Vol. 20(6), pp. 79-84, June 2021
DOI: 10.5897/AJMHS2021.0160
Article Number: E72A18367105
ISSN: 2384-5589

http://www.academicjournals.org/AJMHS

African Journal of Medical and Health Sciences

Full Length Research Paper

Utility of temperature measurement using non-contact infrared thermometer in detecting elevated temperature as an infection control measure in the era of Covid-19

Babatunde Adewale*, Toyosi Raheem, Kazeem Osuolale, Emelda Chukwu, Gideon Liboro4, Ebenezer Odewale, Leona Okoli and Oliver Ezechi

Nigerian Institute of Medical Research, Nigeria.

Received 9 March, 2021; Accepted 11 May, 2021

The pandemic nature of the corona virus diseases that emerged at the end of year 2019 (COVID-19) is a major global health concern worldwide. Since high body temperature is a core symptom of the disease, the use of non-contact infrared thermometer for the detection of people with elevated temperature has become one of the measures for infection control as this will identify people that are likely to be incubating the virus at the points of entry into countries. This study assessed the correlation between elevated body temperatures and being positive to COVID-19 test using reverse transcription polymerase chain reaction (RT-PCR). A cross-sectional study of consented individuals whose temperatures were assessed using non-contact infrared thermometer. Nasopharyngeal and oropharyngeal swab samples were collected and analysed in the laboratory using the RT-PCR. Among the 2160 participants tested 46.9% were males while the rest were females. Of these, 69 (3.2%) were positive to COVID-19 test. Among the total number of participants, 53 (2.3%) had elevated body temperature and 5 of the people with elevated body temperature were positive to test. All participants positive to test fulfilled the Nigeria Centre for Disease Control (NCDC) eligibility criteria. There was no significant relationship between elevated body temperature and SARS-CoV-2 infection. This study gives credence to the fact that asymptomatic transmission plays a role in the overall incidence of COVID-19. Therefore, anybody entering a public place even with normal body temperature must be made to comply with non-pharmaceutical interventions as an infection control measure.

Key words: COVID-19, temperature, reverse transcription polymerase chain reaction (RT-PCR), infrared thermometer, nasopharyngeal, oropharyngeal

INTRODUCTION

In December 2019, a cluster of patients in Wuhan City China were diagnosed with pneumonia of unknown cause. Those set of patients were subsequently reported to have a novel coronavirus infection revealed through severe acute respiratory syndrome SARS-CoV-2 (Baj et al., 2020). Corona viruses (CoVs) have been traditionally considered non-lethal pathogens to humans, mainly causing approximately 15% of common colds (de Wit et al., 2016). However, in this century, we have earlier encountered highly pathogenic human CoVs twice that is,

*Corresponding author. E-mail: badewale@hotmail.com.

SARS – CoV and MERS-CoV, which caused an outbreak originally in China in 2003 and Saudi Arabia in 2012, respectively, and later spread to many other countries with horrible morbidity and mortality (Paules et al., 2020). Therefore, the current COVID-19 is the third CoV outbreak in the recorded history of humans (Ye et al., 2020).

Subsequent to the outbreak of COVID-19, the disease has since spread to almost all countries of the world and it was declared a global pandemic by World Health Organisation on 11th March, 2020 (Baj et al., 2020; Cucinotta and Vanelli, 2020). Efforts have been made by the global community to contain the virus through infection control practices such as hand hygiene, use of Personal Protective Equipment (PPE) and social distancing. In addition, a number of screening modalities have been adopted to flag possible suspects of infection. A key component of this infection control measure involves the use of temperature measuring devices to identify individuals who will be eligible for SARS CoV-2 testing.

The non-contact infrared thermometer is one of the screening tools deployed for use in public settings. Nigerian Institute of Medical Research (NIMR) is one of the designated centres in the country where testing is performed for the novel corona virus. The Institute is also a leading centre for the care and treatment of other leading infectious diseases such as TB and HIV/AIDS. It is therefore imperative to ensure that infection control measures are deployed in order to ensure that patients who already have pre-existing medical conditions and their care-givers are protected from the novel corona virus.

The year 2014 experience with the Ebola Virus Disease (EVD) outbreak in Sierra Leone showed that women with fever and other self-reported symptoms and complications were found to be more likely to test positive for EVD infection (Mpofu et al., 2019). Unlike EVD the other symptoms of COVID-19 are similar to those of malaria and a number of other infectious diseases. Therefore, this study assessed the proportion of people with elevated body temperature (fever) using the non-contact infrared thermometer at the frontal part of the head and those that became eligible for COVID-19 test thereby determining the usefulness of the temperature as a criterion for the eligibility for COVID-19 test for identification of infected people.

MATERIALS AND METHODS

Study site and design

The study site was NIMR a leading national institute located in central part of Lagos and has many research and non-research Departments. It has clinics offering clinical services and laboratories for research and diagnosis of infectious diseases such as TB and HIV/AIDS. It accommodates staff, non-staff and visitors who usually enter and exit the Institute either by driving or walking through every day of the week. The Institute has about 300 members of staff while many visitors and patients come into the Institute for one reason or the other. This was a cross sectional study for measuring the prevalence of COVID-19 infection among individuals. Data were collected from March 31, 2020 to April 30, 2020. Trained data collectors measured the body temperature of participants entering NIMR premises after obtaining verbal consent from participants. Standard questionnaires were administered. Demographic data of participants were recorded. The temperature measurement was performed using the non-contact infrared thermometer, and the readings were recorded. The participants were offered hand sanitizer on the palm before being allowed into the Institute.

Study population

Study participants were recruited among visitors to the Institute during the COVID-19 pandemic and lock down order in Lagos State, Nigeria. Consented participants had their temperatures taken using infra-red non-contact digital gun thermometer followed by collection of nasopharyngeal and oropharyngeal swabs collection for COVID-19 diagnosis.

Procedure

Validated trained data collectors obtained informed consent of participants before taking temperature measurement and collection of bio-data. Non-contact Infra-red thermometer (Imose, model™ IM-201-IT accuracy +/-0.3) was used for the temperature measurement as described in the thermometer's user manual. The distance-to-spot ratio of 3-5 cm was maintained and the temperature measurement was done by pointing the detector head of the thermometer to the fore head of participants (Hsiao et al., 2020) and pressed the measurement key on the thermometer. Within a second, the tester quickly measured the body temperature. Average of two measurements was taken. The thermometer has a measuring range of 34-42.9°C at an ambient temperature of 0-42°C. The cut-off of normal body temperature point was set at 36.1 to 37.9°C (Baj et al., 2020). The battery of the thermometer was replaced once there was a low battery warning by the instrument. The measuring area was the area of the forehead not covered by hair. Information on age, gender and reasons for the visit was recorded using an approved questionnaire. Participants with elevated temperature were referred to a clinician for further clinical evaluations. Eligible participants were referred for COVID-19 testing according to NCDC criteria.

Procedure for COVID 19 sample collection

Health personnel responsible for sample collection were provided and kited with full personal protective equipment (PPE), collected the request form and checked that the codes on the bottles correspond with the code on the form. The patient was asked if there was any medical concern in the Nasopharyngeal or Oropharyngeal passage ways such as nasal obstruction etc. Precautions were taken based on the information provided by the patient. A new and sterile swab stick was inserted into the nose of the patient to reach post-nasal pharynx. The swab was rotated at the nasopharynx for like five times gently and removed the swab. The same hydra flocked swab was used for the other nose but a new hydra flocked swab was used for the Oropharyngeal sample collection.

For Oropharynx, the patient's head was slightly tilted backwards, the mouth widely opened and the tongue out. The tonsil patches was swiped gently with the plastic hydra flocked swab and also the Oropharynx was gently scrubbed with the same swab. The swab stick was immediately inserted into the VTM bottle. The swab stick

Table 1. Socio-demographic characteristics of respondents.

Characteristics	N	%	Mean±SD
Gender			
Female	1147	53.1	
Male	1013	46.9	
Total	2160	100	$39.4^{\pm}11.5$
COVID-19 results			
Negative	2091	96.8	
Positive	69	3.2	

was cut at the joint close to the cotton bud. The sample was placed in a cold chain container and transported to Molecular Laboratory for further investigation. The COVID-19 test was done in the Institute using the Reverse Transcription Polymerase Chain Reaction (RT-PCR). The RT-PCR COVID-19 test was free.

Sample size

The minimum number of the sample size for the study was calculated using the formula (Suresh et al., 2020).

$$\mathrm{n} = \frac{z^2 p(1-p)}{d^2}$$

where n is the sample size, z is the selected critical value of desired confidence level for a two-tailed test and it is equal to 1.96, p is the estimated prevalence set at 5% and d is the desired level of precision given by 1.5%.

$$\mathrm{n} = \frac{1.96^2 0.05(1-0.05)}{(0.015)^2} = 811.004$$

The required minimum sample size for this study was approximated to 815 participants.

Ethical clearance

Expedited approval from NIMR IRB was requested for the study protocol. Written informed consent was waived while verbal consent of each participant was taken because of the pandemic nature of the disease and the high clinical importance. Also, the study was classified as such that did not expose the participants to more than minimal risk. Informed consent of participants was taken before the collection of samples for laboratory testing for those that are eligible for the COVID-19 test. Samples were privately collected from participants for privacy and confidentiality of information given after consent was voluntarily given. Information was entered into the computer without identifiers and the file was password protected.

Data management

Data entry and analysis: The data was compiled using Excel spread sheet, cleaned and analysed using SPSS version 23 statistical tool. Descriptive statistics such as frequency count, mean and percentage were used to describe the overall data collected from the participants. Proportion of the participants with abnormal temperature was estimated as well as the proportion of those participants that are eligible for testing for COVID-19. Pearson's correlation coefficient was used to analyse the relationship between the COVID-19 test outcome and NCDC eligibility criteria and p-value < 0.05 was considered to be statistically significant.

RESULTS

A total of 2,160 participants were recruited (Female, 53.1%; Male, 46.9%) which was higher than the minimum sample size calculated. The mean age of the participants was 39.4± 11.5. They all had their nasopharyngeal and Oropharyngeal samples collected for the test. Among these participants, 69 (3.2%) were positive for the SARS-CoV-2 infection using the Reverse Transcription Polymerase Chain Reaction (Table 1).

The temperature readings taken from the frontal part of the head ranged from 36 to 39.8°C (Figure 1). Among the participants, 53 (2.5%) had elevated temperature above the cut off for the normal temperature which gave a proportion of 0.025 among the total number of participants. The mean of the elevated temperature was 38.5 ± 0.4. Five (9.4%) among the participants with the elevated temperature were positive while the others were negative to test. The mean of the temperature of those positive was 38.5 ± 0.3 while the mean of those negative was 38.5±0.4°C. The proportion of participants with elevated temperature that were positive to test among the total number of participants was 0.002. Of the total number of participants, 624 fulfilled the NCDC criteria while the rest were those that were interested in knowing their COVID-19 status. While 10.7% (69) of those that fulfilled NCDC criteria were positive, there was none positive among those who did not fulfil the criteria and 0.9% (14) had elevated temperature. The proportion of those with elevated temperature among positive participants was 7.2% (5) while the rest positive had normal temperature (Table 2). There was a low positive relationship between the participants with elevated temperature that were eligible for COVID-19 test and those that were positive (0.21) and this implied that as more participants were recruited into the study, the test outcome being positive would be higher while the test outcome being negative would be lower based on (elevated temperature) the temperature data obtained in the study. However, the correlation coefficient is not significant at 0.05 level (p=0.05) which implies no significant difference in the two groups (Table 3).

DISCUSSION

In Nigeria three main categories of people are focused on for the criteria to qualify for testing for COVID-19. These are people that fulfil the following three criteria after the initial non-invasive screening using the non-contact thermometer and questionnaire for screening. These set

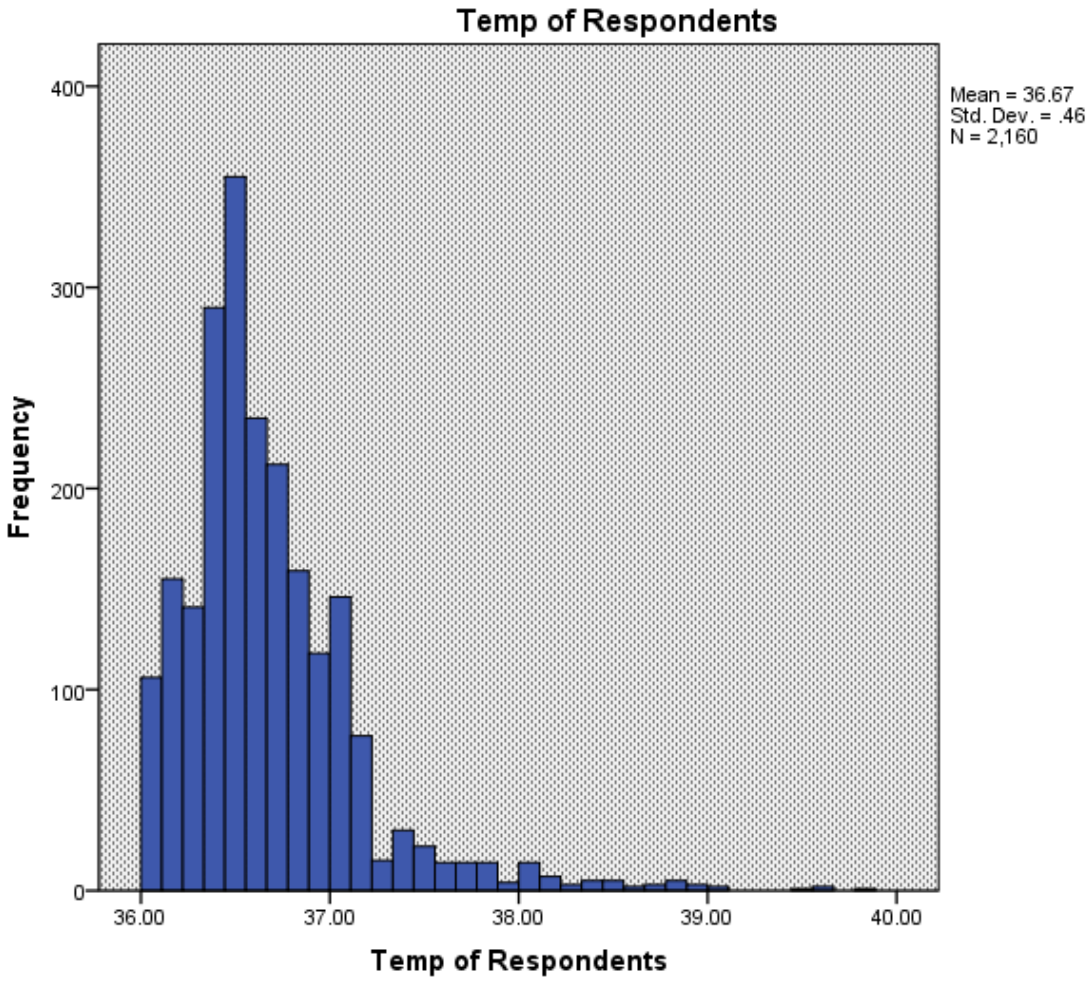

Figure 1. Showing the range of temperature of all participants.

Table 2. Proportion and other measures using temperature data.

Participants'	Temperature readings (N=2160)		Measures	CI (°C)
	n (%)	P	Mean ± SD	
Participants with elevated temperature	53 (2.3)	0.023	38.5 ±0.4	38.4 – 38.6
Participants with elevated temperature and positive results	5 (9.4)	0.094	38.5 ± 0.3	38.2 - 38.6
Participants with elevated temperature and negative results	48 (90.6)	0.906	38.5 ± 0.4	38.4 – 38.6

of people are: Contacts of confirmed cases, Residents in areas of moderate – high prevalence of COVID - 19, and recent returnees. Though fever has been highlighted as one of the symptoms of COVID-19, this study has not shown any correlation with elevated body temperature and positivity for SARS-CoV-2 infection. There was no significant relationship between elevated body temperature and SARS-CoV-2 infection. The proportion of people that were positive from the people with elevated body temperature showed that approximately 1 out of every 10 people with elevated body temperature will be positive for infection. The proportion of people with elevated body temperature in the total population sampled that were positive may not be a reflection of the prevalence of COVID-19 infection in the population, although this could give credence to the fact that asymptomatic transmission played role in the epidemic overall incidence of the disease (Bwire and Paulo, 2019). This may be connected to the rate of awareness for people to come for testing or the availability of testing facility for the people despite the fact that testing is free. This is in contrast to the prevalence observed by Hoehl et

Table 3. Relationship between the COVID-19 test outcome and NCDC eligibility criteria.

Characteristics	NCDC Criteria (624)	Non NCDC criteria (1536)
Results		
Negative	555	1536
Positive	69	-
Elevated temperature	39	14
Negative	34	14
Positive	5	-
Normal temperature	585	1522
Negative	521	
Positive	64	
Pearson's correlation coefficient (r): Participants with NCDC criteria and participants without positive results	p-value	Remark
0.05	0.21	r is not significant at 0.05 level

al. (2020) who reported that 2 out of 114 travellers (1.8%) from Wuhan, China, who had passed the symptom-based screening tested positive for COVID-19 by RT-PCR. Though, the proportion found in the present study is lower than the Wuhan travellers, taking into cognizance of the factor that Nigeria is the largest black nation with a proportion of more than 200 million people and with about 3.1% elderly population which translates to about 6.4 million people aged >65 years that are at risk of this infection. This is aside from other vulnerable populations such as those with pre-existing underlying health conditions like diabetes, high blood pressure, other cardiovascular diseases, and cancers (Ohia et al., 2020) Currently, the case fatality ratio of COVID-19 infection in Nigeria is 0.03% (3% of total confirmed cases) which is lower than that calculated from global figures (CFR=0.06) (Ohia et al., 2020). The actual numbers of people infected are unknown as apparently healthy people are not tested unless they fulfil the criteria set by the Nigeria Centre for Disease Control (NCDC). The current evidence showed that people without elevated temperature could be incubating the virus and could serve as a means of contracting the infection. Though people with symptoms such as coughing or sneezing are more likely to be identified easily, the proportion of people with elevated temperature who are infected among the total number of participants is quite minimal pointing to the fact that elevated temperature plays only a minor role in the identification of people who could likely be a potential carrier of the virus.

Conclusion

The study showed a low correlation between elevated body temperature and positivity to SARS-Cov-2 infection. This study revealed that there is relationship between test outcome and NCDC eligibility criteria though elevated body temperature among other factors used in the selection of the participants that could be positive for infection may not be adequate even as indicator of infection prevention and control measures. This is because there were participants with normal body temperature yet were positive for SARS CoV-2 infection. Therefore, as a matter of policy anybody entering a public place even with normal body temperature must be made to comply with non-pharmaceutical interventions as an infection control measure.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ACKNOWLEDGEMENTS

The authors appreciate the support of the management of Nigerian Institute of Medical Research and the cooperation of all the study participants during the study.

REFERENCES

Baj J, Karakuła-Juchnowicz H, Teresinski G, Buszewicz G, Ciesielka M, Sitarz E, Forma A, Karakuła K, Flieger W, Portincasa P, Maciejewski R (2020). COVID-19: Specific and Non-Specific Clinical Manifestations and Symptoms: The Current State of Knowledge. Journal of Clinical Medicine 9:1753 doi:10.3390/jcm9061753

Bwire GM, Paulo LS (2019). Coronavirus disease-2019: is fever an adequate screening for the returning travelers? Tropical Medicine and Health 48:14.

Cucinotta D, Vanelli M (2020). WHO declares COVID-19 a pandemic. Acta Bio Medica: Atenei Parmensis 91(1):157.

de Wit E, van Doremalen N, Falzarano D, Munster VJ (2016). SARS and MERS: recent insights into emerging coronaviruses. Nature Reviews Microbiology 14(8):523.

Hoehl S, Rabenau H, Berger A, Kortenbusch M, Cinatl J, Bojkova D, Ciesek S (2020). Evidence of SARS-CoV-2 infection in returning travelers from Wuhan, China. New England Journal of Medicine 382(13):1278-1280.

Hsiao SH, Chen TC, Chien HC, Yang CJ, Chen YH (2020). Measurement of body temperature to prevent pandemic COVID-19 in hospitals in Taiwan: repeated measurement is necessary. Journal of Hospital Infection 105(2):360-361.

Mpofu JJ, Soud F, Lyman M, Koroma AP, Morof D, Ellington S, Kargbo SS, Callaghan W (2019). Clinical presentation of pregnant women in isolation units for Ebola virus disease in Sierra Leone, 2014. International Journal of Gynaecology and Obstetrics 145(1):76-82.

Ohia C, Bakarey AS, Ahmad T (2020). COVID-19 and Nigeria: putting the realities in context. International Journal of Infectious Diseases 95:275-281.

Paules CI, Marston HD, Fauci AS (2020). Coronavirus Infections-More Than Just the Common Cold. JAMA 323(8):707-708. https://jamanetwork.com/journals/jama/article-abstract/2759815

Suresh KS, Shiv KM, Kalpana T, Rakhi G (2020). How to calculate sample size for observational and experimental nursing research studies? National Journal of Physiology, Pharmacy and Pharmacology 10(1):1-8.

Ye Y, Philip NP, Lagniton SY, Enqin L, Ren-He X (2020). COVID-19: what has been learned and to be learned about the novel coronavirus disease. International Journal of Biological Sciences 16(10):1753-1766.