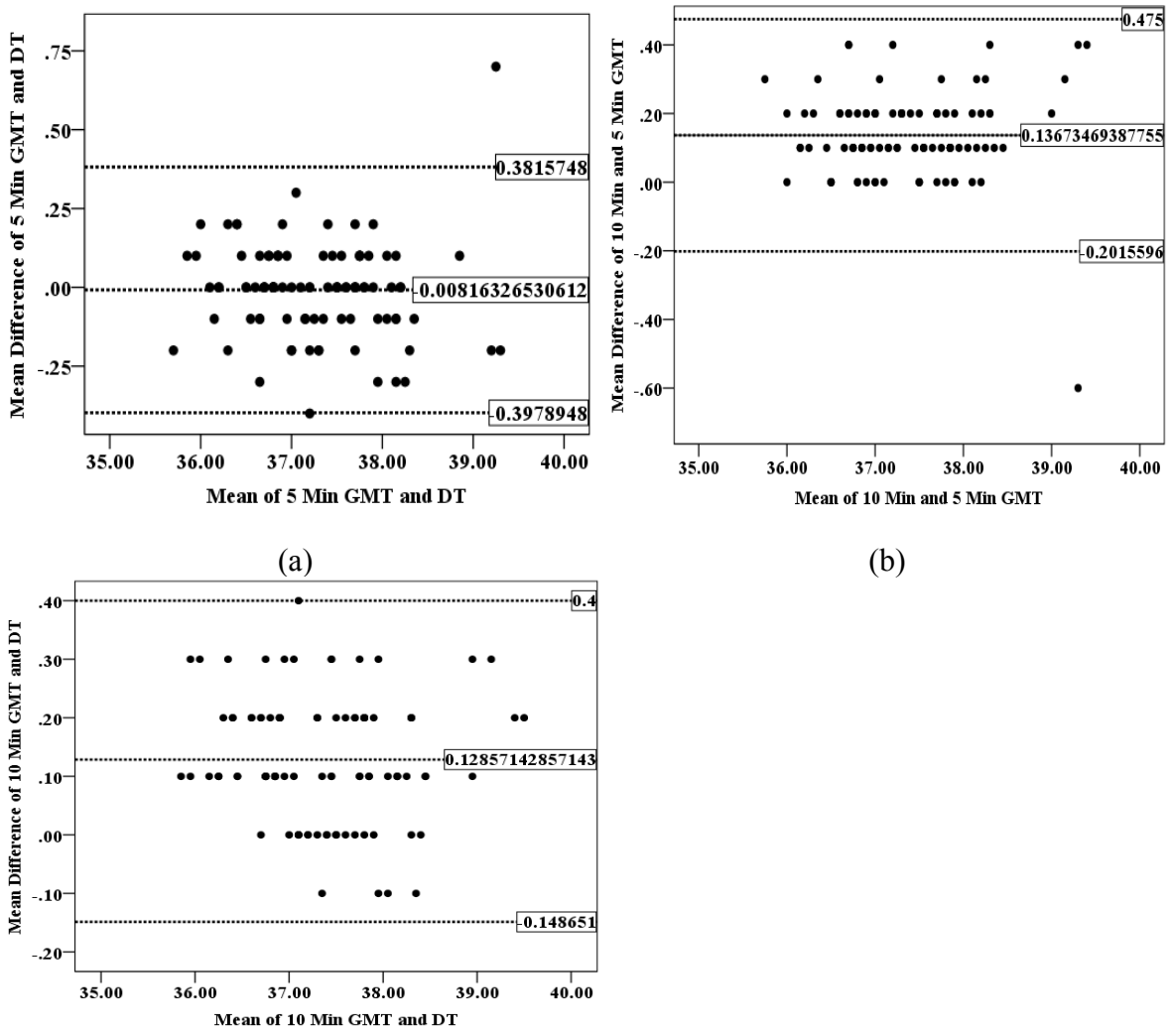


Fig.5.3 (a) Bland-Altman plot of 5min GMT and DT, (b) Bland-Altman plot of 5min GMT and 10min GMT and (c) Bland-Altman plot of 10min GMT and DT

5min GMT was agree with 10min GMT and DT 93 and 87 of 98 measurements respectively in grading fever. Similarly 10min GMT and DT was agreed 88 of 98 measurements. For detail see Table 5.8. (a), (b) and (c)

TABLE-5.8 (a)The Agreement of 10Min GMT with DT, (b) Agreement of 10Min GMT with 5min GMT, (c) Agreement of 5Min GMT with DT in Specific Range of Temperature among Under-5yrs of age Children with FI visiting Under-5 OPD in Axum St. Marry hospital, Tigray, Ethiopia in 2014GC.

10Min GMT \ Digital		Temperature Results in °C		
		<36.5	36.5 - 37.5	≥37.5
Temperature Results in °c	<36.5	8	0	
	36.5-37.5	5	39	0
	≥37.5	0	5	41

(a)

5Min GMT \ 10Min GMT		Temperature Results in °C		
		<36.5	36.5 - 37.5	≥37.5
Temperature Results in °c	<36.5	8	2	0
	36.5-37.5	0	42	3
	>=37.5	0	0	43

(b)

5Min GMT \ Digital		Temperature Results in °C		
		<36.5	36.5 - 37.5	≥37.5
Temperature Results in °c	<36.5	**10**	0	0
	36.5-37.5	3	**42**	0
	≥37.5	0	2	**41**

(c)

Clinical implications: the numerical value represents number of recording in each category. The shaded area represents agreement for that specific temperature range.

CHAPTER-SIX

DISSCUSION AND CONCLUSION

6.1 DISSCUSION

Due concerns about the breakages and environmental hazards newer thermometers have evolved with the hope of replacing the glass mercury thermometer. The variability of GMT placement time and importance of speed of application and ease of use is important in busy clinical area, but accuracy must be primary concern.

The present study was conducted to find the concordance of the digital thermometer with the glass mercury thermometer with hypothesis: there is difference in temperature result among 5min GMT, 10min GMT and DT.

In this study the dwelling time of GMT (5min and 10min) was statistically significant ($p<0.00$) which is comparable with the studies conducted in Turkey ($P<0.05$, 27), Korea ($P<0.05$, 44), China ($P<0.001$, 45), and Canada (19). Similarly a systematic review conducted by Craig, 2000 [1a] (43) demonstrates the longer placement time for axillary thermometers the increase accuracy of the temperature measurement (47), but studies from china and India shows not statistical significant ($P>0.05$)40-41. This may be due to narrow dwelling time (5min with 8min), (6min with 10 min), study subjects were non-febrile (normal) in which the sensitivity of GMT may differ and body temperature may have variation within 10min difference as 10min GMT was taken after 6min with calibration unlike this study.

The study also shows 10min GMT is sensitive than 5min GMT since no mean difference value is below 0.0 in Bland –Altman plot fig.(b) But clinically 5min and 10 min GMT shows no significance difference since mean difference was 0.1367 ± 0.13112 which is less than $0.2^{o}c$. Similarly 5min GMT and 10min GMT shows strong positive correlation($r=0.99$).

The analysis of limits of agreement by Bland-Altman method indicates the 99% CI of the mean difference was 0.10193 and 0.17154 with mean difference of 0.1367. All of the readings were falling within the lines of limits of agreement i.e upper limit of 0.475 and lower limit of -0.2016 except the out liar. 99% CI the mean difference was among 0.1 and above 0.172^{o}c which is not clinically significant difference. Mean difference of 5min and 10 min GMT of neonates' shows clinical significant but this is probably due to few observations. Both GMT 93 of 98 observed records were agreed in specific range of temperature.

When analyzed statistically and clinically 5min GMT with DT no significance difference was observed as $p>0.01$ and mean difference $<0.2^{o}$c respectively. This result was parallel with study conducted in USA regardless of greater fluctuation.(32)Moreover, study in Denmark by Jensen etal and Shanks etal found no significant difference between GMT and DT. (51, 52)

Furthermore the clinical finding or mean difference (0.008) was not statistically significant which is similar with studies conducted in Turkey and surgical and medical ward of Nehru hospital, Chandigarh which found mean difference of 0.02^{o}c and 0.05^{o}F respectively which are not clinically significant.(16, 29)

The correlation analysis result also shows strong positive correlation($r=0.98$) which is analogous with study conducted in Turkey ($r=0.94$) (29) and other studies from USA also shows from 0.748-1.0.(28) Bland-Altman plot of 5min GMT and DT this study demonstrates all of the readings were falling within the lines of limits of agreement i.e upper limit of 0.3816 and lower limit of -0.3979. The 99% CI of the mean difference fall among 0.04826 0.03193 which is not clinically significant. The limit of agreement was 0.008 which is nearest to perfect agreement (0.0). This finding was similar with study conducted in Malaysia found best concordance (limits of agreement) of 0.48–0.59°C. (13) Other study from surgical and medical ward of Nehru hospital, Chandigarh also show best concordance (limits of agreement) 0.05^{o}F. (16)

But one study found GMT and DT was clinically and statistically significant with mean difference of 0.278 and P<0.05. This difference may be due to the route difference since the study was conducted in oral route which is highly influenced the GMT by ingestion of food prior to 30min. (59)

The analysis of 10min GMT and DT of this study shows statistical significance (p<0.000). But the mean difference (0.12857) was not clinical significant or less than 0.2^{o}c. 99% of the mean difference was among 0.10005 and 0.15709. The correlation also shows strong positive correlation (r=0.99) and all the mean difference was also fall in the limit of agreement.

6.2 Strength and Limitation of the study

6.2.1 Strength

Recording the temperature of GMT and DT at the same time and recording 10min GMT without calibration of 5min GMT was some strength of the study.

Randomization of right and left axillary with consecutive study subject for GMT and DT was strength of the study.

Prior to data collection the instruments used were tested their reliability and validity.

Use of multi-dimensional analysis (paired t-test, correlation, Bland-Altman, clinical significance) makes the result more conclusive.

6.2.2. Limitation

The concordance of the instruments were limited for febrile illness so the generality could not include in detecting hypothermia as the study subjects was selected based on their diagnosis.

The study did not use a core temperature as gold standard for comparison.

The clinical significant observed in neonatal was may be related to few observations and the cut point of clinical significant (0.2^{o}c) was not representative (scientific).

6.2 Conclusion and recommendation

6.2.1 Conclusion

The mean difference between 5min GMT and DT was not significant statistically and clinically. Their variation in temperature is not likely to change any clinical decision. Similarly even a statistical significant ($p<0.000$) difference was observed in 5min and 10min GMT, and 10min GMT and DT their mean differences were not clinically significant($<0.2^{o}c$) or do not differ enough to cause problems in clinical interpretation then the device could be used interchangeably. Their correlations were also strong positive correlation($r>0.75$) and all the mean differences among them were fall in the limit of agreement in Bland-Altman plot. As luck of consistent mean difference (homogeneous variation) between GMT and DT was shown and their difference was clinically not significant no compensation for the difference is needed.

Generally the strong correlation, good agreement, clinical insignificant, some important disadvantages of GMT such as danger of breakage, potential harm and toxic vapor effects; difficulties in reading the values on the device; and possible role in spread of hospital acquired infections, long dwelling time and some important advantage of DT such as rapid result delivery, improved patient comfort, being an easy and noninvasive procedure makes DT good alternative to the traditional glass mercury thermometer.

6.2.2 Recommendation

Health professionals should use DT for measuring body temperature in under-5 febrile illness except for neonate.

Further researchers study the instruments in neonatal as clinical significance is different from the present study and the age groups were few and the sensitivity may different from other since their skin integrity is different. Similarly their concordance in detecting hypothermia should be investigated since the sensitivity may differ.

Moreover researchers should repeat the study by using core temperature as gold standard for comparison.

REFERENCES

1. Shaheed.J, Rahman N, Kasem FB, Islam MR, Sultana R, A.M: Comparison Between Mercury and Liquid Crystal Forehead Thermometers for Measurment of Body Temperature. Suhrawardy Med Coll. 2012;4(2):60-1.
2. Holtzclaw, B.J Circadian rhythmicity and homeostatic stability in thermoregulation. Biological Research for Nursing, 2001;2:221-35.
3. Abyot Bekele Woyessa, Worknesh Ayele, Abdi Ahimed, Nega: A. Investigation of acute febrile illness outbreakAsyaita and Dupti districts, Afar Region, Ethiopia. bmj. February 2011;9(Suppl 1):46.
4. World Health Organization (WHO) Department of Child and Adolescent Health and Development (CAH). Technical seminar - other causes of fever, 1-5.
5. Ng D, Lam J, Chow K. Childhood fever revisited. Hong Kong Medical journal= Xianggang yi xue za zhi/Hong Kong Academy of Medicine. 2002;8(1):39.
6. Çultu Ö, Yildirim I, Ceyhan M, Korkmaz A, Yurdakök M, Karaagaoglu E, et al. Comparing body temperature measurements by Mothers and physicians using mercury-in-glass, digital mercury and infrared tympanic membrane thermometers in healthy newborn babies. Turk J Pediatr. 2008;50:354-8.
7. Zeal JD, Consultants C: ThermoSpot-a non-invasive hypothermia indicator for neonates, infants and children.
8. Mehreen Adhi, Rabia Hasan, Fatima Noman, Syed Faisal Mahmood, Anwar Naqvi, Adib-ul-Hasan Rizvi: Range for Normal Body Temperature in the General Population of Pakistan, 2008;58(10).
9. Märtha Sund-Levander: Measurement and Evaluation of Body Temperature, Implications for Clinical Practice. [dessertation]. 2004(872).
10. Bailey J, Rose P. Axillary and tympanic membrane temperature recording in the preterm neonate: a comparative study. Journal of advanced nursing. 2001;34(4):465-74.
11. Chung W, Chen C. Evaluation of performance and uncertainty of infrared tympanic thermometers. Sensors. 2010;10(4):3073-89.
12. El-Radhi A, Barry W. Thermometry in paediatric practice. Archives of disease in childhood. 2006;91(4):351-6.

13. Fadzil FM, Choon D, Arumugam K. A comparative study on the accuracy of noninvasive thermometers, Australian family physician. 2010;39(4):237-9.
14. Devrim I, Kara A, Ceyhan M, Tezer H, Uludağ AK, Cengiz AB, et al. Measurement accuracy of fever by tympanic and axillary thermometry. Pediatr Emerg Care. 2007;23(1):16-9.
15. Benkovich N, Farrell BC, Nimunkar A, Baran J, Webster JG. Low Cost Digital Thermometer. 2009.
16. Dolkar R, Kapoor S, Singh NV, Suri V. A comparative study on the recording of temperature by the clinical mercury thermometer and digital thermometer, Nursing and Midwifery Research, 2013;9(1):40-6.
17. Gasim GI, Musa IR, Abdien MT, Adam I. Accuracy of tympanic temperature measurement using an infrared tympanic membrane thermometer, BMC research notes, 2013;6(1):194.
18. ByadMinon, editor. Best Infant Thermometers,Tympanic Thermometersk, August 17, 2013.
19. Y vonne M. Shevchuk B, PharMD, FCSHP. chapter-9 fever.85-92.
20. Pušnik I, Miklavec A. Dilemmas in measurement of human body temperature. Instrumentation Science and Technology, 2009;37(5):516-30.
21. Schmitz T, Bair N, Falk M, Levine C. A comparison of five methods of temperature measurement in febrile intensive care patients, American journal of critical care. 1995;4(4):286-92.
22. McCallum L, Higgins D. Measuring body temperature, Nursing Times. 2012;108(45):20-2.
23. Jeanette Grady. Nursing Procedure: Measuring and Monitoring Temperature in the Highly Dependent or Critically Ill Infant or Child – Axilla temperature review
24. Smith LS. Reexamining age, race, site, and thermometer type as variables affecting temperature measurement in adults–A comparison study. BMC nursing. 2003;2(1):1.
25. Elizabeth Bridges and Karen Thomas Noninvasive measurement of Body Temperature in Critically Ill. CriticalCareNurse. JUNE 2009;29(3):97-.
26. Rosenthal HM, A. L. Measuring temperature of NICU patients-A comparison of three devices. J Neonatal Nurs. 2006;12:125–9.
27. Khorshid L, Eşer İ, Zaybak A, Yapucu Ü. Comparing Mercury‐in‐glass, tympanic and disposable thermometers in measuring body temperature in healthy young people. Journal of clinical nursing. 2005;14(4):496-500.

28. Sganga A, Wallace R, Kiehl E, Irving T, Witter L. A comparison of four methods of normal newborn temperature measurement. MCN: The American Journal of Maternal/Child Nursing. 2000;25(2):76-9.
29. Uslu S, Ozdemir H, Bulbul A, Comert S, Bolat F, Can E, et al. A comparison of different methods of temperature measurements in sick newborns, Journal of tropical pediatrics. 2011;57(6):418-23.
30. Arslan GG, Eser I, Khorshid L. Analysis of the effect of lying on the ear on body temperature measurement using a tympanic thermometer Analysis, 2011.
31. Cassandra Sutton S, Year 2 Issue: Oral versus axilla temperature measurement [a review of the evidence]. Tasmania: Tasmanian School of Nursing Nuritinga 1999.
32. Davies, S.P, Kassab, J.Y., T hrush, A.J. aS, et al. A comparison of mercuryand digitalclinical the rmomete rs. J A dvancedNurs,. 2006;11(5):535-43.
33. Lawson L, Bridges EJ, Ballou I, Eraker R, Greco S, Shively J, et al. Accuracy and precision of noninvasive temperature measurement in adult intensive care patients. American journal of critical care. 2007;16(5):485-96.
34. Cutter J. Recording patient temperature--are we getting it right? Professional nurse (London, England). 1994;9(9):608-10, 12, 15-6.
35. Potter PA, Perry AG, Hall A, Stockert Patricia A. Fundamentals of nursing: Elsevier Mosby; 2009.
36. Fulbrook P. Core temperature measurement in adults: a literature review. Journal of advanced nursing. 1993;18(9):1451-60.
37. Ulusoy MF & Go¨rgu ¨lu ¨ R. Hems¸irelik Esasları-Temel Kuram Kavram_ Ilke ve Yo ¨ntemler, Cilt TDFO Ltd S¸ti,Ankara,. 1996;1(2. bs. 72):151-3.
38. Haddadin R. Study between axillary and rectal temperature measurements in children. Eastern Mediterranean health journal. 2007;13(5):1060-6.
39. Roy AS, Chowdhury T, Bandhopadhya D, Ghosh G. Time required to document temperature by electronic skin thermometer in a healthy neonate. Indian pediatrics. 2009;46(12):1103.
40. Deorari A. Neonatal hypothermia In Newborn Care Practice and Care Settings. 2004:65-71.
41. Yu-qin Z. sududy on accuracy of three different time to obtain readings in measuring axillary temperature. Journal of Clinical Nursing. 2007;1.

42. Chaturvedi D, Vilhekar K, Chaturvedi P, Bharambe M. Comparison of axillary temperature with rectal or oral temperature and determination of optimum placement time in children. Indian pediatrics, 2004;41(6):600-4.
43. Greyling G, Viljoen M, Joubert G. Axillary temperature compared to tympanic membrane temperature in children] Curationis, 2000;23(3):54.
44. JI He Journal Editorial Staff of Henan University Kaifeng KaiFeng 475001, China. The Study on Different time to Take Temperature in Axillary, China Foreign Medical Treatment. ;2009;29.
45. Sheng L, Heping C, Qinfang Z. Probe into measuring time of auxillary temperature for patients,Chinese General Nursing. 2008;33:002.
46. Li Shu-Ying, Lin Min, Huang Cai-hui. Research and practice of axillary temperature measurement at interval. Journal of Henan University(Medical Science), 2012;01.
47. Craig JV, Lancaster GA, Wasiamson PR, Smyth RL. Temperature measured at the axilla compared with rectum in children and young people: systematic review. BMJ: British Medical Journal, 2000;320(7243):1174.
48. Leick-Rude. MK, LF: B. "A comparison of temperature-taking methods in neonates",. Neonatal Network August, 1998;17(5): 21-37.
49. Replacing Mercury-in-Glass Thermometers in ASTM Test Methods, editor. November/December 2009.
50. Dollberg S, Lahav S, FB: M. Precision of a new thermometer for rapid rectal temperature measurement in neonates. AM J Perinatol, 2001;18:103-5.
51. J ense n, B.N , J ense n, F.S , Madse n, S.N , A, K: Accuracy of digital tympanic,oral, axillary, and rectal thermometers compared with standard rectal mercury thermometers Euro J Surg ery, 2003;16 6(11):848-51.
52. Shanks NJ, Lambourne,A.,Morton,C., etal.: Comparison of accuracy of digital and standard mercury thermometers , Brit Med J.287(6401):1263.
53. Davies SP, Thrush AJ, BA PH. A comparison of mercury and digital clinical thermometers. Journal of advanced nursing, 1986;11(5):535-43.
54. Leick-Rude M, Bloom L. A comparison of temperature-taking methods in neonates. Neonatal network: NN, 1998;17(5):21-37.

55. Imani R, Salehi S, Habibian R, Sadeghi B, Hatamipour K. Comparative Study of measuring Body Temperature by Mercury and Digital Thermometer. Iran Journal of Nursing. 2009;21(56):9-16.
56. Chand MS. A comparative study on difference in manual and electronic recording of vital signs in patients admitted in CTVS-ICU and CCU of advanced cardiac centre at PGIMER. 2010;11.
57. Latman NS, Hans P, Nicholson L, Zint SD, Lewis K, Shirey A. Evaluation of clinical thermometers for accuracy and reliability. Biomedical instrumentation & technology. 2001;35(4):259-65.
58. Ratchada Kitsommart, Phatthanasiriwetin: S. Accuracy and Precision of Digital Thermometer in Neonatal Temperature measurement Siriraj Med J. 2005;57(5):126-30.
59. Dowding D, Freeman S, Nimmo S, Smith D, Wisniewski M. An investigation into the accuracy of different types of thermometers. Professional nurse (London, England). 2002;18(3):166.
60. McKenzie NE. Evaluation of a new, wearable, precision phase-change thermometer in neonates. Pediatric nursing. 2002;29(2):117-25.
61. Wikipedia, encyclopedia tf. National Statistics-population-2011 by town and sex. 2011 [cited 2014].
62. Climate: Aksum - Climate graph, Temperature graph, Climate table [database on the Internet]. Climate-Data.org. 2013- [cited 1/1/2014].
63. World Health Organization, (WHO), editors. integrated management of newborn and childhoodillness(IMNCI) chart booklet for health workers. addis ababa: federal ministry of health 2008.
64. Yetman RJ, Coody DK, West MS, Montgomery D, Brown M. Comparison of temperature measurements by an aural infrared thermometer with measurements by traditional rectal and axillary techniques. The Journal of pediatrics. 1993;122(5):769-73.

ANEXESS
Annex I: Protocols for Use of Each Thermometer

Zeal National Health Service MGT

1. Ensure the mercury is in the bulb of the thermometer
2. Place the thermometer tip midpoint in the axilla; ensure the child's arm is held firmly against that side of the body for the full duration of the procedure.
3. Using the stop clock time the procedure, leave the thermometer in place for 5 or 10Min
4. Remove the 5Min thermometer and record the temperature
5. While the thermometer is in site, perform the other recording.

Becto-Dickinson DT

1. Activate the unite by pressing the on button

2. Place the thermometer tip midpoint in the axilla; ensure the child's arm is held firmly against that side of the body for the full duration of the procedure.

3. When the display stops flashing the buzzer beep indicating that the peak temperature has been reached

4. Remove the thermometer and record the temperature.

Annex II: Information Sheet English Version

Addis Ababa University, College of Health Sciences, School of Allied Health Sciences,

Department of Nursing and Midwifery

This questionnaire is prepared to Compare Body Temperature among 5Min Mercury, 10Minite Mercury and Digital Thermometers among Under-5 Children with Febrile Illness using Axillary Site.

Hello, my name is_____ I am here today to measure your Child Body Temperature using Mercury and Digital Thermometers. The study is being conducted by Hadgu Gerensea from Addis Ababa University, College of Health Sciences, School of Allied Health Sciences, Department of Nursing and Midwifery, Post Graduate Program Student in Pediatrics and Child Health Nursing. The objective of this study is to Compare Body Temperature among 5Min Mercury, 10Minite Mercury and Digital Thermometers among Under-5 Children with Febrile Illness using Axillary Site.

I request you to participate yours child in this study. Your cooperation and willingness is greatly helpful in Comparing body temperature among 5Min mercury, 10Minite mercury and digital thermometers. The study was conducted through interview and measuring body temperature for about 15 Min. Your Child's name was not be written in this form and was never be used in connection with any information you tell us.

There is no possible risk associated with participating in this study except the time spent for responding to the questionnaire and risk of irritation. All information given by you was kept strictly confidential, your participation is voluntary and you are not obligated to participate you do not want to participate. If you feel discomfort with the interview and body temperature measurement, it is your right to discontinue at any time you want. If you have questions regarding this study or would like to be informed of the results after its completion, please feel free to contact the principal investigator.

Address of the Principal Investigator

Name: Hadgu Gerensea Gebre Cell –Phone: +251-914 -38- 8918

E–Mail: hadguellen1@gmail.com

Are you willing to participate in this study?

1. Yes ---------- Continue to the next page
2. No ---------- Skip to the next participants

Annex III: Questionnaires English Version

Addis Ababa University, College of Health Sciences, School of Allied Health Sciences,

Department of Nursing and Midwifery

Instruction:

This questionnaire is developed to compare body temperature among 5Min mercury, 10Min mercury and digital thermometers among Under-5 Children with febrile illness using axillary site. It has 2 parts. Part-one: Socio-Demographic Characteristics of Child and part-two: Results of Body Temperature. Tick (✓) specific answer for those questions that have box in front and fill the space provided for each questions.

1. Name of Health Institution: Axum St. Marry hospital
2. Date: ------/---------/----------
3. Name of service delivery: Under- 5 children OPD
4. Time: Morning ☐ Afternoon: ☐
5. Daily Environmental temperature: _____

Part-One

1. Socio-demographic Characteristics

1. Code Number: _____
2. Age in: Year ☐ Month ☐ Week ☐
3. Sex: Male ☐ Female ☐
4. Address: _____
5. Religion: Orthodox ☐ Muslim ☐ Protestant ☐ Other ☐
5. Diagnosis: _____
5. Source of History: Mother ☐ Father ☐ Sister/Brother ☐
   Servant ☐ other ☐
6. Taking Antipyretic Medication: Yes ☐ No ☐
7. Taking Bath with in 30Min: Yes ☐ No ☐

Part-Two

2. Results of Body Temperatures

Time of Taking Body Temperature Measurement: _____Hr_____Min

1. Right Axillary Glass Mercury:

5Min _____ºC, 10Min _____ ºC and Left Digital: _____ ºC

Or

2. Left Axillary Glass Mercury:

5Min _____ ºC, 10Min _____ºC and Right Digital: _____ ºC

Annex IV: Information Sheet Tigrigna Version

ኣዲስ ኣበባ ዩኒቨርሲቲ
ኮሌጅ ጥዕና ሳይንስ፤ ክፍሊ ትምህርቲ ነርሲንግን ሚድዋይፈርን

እዚ ኣብ ክልል ትግራይ ከተማ ኣኽሱም ቅዱስት ማርያም ሆስፒታል ኣብ ትሕቲ 5 ዓመት ህፃናት ሙቐት ንምልካዕ ዝጠቕሙ መሳርሒ ንምውድዳር ንዝካየድ መ ፅናዕቲ ዝተዳለወ መ ሕተቲ ቐጥዒ እዩ።

ኣነ ሽመይ----------ይበሃል። ሎሚ እዚ ኣብዚ ዝመፃኹሉ ምክንያት ኣብ ህፃናት ሙቐት ንምልካዕ ዝጠቕሙ መሳርሕታት ንምውድዳር ንዝግበር መፅናዕቲ ሐበሬታ ንምእካብ እዩ። እቲ ፅንዓት ዝካየድ ብሓድጉ ገረንሰአ እንትኸውን ኣብ ኣዲስ ኣበባ ዩኒቨርሲቲ ክፍሊ ትምህርቲ ነርሲንግ ናይ ካልኣይ ዲግሪ ተምሃራይ ብናይ ህፃናት ሕክምና ነርሲነግ እዩ። ዓላማ ናይዚ መፅናዕቲ ኣብ ትሕቲ 5 ዓመት ህፃናት ሙቐት ንምልካዕ ዝጠቕሙ መሳርሕታት ንምውድዳር እዩ። ኣብዚ መፅናዕቲ ባዕልኽን/ኩም ኮነ ዉላድኽን/ኩም ንክትሳተፉን ትክክለኛ ሓበሬታ ክትህባን/ቡን ብትሕትና ይሓትት። ናትክን/ኩም ምትሕብባር ኣብዚ ዝግበር መፅናዕቲ ኣዝዩ ጠቓሚ እዩ። እዚ መፅናዕቲ ብቃለ መሕትትን ምልካዕን ዝካየድ ኮይኑ ንኣስታት 15 ደቒቓ ግዜኽን/ኩም መስዋእቲ ንክትገብሩለይ ብትሕትና ይሓትት። ኩሉ ክይዲ ምምላእን ዝሃብክምዎ ሐበሬታን ብምስጢር ዝተሓዝ ምኺኑ ከረጋግፅ ይፈቱ። ከምኡውን ናይ ውልቀ ሰባት መልሲ ዝተሓዝ መሕተቲ ቐጥዑ ዝፍለይ ብዝወሃብ ፍሉይ ቁፅሪ ክኽውን ከሎ ናይ ውልቀ ሰብ ሽም ይኹን ኣድራሻ ኣይተሓዝን። ውፅኢት እውን ዝግለፅ ናይ ኩሉ ተሓታታይ ተጠቓሊሉ እምበር ናይ ውልቀ ሰባት ዉፅኢት ኣይኮነን።

እዚ ቃለ መሕትት ኣብ ዴሌት ዝተመስረተ ጥራሕ ብምኻኑ ኣብዚ ሕቶን መልስን ሙቀት ምልካዕን ብምስታፍኩም ኮነ ብዘይምስታፍኩም ኣብ ቀፃሊ ኣብ ባዕልኩም ኮነ ኣብ ዉላድኩም ዝፈጥሮ ምንም ዓይነት ፅዕንቶ ከምዘየለ ከረጋግፅ ይፈቱ። እቲ ቃለ መሕትት እንተዘይተመዝዩኩም ኣብ ዝኮነ እዋን ናይ ምቁራፅ መሰልኩም ዝተሓለወ እዩ። እዚ መፅናዕቲ ብዝምልከት ሕቶ እንተሃሊዩኩም ወይ ድማ ናይዚ መፅናዕቲ ውፅኢት ክፈልጡ እንተደሊኩም ከይተሰከፍኩም ንበዓል ዋና እዚ መፅናዕቲ ብዝስዕብ ኣድራሻ ምጥያቕ ይከኣል እዩ።

ኣድራሻ በዓል ዋና ናይዚ መፅናዕቲ፦

ሽም፡ ሓድጉ ገረንሰአ ቁፅሪ ስልኪ ሞባይል ፡ +251-914- 38-8918

ኢ-ሜይል: hadguellen1@gmail.com

እዚ ፈሊጠን ንምስታፍ ፍቃደኛ ድዩን?

1. እወ---------- ናብ ዝቐፅል ገፅ ቀፅል/ሊ

2. ኣይፋለይን----------ናብ ዝቐፅል ተሳታፋይ ቀፅል/ሊ

DECLARATION

I, the undersigned, declare that this is my original work and has never been presented in this or any other University and that all the source materials used for this thesis have been duly acknowledged;

Name: _____

Signature: _____

Place: _____

Date of Submission: _____

The thesis has been submitted for examination with my approval as a University advisor.

Name: _____

Signature: _____

Date: _____