

# Analysis of public health students' knowledge on health effects of thermoneutral, hot and cold water

## Abstract

Water is a very important nutrient with numerous health effects when ingested or applied on the body in thermoneutral, hot or cold forms. These health effects are however often neglected in public health studies, leaving students to access majority of their information from mostly unregulated Internet sources.

**Objective:** To investigate the level of knowledge and sources of information of final year public health students on the health effects of thermoneutral, hot or cold water.

**Materials and methods:** Data were collected using structured self-administered questionnaire. Analysis was performed by simple calculations of percentages.

**Results:** The students' main source of information, at up to 50% was leisure time Internet Googling with social media. The students' highest score of 54% was on knowledge of water as a nutrient, a basic Biology, Health and Nutrition subject. The next high score was 49% on externalized use of water, an area very familiar with the students since they habitually indulged in cold water baths. 44% was recorded for water hydration while the lowest score of 24% was on health effects of ingested water/inhaled steam. The overall knowledge level on health effects of thermoneutral, cold or hot water was 43%.

**Conclusion:** Dependence on leisure time, i.e. unguided Googling and social media tends to corrupt health knowledge. Previous exposure through formal education, guided internet searches and personal experience enhance level of knowledge. There is serious need to guide students early in their careers on how to obtain authentic health information from the internet.

**Keywords:** chilly water, Nigerian universities, gargling, social media, googling

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## Introduction

Water, regarded as the most important nutrient required by man also has health effects when ingested or used on the body in hot or cold form.<sup>1-4</sup> As the most essential nutrient, abstaining from water could lead to severe dehydration and death within days.<sup>5</sup> A nutrient is any substance that is obtainable from food and beverage for nourishment of the body, and to promote metabolism.<sup>6</sup> During metabolism, water is a universal solvent or reaction medium, and can also be a reactant as in hydrolysis.<sup>7</sup> Besides water ingested orally, normal metabolic processes release water internally into the body.<sup>8</sup>

Water, sanitation and hygiene have been described as the foundation of health.<sup>9</sup> Thus, a robust understanding of the health effects of water whether potable or contaminated should be a fundamental part of public health studies. The role of water as a food nutrient, and in the transmission of diseases have been widely studied, unlike the impact of hot or cold water on human health. The popular information gathering tools like the Internet and social media can impart factual information like those from American Medical Association or myths and presumptions like those from Patel, Patel & San.<sup>3,10</sup> In fact, some of the most misleading publications like those from Patel, Patel & San may superficially appear scholarly, and thus confusing to learners.<sup>10</sup> Obviously health effects of cold water, like those of hot water and other constituents of our environment, can be beneficial or harmful.<sup>11</sup> It is therefore important that the potential adverse outcomes be learnt to enhance the exploitation of the benefits.

That all cultures harness the beneficial health effects of water through the practice of home remedies, especially around measures

of symptom management for minor health conditions was reported by Parisius, et al.<sup>12</sup> These authors noted that home remedies positively impact wellness since orthodox medicine encourages patients to take active part to ensure their own health. They discovered that application of inhalation for management of upper respiratory tract infection (URTI) was among the most frequently used home remedies. It is further known that the home remedy of cold water sponging is used on febrile child to produce rapid temperature reduction although the use of Paracetamol over the counter medication works faster.<sup>13</sup> Hot water compress on the lumber region can aid defecation during hydrotherapy but care must be taken to avoid scalding in children.<sup>4</sup> In addition, alternating hot and cold compresses have been used very effectively in reducing pain and breast engorgement in post – natal mothers.<sup>4</sup>

Different fields of health care utilize the effects of water at different temperatures to promote health. Ice can be used in dentistry or surgeries and in acute injuries for vasoconstriction within the first fifteen to twenty minutes and to control inflammation, muscle spasm, pain and bacterial growth.<sup>14</sup> However, prolonged vasoconstriction could cause tissue death and impaired healing.<sup>14</sup> In dentistry, use of hot saline water mouth wash twenty four hours after dental extraction is a recognized method for preventing complications of alveolar osteitis.<sup>15</sup> Since respiratory viral pathogens are temperature sensitive, continuous nasal steam delivery for thirty to sixty minutes has the potential to cure URTI or common cold, humanity's most frequent infection unlike steam inhalation which merely relieves the symptom.<sup>16,17</sup> Though the mechanism of action is yet unknown, gargling with fluids e.g tap water, saline water etc is one of the

measures long recommended by Japanese health authority to prevent upper respiratory tract infections caused by rhinovirus, coronavirus, influenza virus, pneumococci, streptococci etc.<sup>18</sup>

Experience in clinical dentistry reveals the prevailing ignorance surrounding health effects of cold beverages. For instance, information from the patient concerning the reaction of a diseased dental pulp to hot and cold drink is an important aid in diagnosis.<sup>19</sup> However, many patients offer no useful elucidation in this regard claiming complete aversion to cold water because of alleged deleterious health consequences. A common false claim is that chilled water damages the teeth.<sup>19</sup> However, finding is that even alternating chilled and hot material in the mouth can only at the worst, cause craze lines on the enamel and no serious damage or cracking which is a deeper fracture involving the dentine.<sup>20</sup> On frequent allegation of URTI causation, research has not shown any relationship between ingestion of chilled drink and URTI which instead is associated with long period of breathing cold air.<sup>21</sup> The widespread belief that cold water ingestion inhibits digestion by solidifying fats or that having a cold shower after meals diverts blood away from the digestive system are completely false. According to Leiper, the former is unattainable since temperature of ingested materials quickly normalizes, achieving normothermia within ten minutes in the stomach.<sup>22</sup> By maintaining deep tissue circulation and constant temperature, the body system ensures that internal functions are not compromised by cold or hot water shower, before or after meals.<sup>4</sup>

In spite of the misinformation on the effects of cold water during many un-orthodox medical practices like Ayurveda, Muslims or naturalistic medicine, Mooventhan & Nivethitha noted that using cold water in sports, physical therapies and in other hydrotherapies remain beneficial to health especially when the relevant knowledge is harnessed. During high ambient temperatures, ice cold drinks for body cooling and other forms of precooling are highly recommendable for healthy adults to avoid any increase in core body temperature as a result of dehydration caused especially by physical exertions or exercises in hot environment.<sup>23</sup> On the other hand, cold fluid ingestion has been found to exhibit deleterious cardiac effects through vagal nervous enhancement precipitated by temperature.<sup>24</sup> This effect raises the fear of dangerous bradycardia, cardiac arrhythmia and syncope in patients suffering from pre-existing cardiovascular disease. According to Park, it can provoke dysphagia or chest pain in achalasia (oesophageal motility disorder) by causing temporary paralysis in distal oesophagus and oesophageal sphincter.<sup>2</sup>

Whereas regular consumption of hot fluids can cause cancer of the oesophagus, it can however improve the dysphagia caused by chilled water.<sup>25</sup> Notwithstanding those unpalatable outcomes in the sick including forms of rare allergic manifestations to cold, early morning cold water as opposed to hot water shower invigorates the healthy. This is because cold shower discomfort activates the great number of cold receptors in the skin as it applies a mild electroshock to the sensory cortex.<sup>4</sup> The anecdotal advice for those lacking in courage for cold water showers is the gradual approach – first wetting the limbs, face, chest and belly or starting with thermoneutral water. This method also applies to patients with lower back pain who on sudden contact with cold water may experience painful contraction of the back muscles since they are already in spasm. However, these healthy practices of habitual cold water shock, like strenuous exercises are contra-indicated in presence of pre-existing cardiac pathology.<sup>4</sup> Habitual cold water stimulations—controlled cold water immersions, cold water (winter) swimming or the common place chilly water showers—improve memory, immunity, lymphocyte count and blood

levels of mood lifting beta-endorphins thereby increasing feeling of well being, decrease depression (sadness, fatigue, social withdrawal) and pain even from rheumatism within the period of the stimulations.<sup>4</sup>

Public health students as future custodians of community health education would be responsible for disseminating these factual information about the health effects of hot or cold water in their communities. For practical purposes, cold water exploitation appears more attractive since cold water stimulation could be demonstrated easily in every home without need for water heating appliances and infrastructure, and could positively impact the community's well-being.

Though information on the health effects of water could be gathered by students from multiple sources, Abbah, Nguungwan, Okeke, et al argued that most students resort to electronic screen media to access information as leisure activity.<sup>26</sup> Considering the myriad of health benefits that may accrue from the acquisition of authentic information or the gravity of associated danger when falsehoods are acquired by prospective public health professionals, it is essential to engage these students appropriately, and train them to access reliable sources for accurate health related information.

## Statement of problem

Water is the most important nutrient for life. It is indispensable for metabolic processes. It is also important both in the prevention and transmission of infections. These facts are recognized in public health studies. However, its temperature dependent health effects, including its beneficial and deleterious effects are not given enough attention in public health studies. Nevertheless, some of these benefits are continuously harnessed in different cultures as home remedies, and effectively employed in different health care settings for effective therapy. Of all the health applications of hot and cold water, knowledge about controlled cold water stimulation in the form of common place cold shower can be disseminated for the benefit of community health. This is because habitual cold water stress whether in the bath, river or pool can, among others, increase memory, immunity, feeling of wellbeing, and tolerance to life's stressors while decreasing depression and pain even from rheumatism within the period of application. Since public health students are soon to serve the community professionally, it is absolutely necessary to set them up for success by equipping them with the right training and directives on how to gather authentic health related information.

## Purpose

The aim of this study was to determine the main source of information and the knowledge level of final year public health students on the health effects of thermoneutral, hot or cold water. Specifically, the study sought to determine the students' main source of information concerning health effects of water. Their knowledge level on health effects of water as a nutrient and on hydration are sought. The students' knowledge on the health effects of ingested water and inhaled steam (internalized water) and on water used on the skin and for rinsing the mouth (externalized water) will also be explored.

## Methodology

### Research questions

The following research questions guided this study.

- i. What was the students' main source of information on health effects of water?

- ii. What was their knowledge level on health effects of water as a nutrient?
- iii. What was their knowledge level on hydration?
- iv. What was their knowledge level on health effects of ingested water and inhaled steam (internalized water)?
- v. What was their knowledge level on health effects of water used on the skin and inside the mouth without swallowing (externalized water)?
- vi. What was the overall knowledge on health effects of thermoneutral, hot or cold water?

### Study design

This was a descriptive quantitative study using a self-administered structured questionnaire to collect data.

### Study setting

This study was carried out at the Elele Campus of Madonna University, Nigeria, a mission affiliated institution. The motto of the university is Education with Morals. Students are guided by strict academic discipline with little room for corner cutting. All students reside on campus hostels under university residential guidelines. The use of electric or gas heating element for water is strictly prohibited on students' residential buildings due to associated fire hazards. Consequently, most students use cold water for shower. Health care courses at Elele campus include medicine, optometry, nursing, public health, medical laboratory science and pharmacy. Public health students were chosen for this study because of their importance in community health education outreach.

### Study population

The study population consisted of 46 final year public health students, who voluntarily agreed to participate in the study, and were given survey questionnaires. Completed survey questionnaires were returned to the researcher by only 36 students. These final year students were chosen for the study since they have completed their degree programme and on the verge of graduation to start their professional career in public health.

Ethical approval for the study was obtained from the Ethical Committee headed by the Dean, School of Health Sciences, Madonna University, with an understanding that student participation should be a voluntary and anonymous without personal identifiers in the survey questionnaire.

### Sample and sampling techniques

This was a convenience sample of all 46 final year public health students. Students were participants in an academic class organized by one of the researchers. Purpose of study was explained to the students and their voluntary participation solicited.

### Inclusion/exclusion criteria

Only final year public health students were qualified for this study. Final year students are ready to graduate and start their professional careers in public health.

### Data collection instrument

A close ended questionnaire (Appendix 1) was developed by the authors and required respondents to check one of four boxes for Part I, and check either "Correct Statement" or "Wrong Statement" for

each of the questions in Part II. Part I sought to explore each student's main source of information. Part II was divided into four sections for knowledge assessments with five questions per section. Section A was concerned with evaluating students' knowledge about water strictly as a nutrient. Sections B, C, and D concentrated on common beliefs and opinions gathered during professional encounters. Section B was about factors in hydration, while section C explored health effects of internalized water, like ingested beverages when hot or cold and if inhaled as steam. Section D investigated the health effects of hot or cold water that was not internalized, but used on the skin or introrally without swallowing. The research questions were regarding health effects of water in the forms of ice, liquid, and vapor. Other beverages, semi-solid and liquid foods were also included since they all contain majority water, which acts as conveyor or absorber of heat depending on temperature. Very hot beverages were excluded because they damage tissues by coagulation. The study considered the adaptive responses to habitual, intentional and controlled cold or hot water externalization. Thus, effects during accidental externalization like falling into cold pools were excluded. Since the research was done prior to Covid-19 pandemic, no information was directly sought in that area.

No demographic information was required from the students. Social and economic information were not collected because the study was carried out with students all living in the campus dormitories where basic amenities for information like library, computer room, newspapers, journals etc were common to all. Thus the students were reduced to the same level with respect to availability of required information. Personal interest, inclination and retentive ability but not social status may thus affect their level of knowledge.

### Validity/reliability of the survey instrument

The self developed questionnaire was examined by two key public health teachers, to determine its validity and applicability to the study's research questions. Appropriate modifications like dividing internet googling into guided and leisure time (unguided) Googling were made based on their findings. The reliability of the survey instrument was not tested.

### Data collection method

Authors distributed forms to students who volunteered to participate in the study. Survey was performed after last class with the students at the end of the 2017/2018 academic session. Survey forms were collected after 15 minutes, followed by a 20 minute discussion to provide correct answers to the questions, increase knowledge and awareness, and encourage individual exploration on the subject matter using authentic sources of information.

### Data analysis

Analysis was carried out using simple calculations. Results were presented in percentages.

## Results

About 50% of the study population identified leisure time (unguided) Googling with social media as their main source of information regarding health effects of thermoneutral, hot and cold Water (Table 1). Surprisingly, only eight percent of the students use authentic verifiable sources of information like guided sources, school/class work and textbooks. Nearly 28% of the students depend on friends and relations to gather information on this very important public health issue.

Expectedly, majority of the study population (almost 54%) were knowledgeable on the fact that water is considered a food nutrient (Table 2). About 49% knowledge was obtained on the health effects of water when used orally or on the skin, whereas, the health effects of

ingested hot or chilled water, inhaled as steam was only 24%. Finally, the overall knowledge i.e, percentage of all the correct answers on all the questions did not fare so well, at 43% (Table 2).

**Table 1** Percentage distribution of students' sources of information regarding health effects of water at different temperatures

Main Source of information	Number of Students (n=36)	% of Students
Relations and friends	10	28.
School/Classwork/Textbooks/ Guided Internet Googling	3	8
Mass media and other written works	5	14
Leisure time Internet Googling and social media	18	50
<b>Total</b>	<b>36</b>	<b>100</b>

**Table 2** Students' scores in percentages and grades of knowledge

Sections	Total number of questions (36 students answered 5 questions per section)	Total number of Correct answers	Students' scores in Percentage (%)
A. Water as a nutrient	180	97	53
B. Hydration	180	79	44
C. Health effects of ingested hot and chilled water or inhaled as steam	180	43	24
D. Health effects of water used on the skin or intra-orally without swallowing (externalized hot or chilled water)	180	88	49
Overall	720	307	43

## Discussion

Self education is necessary for knowledge enhancement but this quest in specialized field requires appropriate guidance to avoid resultant mis-education. In the present study, about half of these potential public health professionals sourced information on the health effects of water from unguided internet searches and unverified social media. The Internet is highly unregulated, with lots of non-evidence based medical views, and thus, it's simplistic use is not a reliable source of information for a sensitive subject matter like health. It should however be noted that there are credible internet sources for health information, and these include websites published by government agencies (dot gov), educational institutions (dot edu), and nonprofit organizations (dot org).<sup>27</sup> Most commercial websites (dot com) tend to skew towards their commercial interests, and thus cannot always be trusted.

Extensive use of the Internet by Nigerian University students was documented by Ani.<sup>28</sup> The author however, observed poor quality in the Internet searches, without authentic electronic resources such as online peer-reviewed journals and online government and educational institutions' databases, which are indispensable in research and learning. On the other hand, Dean, Fielding, Newton observed that a person's knowledge and awareness about water is related to previous exposure to sources of water-related information which may include the social media, radio, TV and newspaper publications.<sup>29</sup>

Today, both qualified and upcoming professionals in Nigeria disseminate through their group social media platforms, health and

other information obtained from diverse sources. Wherever health effects of cold water is mentioned, forwarded from other platforms, it is mostly negatively in consonance with social media notoriety for rumour mongering and uninspiring alternative medical views. As custodians of medical knowledge, qualified health professionals are duty bound to investigate appropriately the authentic orthodox medical views before sharing information so as to simultaneously educate and entertain.

The students' knowledge base on water as a food nutrient had the highest score, as expected perhaps from the recollection of basic Biology, Health and Nutrition classes. 44 % was obtained as water hydration knowledge level, reflecting low knowledge retention from their Physiology classes about 2 years earlier. Zuo et al, observed in water ingestion study in China, that awareness rate of the minimum recommended daily drinking water volume was 71.6%.<sup>30</sup> Whereas in Saudi Arabia, 93% had good knowledge of dehydration, 84% knew how to prevent dehydration, while 74% were aware of appropriate water intake recommendation.<sup>31</sup> Drinking a minimum of 8 ounces 8 times daily (8x8), totaling 64 ounces or 1900 ml a day is higher than the widely accepted volume of 1500 ml a day for sedentary adults.<sup>7</sup> Yet being only slightly higher and with implied regularity, the practice can be adjudged beneficial for most people. However recent recommendations have shifted to total amount of water that must be obtained from all external sources including food moisture, drinking water and other beverages to balance body water loss.<sup>32</sup> The total water intake recommended by the US Institute of Medicine stands at 3.7 liters /day for adult males, and 2.7 liters/day for adult women

at moderate environmental temperature and moderate physical activities.<sup>8</sup> (European recommendations are 2.5 liters and 2.0 liters respectively.<sup>32</sup>)

During periodic dry fasting, Jequier & Constant observed that water deficiency can result in grievous physical and mental consequences, whereas some days without food may not result in any harm.<sup>7</sup> Since body water must be lost even in sedentary conditions during fasting through feaces, sweating and exhalation, a patient on dry fasting must experience dehydration.<sup>8</sup> Drinking excess alcoholic beverage can lead to water intoxication in spite of the diuretic effect. According to Iman, this may occur following days of gulping alcoholic beverage without food which ought to provide urinary solutes to propel water excretion in excess of 20 liters/day.<sup>33</sup> Besides, alcohol acts as a diuretic only for some time.<sup>8</sup>

Concerning consumption of voluminous quantity of water first thing every morning, water ingestion is beneficial to avoid dehydration but there is little to support any benefit derivable from additional water in an adequately hydrated state.<sup>5</sup> However, since people are prone to dehydration in the mornings, many having restricted late drinking to avoid sleep disturbances due to frequent nocturnal urination, early morning drinking of water seems a healthy practice. Actually regular and less voluminous consumption seem more effective for rehydration and its desired health outcomes. However, proper timing of water ingestion during meals, enhances digestion and absorption.<sup>3</sup> It also helps in weight control by reducing amount of food taken and promotes hydration even in people who limit regular water drinking because of impaired thirst mechanism.<sup>1</sup>

There is usually a fear of dehydration when a baby is on exclusive breast feeding in hot weather conditions. It should be noted that breast milk is more than 80% water and thus always adequate to satisfy baby's regular thirst and hunger.<sup>34</sup> Since breast milk is sterile, exclusive breast feeding eliminates chances of infection and malnutrition due to under ingestion of breast milk both of which may occur with water supplementation.<sup>34</sup>

The very poor knowledge level of 24% obtained on the health effects of internalized water i.e. inhaled steam and ingested hot or chilled water may be attributable to the gullibility of students to social media and unguided Internet Googling searches. A surprising 49% knowledge level was obtained on health effects of water when used externally i.e. intra-orally or on the skin, in a hot or cold state. This comparatively high score might have been as a result of the students' widespread habitual practice of using cold water during showers in their hostels. This healthy habit might have contributed to the general feeling of well-being, pervading peace and salubrious atmosphere though taken for granted in the school environment which freshmen initially perceive as harsh, frustrating and unbearable. Tipton, Collier, Massey et al explained that habitually bearing the stress of cold water shocks, could enhance tolerance to other forms of stress (cross-adaptation or cross-tolerance).<sup>11</sup> These future community health educators have experienced this fact without realizing it. During post survey awareness session, students emphasized how the hitherto harsh environment including cold water showers became pleasantly bearable for the rest of their student days at Madonna University.

Adeyemo, Ohaeri, Okpala, et al, earlier noted that many antisocial behaviors including drug abuse pervade several campuses of Nigerian universities.<sup>35</sup> It is possible that an unconscious stress management strategy of cold water usage by students may have contributed to the serenity on campus among our students.

## Conclusion

High dependence on unverified sources of information through unguided Internet Googling and social media is inimical to knowledge acquisition in a specialized area like public health. Previous exposure through formal education, and personally experiencing the effects of water after actual use at different temperatures enhanced associated knowledge. This observation may explain the high level of knowledge and awareness exhibited by students on water as a nutrient, hydration and when hot or cold water is applied externally. One important positive social change implication of this study is that these future public health professionals will be motivated to seek for information in reliable, verified sources and peer reviewed journals to ensure authenticity of information used in their public health practice. It is absolutely important that accurate information be disseminated during community health education, to help enhance the overall health of the community. Furthermore, redirecting these future public health educators to the right source of information will definitely increase the public perception and confidence in them, as a repository authentic health knowledge that the community can depend on. Such public confidence will engender positive health seeking behavior to the benefit of public health.

## Recommendation

With the uncontrolled explosion of social media and unregulated Internet access, public health curriculum should be revised to teach potential public health professionals how to seek and acquire authentic and credible information, to enhance the quality of public health practice. Where curriculum congestion may preclude free-standing course in this area, it is recommended that relevant health knowledge instructions, including the health effects of water, be inserted into relevant health education domains.<sup>36</sup> Public health students' knowledge will be enhanced if researches are done in Covid-19 quarantine centers to authenticate the suspected prevention regimens of internalized and externalized hot water, frequent gargling, hourly ingestion of hot beverages and especially continuous nasal steam delivery for 30 – 60 minutes during the very early stage of the virus infection.<sup>37,16</sup>

## Limitations of the study

This study is based on a small convenient sample, without randomization, and thus results cannot be generalized. The survey instrument was not verified through key witness interviews or focus group to determine clarity of understanding by study participants. Since study was carried out in a classroom setting with final year students, potential response bias may have occurred due to students' familiarity with each other, having been together in the same classroom for four years. There is need for further studies to address these limitations.

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## Conflicts of interest

The author declares that there was no conflict of interest.

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