



## Research article

## Hydration and water intake practices of commercial long-distance drivers in Ghana: what do they know and why does it matter?

Christiana Naa Atsreh Nsiah-Asamoah<sup>a,\*</sup>, David Nii Baah Buxton<sup>b</sup><sup>a</sup> Department of Clinical Nutrition and Dietetics, University of Cape Coast, Ghana<sup>b</sup> Department of Geography and Regional Planning, University of Cape Coast, Ghana

## ARTICLE INFO

## Keywords:

Water intake  
Hydration practices  
Commercial drivers  
Long-distance  
Ghana

## ABSTRACT

**Background:** The World Health Organization indicates that hydration is indispensable to human life. A long-period of dehydration can result in fatigue, drowsiness and mental confusion which can result in committing serious blunders. For commercial drivers, however, these blunders can be life-threatening and their hydration cannot be overemphasized.

**Aim:** This study was therefore undertaken to assess the water intake practices of Commercial Long-Distance drivers (CLDDs). The study was also aimed at assessing their knowledge levels on the role of water in promoting a healthy body and the consequences of dehydration.

**Setting:** CLDDs in Ghana who ply between Accra – Cape Coast – Takoradi or Accra – Kumasi.

**Methods:** A cross-sectional study which involved 256 CLDDs was conducted at six (6) commercial bus stations in Accra and Cape Coast from December 2019 to January 2020. Structured questionnaires were administered to obtain socio-demographic and water intake practices of CLDDs. SPSS was used to generate descriptive statistics based on the data collected.

**Results:** A high proportion (57.8%) of the CLDDs reported that they drunk about 2500ml–3000ml of water on a daily basis. Most (53.1%) relied on their thirst feeling to prompt them to drink water. A little over half (51.1%) consumed energy drinks believed to hydrate the body. A major barrier to drinking water regularly was to avoid frequent stop-overs to use the washroom while travelling.

**Conclusion:** The findings reveal concerns about knowledge gaps with regard to the importance of water consumption and barriers to adequate drinking of water among CLDDs. Findings also suggest that many CLDDs relied on their thirst perceptions to prompt them to drink water. Health Education programmes targeting CLDDs should include conveying the importance of water intake and healthy hydration practices for optimal physical and cognitive performance.

## 1. Introduction

Commercial Long-Distance Drivers who usually drive buses continue to contribute significantly to road accident fatalities in Ghana [1]. The increase in accidents in recent times despite the improvements in road networks and quality, improved and safe vehicles and the advocacy for drivers to be well-trained before driving, calls for a more robust approach (multidisciplinary approach) in investigating some possible causes of road accidents. Considering the importance of water to the human body and the known effects of dehydration on humans, could the frequent accidents be as a result of poor hydration of some drivers? Probably, dehydration could be a contributory factor to experiences of fatigue, lack

of alertness, stress among commercial drivers who stay long behind the wheel.

Water is regarded as being a very vital part of our diet. However, water has been neglected and has not been given the due recognition in nutrition research. Hence, its importance in nutrition and health has been relegated to the background [2]. Hydration is indispensable in life because whereas, we can live far longer without food, we cannot live without water for long [3]. According to the World Health Organization (WHO), dehydration is the adverse consequence of inadequate water intake which results in difficulty in concentrating, headache, and sleepiness [4] which can be linked to the occurrence of road accidents. This

\* Corresponding author.

E-mail address: [cbuxton@ucc.edu.gh](mailto:cbuxton@ucc.edu.gh) (C.N.A. Nsiah-Asamoah).

<https://doi.org/10.1016/j.heliyon.2021.e06512>

Received 3 November 2020; Received in revised form 4 January 2021; Accepted 10 March 2021

2405-8440/© 2021 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

should sound a caution of how indispensable and critical water is for the sustenance of life and the survival of all.

To date, while there are no widely accepted specific threshold values for urine concentration to assess adequate hydration in adults, the available literature suggests that usually most adults have highly concentrated urine, signifying inadequate fluid intake [5]. In Ghana, previous studies reported an inadequate water intake among the Ghanaian population [6, 7].

In the case of commercial long-distance drivers (CLDDs) there have been reports that suggest that most of them are likely to deliberately reduce their water intake in order to avoid or reduce frequent visits to washrooms particularly when they have to embark on long journeys [8]. This concern of drivers is realistic, because in reality, frequent stops to visit washrooms can affect not only their ability to make on-time deliveries, but may also reduce their daily earnings. As a result, commercial drivers are likely to ignore that they are to make a deliberate and conscious effort to drink adequate quantities of water to sustain them whilst they perform their driving tasks. Yet, the deliberate attempt to avoid frequent stops to use washrooms while on a journey may place drivers at a greater risk of dehydration which can cause symptoms such as headache and tiredness [9].

As hydration levels drop, all kinds of processes that require water begin to become reduced. These body processes include blood circulation, metabolism, body temperature regulation, and detoxification. A long-period of dehydration can result in drowsiness, mental confusion which can result in committing serious blunders. However, in the case of drivers when they become dehydrated, it compounds those blunders since it makes them more confused and foggier at a time when they need to be mentally alert to avoid errors such as missing important turns or highway exits. In addition, dehydration results in grave physiological consequences such as altered moods and deficits in cognition. Impairment of these processes in the case of drivers can be worrying, as it leads to reduced brain activity, impaired cognition, reduced alertness, and short-term memory problems [10]. Dehydrated drivers may also be more susceptible to errors in judgment as compared with when they are well-hydrated. For instance, the study of Waston et al (2015) [8] revealed that the total number of errors among drivers was  $47 \pm 44$  when hydrated but more than doubled to  $101 \pm 84$  when they drove in the dehydrated state. Another study found that driving errors doubled as a result of reduced concentration, alertness and judgment, a consequence from driving dehydrated [11]. This study also revealed that drinking adequate quantities of water helps to boost one's memory and therefore enabled long distance drivers to focus better on their driving activity. These findings highlighted in the aforementioned studies reveal the unrecognized danger of driving while dehydrated and suggest that drivers should be encouraged to adequately drink water to remain hydrated while they perform their driving tasks.

There have been grave concerns regarding situations of dehydration in CLDDs. For instance, there have been calls by the British Nutrition Foundation for the water intake and hydration practices of commercial passenger and cargo drivers to be accorded the needed attention [12]. This is because, adequate hydration is critical for the overall health and performance of drivers on the road particularly when they are engaged in prolonged and monotonous driving tasks. Related to the call to assess the water intake and hydration practices of commercial drivers is the concern regarding the likelihood of CLDD to substitute water for energy and soft drinks considered by drivers are equally serving the purpose of hydrating the body while providing some energy needed to perform one's daily activities [13, 14].

In Ghana, commercial driving has been described as a booming means of employment in the informal sector that supports the livelihood of many Ghanaians. Reports indicate that in the year 2011, there was an estimated membership of commercial drivers of about 120,000 registered under the Ghana Private Road Transport Union (GPRTU) [15]. The usual routine of leaving home early, driving for hours may all impact on the eating practices, water intake, stress levels and overall health of CLDDs [16]. As the

above review has shown, whereas some studies have been conducted to assess the water intake and hydration practices of CLDDs especially in developed countries, no such studies have been conducted on Ghanaian commercial drivers to the best knowledge of the researchers. In addition, in Ghana studies that have been conducted among commercial drivers have mainly focused on their consumption of energy drinks [14], prevalence of diabetes, high blood pressure, dyslipidemia, overweight and obesity [17]. Hence, the study was undertaken to address the following research questions: What are the water intake and hydration practices of CLDDs in Ghana?; What are their knowledge levels on the role of water in promoting a healthy body?; What are the knowledge levels of CLDDs on the effects of low water intake or dehydration on the body? and Is the water intake practices of CLDDs associated with the driving experiences (in years) and usual daily working hours?

The study therefore, sought to investigate the water intake and hydration practices of CLDDs in Ghana, because of the effects of dehydration on the body and the needed role of health professionals in educating this vulnerable group.

## 2. Methods

### 2.1. Study design and settings

This cross-sectional study was conducted from December 2019 to January 2020 at six (6) commercial bus stations in Accra and Cape Coast. This study employed a quantitative cross-sectional approach in which 256 CLDDs participated in the study. For the purpose of this study, a Commercial Long-Distance Driver (CLDD) refers to a professional driver who travels over a distance of 140km or more on a regular daily basis [16].

### 2.2. Study participants

The study population consisted of CLDDs who were registered at the six (6) bus stations of the Ghana Private Road Transport Union (GPRTU). All the sampled drivers had a professional driver's license from the Drivers and Vehicle Licensing Authority (DVLA) and were fully active (full-time drivers). A random sampling technique was used to recruit eligible participants for this study. The Station Masters at the various Bus Stations provided a list of CLDDs who covered a distance of at least 140km between the capital towns of the Greater- Accra, Central, Western and Ashanti Regions of Ghana. Based on the list of drivers obtained from each station, the percentage of the sample size (weighting) to be selected from each station was estimated using proportional allocation. The weighting per station was used to calculate the corresponding absolute number of potential CLDDs to be sampled from each station list based on the calculated sample size. The lottery sampling method was employed to randomly select the calculated number of CLDDs from each station. Identification tags were given to those sampled and the researchers arranged to meet them at their own convenient time and day to interview them. This category of drivers was selected because unlike private drivers who drive long distances, CLDDs do not have the luxury of stopping frequently to either take a rest, drink water or visit the washroom. In the case of CLDDs they have to embark upon a journey and reach their destination within a given time. Since this is their source of livelihood and daily routine and are therefore more likely to ignore thirst feelings for a long period of time, and thus are more prone to the effects of dehydration compared to private long-distance drivers. Again, the CLDDs were selected from these stations due to the fact that these stations link the three busiest commercial cities (Accra, Kumasi and Takoradi) in Ghana. In addition, these busiest trans-city corridors in Ghana is fraught with traffic accidents [18].

### 2.3. Instrument development

The questionnaire that was administered to the commercial drivers was a modified version of previous related studies on water intake and

hydration practices that have been undertaken in Saudi Arabia [19] and United States [20].

The questionnaires were made up of three sections. The first section consisted of demographic questions. The second section consisted of closed-ended questions to determine the knowledge levels of the drivers on the role of water in promoting a healthy body. The third section consisted of questions to determine their water intake and hydration practices.

#### 2.4. Ethical considerations

Ethical clearance and approval to conduct the study was obtained from the Institutional Review Board of the University of Cape Coast, Ghana. Permission and approval to conduct the study was also obtained from the various Station Masters/Heads at each of the bus stations. Participation was voluntary and written informed consent was obtained from each driver who agreed to participate in the study. Prior to volunteering, participants received written information regarding the nature and purpose of the study and a written statement of consent was signed. Each CLDD was individually approached to seek for their consent to voluntarily participate in the study. The consenting process entailed thoroughly explaining the purpose of the study, and the freedom to opt out of the study without any penalty. Strict confidentiality was maintained and anonymity of responses was ensured by avoiding the use of any form of identity of participants.

#### 2.5. Data collection

A pilot sample of 15 CLDDs were used to test the validity of questions in the questionnaire before administering the final questionnaire. The results from the pilot test confirmed the adequate comprehensibility and clarity of the survey. The questionnaire was administered among CLDDs working at six (6) bus stations in Cape Coast and Accra. These were two (2) bus stations in Cape Coast which were providing services for journeys between Cape Coast and Accra or Kumasi. In Accra, drivers were sampled from four (4) bus stations which were providing services for journeys between Accra and Cape Coast or Takoradi. Some of the sampled drivers also travelled between Accra and Kumasi and vice versa.

#### 2.6. Statistical analysis

The data was cleaned by identifying and deleting inaccurate and incomplete data. Completeness and consistency of the data were checked. The data was then entered into the data analysis software - Statistical Package for Social Sciences (SPSS, version 21.0) - for analysis (SPSS Inc, Chicago, IL, USA).

Descriptive statistics were run using SPSS to summarize the data collected; and the results were displayed in frequencies and percentages for the variables being investigated. Chi-square tests were run to assess for any statistically significant difference between the driving experience (in years), and self-reported volumes of water usually drunk in a day. Again, the chi-square test was used to assess for any statistically significant difference between working hours per day and the reported daily volumes of water intake of participants. A statistical significance level of ( $p < 0.05$ ) was applied in this study.

### 3. Results

#### 3.1. Socio-demographic characteristics of the study participants

The general characteristics of the commercial drivers who participated in the study are presented in Table 1. All the participants were males which show that commercial driving as a profession in Ghana is highly dominated by men. Majority (72.6%) of the drivers have attained education from the Junior High School level and above. A comparatively higher percentage (45.4%) of the participants were within the age group

of 31–40 years. Almost 90% of the CLDDs reported that they travelled usually over a period of more than 4 hours per trip. Approximately, three-fourths (75.8%) of the drivers indicated that they always drove in an air-conditioned bus. A higher proportion (85.2%) of the drivers indicated that they had never received any form of education on water intake and hydration. Out of the 38 drivers who had been educated on the importance of water intake and hydration, majority (55.3%) were educated by a health personnel.

With respect to the average amount of water consumed daily, the reasons that influence the water drinking practices of the studied drivers and other means of hydrating the body, are presented in Table 2. A high proportion (57.8%) of the drivers reported that they usually drink between 5-6 sachets (2500ml–3000ml) of water daily. Most (81.6%) of the respondents indicated that, in their opinion, they were drinking adequate volumes of water daily. Regarding, the main reason for drinking water during the day, a higher percentage (53.1%) indicated that they drank water only when thirsty. Only a few (17.2%) reported that they consciously drank water even without waiting to feel thirsty. With regard to other means of hydrating the body, a little over half of the respondents (51.1%) reported that they drank energy drinks such as Lina energy tea and Rush. According to 54.3% of the drivers, a key barrier to drinking adequate volumes of water during the day was to avoid urinating often. The drivers were given a list of signs to indicate whether they suggest that a person is not drinking adequate water or an individual is probably dehydrated. Out of the twelve (12) signs that were given, more than 50% of the participants were able to correctly indicate that seven (7) signs suggest that an individual is not drinking adequate volumes of water in a day. However, for five (5) signs - pains in the joint, muscles and lower back area, headaches, hoarse/rough voice, rapid breathing, dry skin and mouth - less than half of the respondents were able to correctly identify them as signs of inadequate water intake or dehydration of the body.

The findings with respect to the knowledge levels of the surveyed drivers on the role of water in promoting a healthy body is summarized in Table 3. The results revealed that generally apart from the role of water in body temperature regulation which was known by 92.9% of the drivers, the other six (6) roles of water in the body that were presented to the participants were identified by less than 50% of the participants as shown in Table 3. Of particular concern and worth mentioning is that only 17.5% of the drivers knew that water helps in the removal or elimination of waste body products.

The knowledge levels of the drivers on the effects of low water intake or dehydration on the body is presented in Table 4. A high proportion (71.5%) of the participants knew that an individual can become dehydrated as a result of not drinking enough fluids such as water. Majority (76.9%) were of the view that driving under the influence of alcohol was more dangerous than dehydrated-driving. However, less than half of the drivers knew the other effects of dehydration such as draining one's energy levels, tiredness, reducing transportation of oxygen to the body cells, involuntary muscle contraction, a loss of consciousness, urinary tract infections, kidney stones and even kidney failure.

Information regarding the differences between commercial driving experience (in years) with respect to the usual volume of water consumed per day is presented in Table 5. The chi-square test statistics that was run indicated that there is no statistical significance difference between driving for less than 10 years and driving for 10 or more years with regard to the usual volume of water that was consumed in a day. Similarly, there was no statistical significance difference between driving for less than 15 hours per day and 15 or more hours per day with respect to the usual volume of water that was consumed in a day.

### 4. Discussion

To the best of the authors knowledge, this is the first time that self-reported water intake practices and knowledge on importance of hydration has been investigated among commercial long-distance drivers

**Table 1.** Socio-demographic characteristics of commercial drivers.

Variable	Frequency	Percentage
<b>Station</b>		
Cape Coast Station 1	24	9.4
Cape Coast Station 2	27	10.5
Accra Station 1	44	17.2
Accra Station 2	49	19.1
Accra Station 3	57	22.3
Accra Station 4	55	21.5
<b>Age Group</b>		
21-30	17	6.6
31-40	116	45.4
41-50	96	37.5
>50	27	10.5
<b>Highest level of Education</b>		
No education	24	9.4
Primary	46	18.0
JSS/JHS/Middle	122	47.6
SSS/SHS/Tech./Voc.	64	25.0
Tertiary	0	0.0
<b>Commercial Driving Experience (years)</b>		
<10 years	81	31.6
≥10 years	175	68.4
<b>Working Hours/day</b>		
<15 hours/day	92	35.9
≥15 hours/day	164	64.1
<b>Been educated on the importance of water intake/hydration</b>		
Yes	38	14.8
No	218	85.2
<b>Source of education (n = 38)</b>		
Health personnel	21	55.3
Friend/fellow driver	12	31.6
family member	5	13.1
<b>Approximate travelling hours per trip</b>		
3-4 hours	26	10.2
>4-5hours	103	40.2
>5-6hours	95	37.1
>6 hours	32	12.5
<b>Use of air-condition while driving</b>		
Yes	194	75.8
No	62	24.2

(CLDDs) in Ghana. This study was aimed at assessing the hydration and water intake practices of CLDDs who provided transportation services between four capital towns of four regions in Ghana. The study was also conducted to investigate their knowledge levels on the role of water in promoting a healthy body and the effects of low water intake or dehydration on the body. Finally, the study was undertaken to assess whether drivers' driving experience (in years) and daily working hours determined or was associated with their usual daily water intake.

The findings revealed that less than one-third (28.2%) of the CLDDs reported that they usually drank more than 3000ml of water a day. There are various recommendations and discrepancies regarding the ideal volumes of water that should be consumed to meet one's daily requirement. Some health organizations such as the World Health Organization and the European Food Safety Authority recommend that adult men should consume at least 2500ml of water a day, provided they do not engage in any manual and strenuous physical activity [21]. Other health bodies such as the Institute of Medicine (IOM) and the American National Academy of Medicine recommend 3700ml of water per day for an adult male [21]. In Ghana, the recommendation by the Ministry of Health for water intake in its 2013 Dietary and Physical Activity Guidelines is drinking approximately 6–8 sachets (3000–4000ml) or 8–10 glasses a

day. It is further indicated that this should be increased to 8–10 sachets (4000–5000ml) when the weather is hot.

The WHO recommends that water intake should, however, increase to 4500ml when adult males engage in any strenuous or high physical activity especially during hot/high temperature weather conditions that results in sweating. Given that Ghana has a typically tropical climate and driving a bus can be regarded as a moderate physical activity [22], it suggests that drivers have to drink more than 2500mls of water a day. In addition, the study revealed that about three out of every four drivers reported that they drove in an air-conditioned bus over the course of their journeys which even predisposes them more to water losses from the skin as a result of their exposure to the dry air circulating in the bus. Watson et al (2015) [8] asserts that even in an air-conditioned car, evaporative water losses from the skin and lungs are likely to increase during a long drive due to exposure to dry air because of the increased vapour pressure gradient. Therefore, since about 75% of the study participants drove in an air-conditioned bus, they might be susceptible to more water losses and hence the need for them to consciously drink water as they embark on their journeys.

It was also found out that more than half (53.1%) of the drivers reported that they relied on their thirst sensation to drink water. This

**Table 2.** Water intake and hydration practices of Drivers.

Variables	Frequency	Percentage
Amount of water usually drunk daily (sachet/500ml)		
3–4 sachets (approx.1500ml–2000ml)	36	14.0
5–6 sachets (approx. 2500ml–3000ml)	148	57.8
>6 sachets (approx. >3000ml)	72	28.2
Amount of water drunk a day before data collection (sachets/500ml)		
3–4 sachets (approx.1500ml–2000ml)	48	18.8
5–6 sachets (approx. 2500ml–3000ml)	122	47.6
>6 sachets (approx. >3000ml)	86	33.6
Perception of adequacy of water consumed per day		
Yes, adequate	209	81.6
No, inadequate	47	18.4
Main reason for drinking water during the day		
drink only when thirsty	136	53.1
consciously drink water even without feeling thirsty	44	17.2
drink to cool the body's temperature	76	29.7
*Other fluids taken a day prior to data collection		
alcoholic beverage (eg. beer, guinness) (n = 256)	79	30.8
sugar-sweetened drinks (eg. coke, fanta, sprite, malt) (n = 256)	68	26.5
energy drinks (eg. Rush, lina energy tea) (n = 256)	131	51.1
bissap drink (prepared from hibiscus flower) (n = 256)	62	24.2
fruit juices (n = 256)	18	7.0
fruits (water melon, oranges, pineapple) (n = 256)	45	17.6
Perceived major barriers to regular water intake		
avoidance of frequent urination	139	54.3
avoidance of weight gain/feeling of heaviness while driving	54	21.1
weather condition (reduced intake during cold as compared to hot)	35	13.7
state of water available (eg. preference for iced/cold over warm water)	28	10.9
Knowledge of signs that a person is not drinking enough water		
feeling tired very quickly (n = 256)	165	64.4
reduction in work performance (n = 256)	172	67.2
pains in the joint, muscles and lower back area (n = 256)	96	37.5
headaches (n = 256)	124	48.4
constipation (n = 256)	135	52.7
dizziness (n = 256)	162	63.2
strong odour in one's urine (n = 256)	179	69.9
urine colour is darker than usual (n = 256)	193	75.4
hoarse/rough voice (n = 256)	116	45.3
dry skin and mouth (n = 256)	121	47.2
rapid breathing (n = 256)	104	40.6
decreased urination (n = 256)	182	70.1

\* fluids listed were perceived as other sources of hydrating the body.

**Table 3.** Drivers' Knowledge levels on role of water in promoting a healthy body.

Water consumption is critical for the following:	Frequency (Yes responses)	Percentage
a. helps digestive system and absorption of nutrients	124	48.4
b. body temperature regulation	238	92.9
c. transporting and distributing nutrients throughout the body	108	42.2
d. helps in removal (excretion) of waste body products	45	17.5
e. provides a 'lubricant' on the joints and membranes in the body	72	28.1
f. improving blood circulation	96	37.5
h. helps to reduce the frequency of dizziness and headaches	116	45.3

practice has also been reported in another related study which also indicated that most study participants relied on thirst or hot weather conditions to prompt them to drink water [23]. The implication of waiting to become thirsty before one is prompted to drink water is that such people are already dehydrated when they start to feel thirsty

because they have lost as much as 1 to 2 percent of their body's water content [24]. In other words, there is usually a significant fluid loss before one feels thirsty. The implication of this finding is that losing about 2% of the body's water volume impairs both physical and cognitive performance which can result in stress, agitation and forgetfulness while

**Table 4.** Knowledge levels on Effects of low water intake or dehydration on the body.

Question and Answer Options	Frequency	Percentage
Which of the following statements describes dehydration?		
I can become dehydrated if I don't drink enough fluids (e.g. water)	183	71.5
I can become dehydrated if I don't eat properly	27	10.5
I can become dehydrated if I don't get enough sleep	0	0.0
No idea, do not know	46	18.0
Drank-driving is more dangerous than dehydrated-driving		
True	197	76.9
False	36	14.1
Do not know	23	9.0
Lack of adequate water intake can drain your energy levels and make you feel tired		
True	118	46.1
False	43	16.8
Do not know	95	37.1
Lack of adequate water intake prevents transportation of the air we breathe in (oxygen) to the body cells		
True	69	27.0
False	82	32.0
Do not know	105	41.0
Rapid breathing uses up one's water storage reserves		
True	37	14.5
False	124	48.4
Do not know	95	37.1
Dehydration can lead to involuntary muscle contractions and sometimes, a loss of consciousness		
True	62	24.2
False	109	42.6
Do not know	85	33.2
Prolonged dehydration can cause urinary tract infections, kidney stones and even kidney failure		
True	38	14.8
False	121	47.3
Do not know	97	37.9

**Table 5.** Distribution of the daily water intake practices of Drivers according to their driving experiences and working hours per day.

Water/Beverage intake practices	Commercial Driving Experience (years)		p-value (chi-square test)	
	<10 years	≥10 years		
Volume of water usually consumed/day				
3–4 sachets (approx.1500ml–2000ml)	12	24	Sig (p- value) = 0.47	
5–6 sachets (approx. 2500ml–3000ml)	43	105		
>6 sachets (approx. >3000ml)	26	46		
Volume of water consumed a day before data collection				
3–4 sachets (approx.1500ml–2000ml)	14	34	Sig (p- value) = 0.12	
5–6 sachets (approx. 2500ml–3000ml)	45	77		
>6 sachets (approx. >3000ml)	22	64		
Drivers 'working hours per day				
		<15 hours/day	≥15 hours/day	p-value (chi-square test)
Volume of water usually consumed/day				
3–4 sachets (approx.1500ml–2000ml)	17	19	Sig (p- value) = 0.23	
5–6 sachets (approx. 2500ml–3000ml)	47	101		
>6 sachets (approx. >3000ml)	28	44		
Volume of water consumed a day before data collection				
3–4 sachets (approx.1500ml–2000ml)	23	25	Sig (p- value) = 0.34	
5–6 sachets (approx. 2500ml–3000ml)	39	83		
>6 sachets (approx. >3000ml)	30	56		

driving [25]. The finding also suggest that it is likely in approximately half of the study participants they might be performing their driving tasks dehydrated before they realize that they are thirsty.

The results also revealed that about half of the participants reported that they had consumed an energy drink a day prior to being interviewed.

Again, more than a third of the respondents also indicated that they drank soft drinks during the day. The high consumption of the soft drinks and energy drinks during the day is not surprising considering the tedious and laborious nature of driving for long hours probably with few brief breaks. Energy drinks have been reported to be regarded as fueling the

body with some amount of water and boosting the energy levels of drivers [13]. In support of this finding, other related studies also reported a high prevalence of energy drink intake among commercial drivers [14, 26]. The potential effects of the practice of frequent and high intake of energy drink include its association with a higher tendency to drink more alcohol [27]. In addition, it has been found that people who consume both soft and energy drinks are more likely to have poorer diets which contain less fruits and vegetables [26] and loaded with fats and sugars [28]. The high consumption of energy drink during the day has been found to be directly related to sleep disorders, feeling sleepy during the day while driving and a higher likelihood of engaging in risky and aggressive driving [13]. Sharwood et al. (2013) [28] further indicates that commercial drivers who are not well-rested as a result of drinking high quantities of energy drinks are more likely to be predisposed to road crashes often.

It is also worth noting that the perception that energy drinks can supply the body with some amount of water is not entirely true and as such it should not be used to substitute water. The reality is that intake of energy drinks rather leads to a depletion of the stored water in the body [29]. This comes about as a result of the diuretic effect of caffeine which is often present in energy drinks which increases the amount of water lost by the body through urine [30]. In extreme cases, this can lead to dehydration which becomes particularly harmful in people who drink energy drinks but do not know that they have to consciously refuel and rehydrate the body with additional water. The practice of drinking energy drinks by about half of the drivers suggests that they might rather be at risk of more water losses as a result of the diuretic effect of caffeine which is present in most energy drinks.

From the findings, it was evident that a major barrier to frequent intake of water as reported by majority of the drivers was to avoid frequent urination while on a journey. In support to the findings in this study, similar revelations were made in related studies in which drivers did not drink enough water in order to avoid frequent stop-overs to visit the bathroom which may delay their trips [9]. Even among the general population of non-commercial drivers, people deliberately avoid drinking water if they have to be somewhere without a bathroom [31]. However, regarding commercial drivers, the cautious attempt to avoid regular stops to use washrooms while on a journey may place drivers at a greater risk of dehydration which can impair cognitive performance as a result of a reduction in alertness and thus increase driving errors [31]. Another reason given by some drivers (about one-fifth) as a barrier to frequent intake of water was to avoid weight gain or a feeling of heaviness while driving. Contrary to this perception, there is some evidence that suggest that excessive intake of water can rather be protective against weight gain and thus recommendations have been made on drinking water for weight management [32]. For instance, the study of Vij et al (2014) [32] revealed that excessive water intake helps in weight reduction as a result of a reduction in body fat stores and appetite suppression in overweight persons.

Generally, a greater majority of the drivers did not know that pains in the joint, headaches, muscles and lower back area, hoarse/rough voice, rapid breathing, dry skin and mouth were signs that an individual was not drinking enough water or dehydration of the body. These findings have implications on the safety of drivers, passengers and other road users. This is particularly so when drivers are unable to quickly recognize that they are dehydrated in order to rehydrate their bodies given the daunting task of driving on congested road networks which requires being well-hydrated to fully concentrate. In a related study conducted by a vehicle leasing company, Leasing Options in the UK, it was also reported that around two-thirds (67%) of commercial drivers failed to recognize major symptoms of dehydration which include loss of focus and muscle cramps. In the study by Gursten (2017) [33] it was revealed that less than 60% of the drivers were able to recognize that dizziness, faint feeling and loss of concentration are symptoms of dehydration.

The results also reveal that out of the seven (7) roles of water for the promotion of a healthy body that were presented to the drivers, more

than half were unable to indicate that six (6) of them are some of the essential functions of water to the body. Of major concern is that more than 80% of the drivers did not know that water helps in removal or elimination of waste products from the body. This was also reflected in the findings that about 85% of the surveyed CLDDs were not aware that dehydration was directly associated with an increased risk of urinary tract infections, kidney stones and even kidney failure. This finding deserves to be mentioned considering reports that the burden of Chronic Kidney Disease (CKD) is rapidly rising in Ghana [34]. This poor knowledge levels of the commercial drivers regarding the importance of water intake in facilitating removal of toxic waste products out of the body deserves attention. This is because of the growing body of evidence which shows a protective effect of increased water intake on kidney function and health [35].

With regard to driver's knowledge levels on the effects of low water intake or dehydration on the body, majority had the perception that driving under the influence of alcohol was more dangerous than driving dehydrated. In other words, most of the drivers were of the view that driving while dehydrated was not as dangerous as driving under the influence of alcohol. The finding corroborates with that of another study among drivers in the UK where 84% of drivers thought that driving under the influence of alcohol was more dangerous than driving dehydrated [33]. However, Wing (2015) [9] revealed that drivers who drove in the dehydrated state made similar or the same number of mistakes as drivers who drove under the influence of alcohol. This is because dehydration has been shown to reduce concentration, slow reaction times, impair memory recall, and produce negative effects on mood which has an impact on driver's ability to safely drive, just as the effect of driving under the influence of alcohol [10].

In addition, more than half of the drivers did not know that dehydration was directly associated with reduction in energy levels, tiredness, reduction in transportation of oxygen to the body cells and a loss of consciousness. All these four effects of low water intake have a negative implication on the overall driving performance of drivers in addition to threatening their safety and that of others on the road.

## 5. Limitations

There are some limitations that need to be acknowledged. One limitation of this study is potential selection biases because only passenger CLDDs participated in the study. The use of only this category of drivers makes it impossible to generalize the findings to other categories of commercial drivers such as cargo or goods drivers. Another limitation associated with this study is the self-reports of the drivers on their water intake practices. The self-reports of water intake by the drivers can be biased by their tendency to provide responses consistent with expected norms (social approval bias) when in reality they might be doing otherwise (not drinking enough water daily).

Furthermore, information obtained from the CLDDs on the volumes of water that is usually consumed daily and the amount of water they drank a day before data collection were based on CLDDs' memory recall, which might have introduced recall bias in this study. The effect of recall bias was also present in recalling other fluids that were consumed aside water during the previous day prior to data collection. To minimize recall bias, the interviewer, with the permission of the driver, sometimes verified from sellers of water, soft drinks, fruit juices and fruits around the station about purchases made by some drivers who had difficulty remembering what they had consumed previously.

## 6. Conclusions

In conclusion, the findings raise serious concerns regarding the water intake and hydration practices of CLDDs. Knowledge gaps and misconceptions exist regarding healthy fluid intake, drink choices and overreliance on thirst sensations to prompt CLDDs to drink water. The findings indicate some misconceptions of drivers such as drinking energy

and soft drinks as a means to quench their thirst. Given the current findings, commercial drivers are being urged to recognize the dangers of driving while dehydrated, which can have the same effects as drunk-driving. The findings of this study have implications on an active involvement of Occupational Health experts, Dieticians and Nutritionists to collaborate with Commercial Drivers Unions to roll-out programmes aimed at educating drivers on the importance of staying well hydrated. These public health awareness campaigns aimed at encouraging drivers to keep themselves hydrated may help to reduce the risk of road accidents. A recommendation for further study is the need to have more experimental investigations to gain insight into the hydration status of CLDDs employing biochemical tests using blood and urine indices or hormone analysis.

## Declarations

### Author contribution statement

Christiana Naa Atsreh Nsiah-Asamoah: Conceived and designed the experiments; Analyzed and interpreted the data; Wrote the paper.

David Nii Baah Buxton: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

### Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

### Data availability statement

Data will be made available on request.

### Declaration of interests statement

The authors declare no conflict of interest.

### Additional information

No additional information is available for this paper.

## Acknowledgements

The authors highly acknowledge the two Research Assistants – Samuel Ofori and Clement Adu – who assisted with the data collection. The authors appreciate all the Station Masters and the Drivers for providing a receptive environment for the study to be conducted.

## References

- [1] National Road Safety Commission, Road Traffic Crash Statistics-2016, Accra, 2016.
- [2] E.T. Perrier, Shifting focus: from hydration for performance to hydration for health, *Ann. Nutr. Metabol.* 70 (Suppl. 1) (2017) 4–12.
- [3] E.T. Perrier, L.E. Armstrong, J.H. Bottin, W.F. Clark, A. Dolci, I. Guelinckx, A. Iroz, S.A. Kavouras, F. Lang, H.R. Lieberman, O. Melander, Hydration for health hypothesis: a narrative review of supporting evidence, *Eur. J. Nutr.* (2020 Jul 6) 1–4.
- [4] WHO, Guidelines for drinking-water quality, *WHO Chron.* 38 (4) (2011) 104–108.
- [5] S. Baron, M. Courbebaisse, E.M. Lepicard, G. Friedlander, Assessment of hydration status in a large population, *Br. J. Nutr.* 113 (1) (2015) 147–158.
- [6] P.T. Doegah, A.Y. Amoateng, Water intake among Ghanaian youth aged 15–34 years: quantitative and qualitative evidence, *J. Health Popul. Nutr.* 37 (1) (2018) 3.
- [7] N.A. Wardrop, M. Dzodzomenyo, G. Aryeetey, A.G. Hill, R.E. Bain, J. Wright, Estimation of packaged water consumption and associated plastic waste production from household budget surveys, *Environ. Res. Lett.* 12 (7) (2017), 074029.
- [8] P. Watson, A. Whale, S.A. Mears, L.A. Reynier, R.J. Maughan, Mild hypohydration increases the frequency of driver errors during a prolonged, monotonous driving task, *Physiol. Behav.* 147 (2015) 313–318.
- [9] J. Wing, Dehydrated Drivers Make the Same Number of Mistakes as Drink Drivers, 20, Loughborough University, 2015.
- [10] D. Benton, H.A. Young, Do small differences in hydration status affect mood and mental performance? *Nutr. Rev.* 73 (suppl\_2) (2015) 83–96.
- [11] D. Benton, K.T. Jenkins, H.T. Watkins, H.A. Young, Minor degree of hypohydration adversely influences cognition: a mediator analysis, *Am. J. Clin. Nutr.* 104 (3) (2016) 603–612.
- [12] S. Coe, R. Williams, Hydration and health, *Nutr. Bull.* 36 (2) (2011) 259–266.
- [13] Z. Erdogan, M.A. Kurcer, The effect of energy drink consumption on fatigue and sleep disorders in bus drivers, *J. Transport. Saf. Secur.* 11 (2) (2019) 117–128.
- [14] E.Y. Saku, P. Nuro-Ameyaw, P.C. Amenya, F.M. Kpodo, P.E. Amofo, N.K. Kortei, Energy drink: the consumption prevalence, and awareness of its potential health implications among commercial drivers in the Ho Municipality of Ghana, *BMC Publ. Health* 20 (2020) 1304.
- [15] C. Osei-Boateng, E. Ampratwum, The Informal Sector in Ghana, Accra: Friedrich-Ebert-Stiftung, Ghana Office, 2011.
- [16] H.A. Abban, Cardiovascular Diseases Risk Factors Among Commercial Long-Distance Bus Drivers in Cape Coast, Doctoral dissertation, University of Ghana, 2013.
- [17] C.A. Appiah, E.O. Afriyie, F.E.A. Hayford, E. Frimpong, Prevalence and lifestyle-associated risk factors of metabolic syndrome among commercial motor vehicle drivers in a metropolitan city in Ghana, *The Pan Afr. Med. J.* 36 (2020).
- [18] S. Sasu-Mensah, Road Traffic Accidents on the Accra–Kumasi–Tamale Road Corridor, Doctoral dissertation, University of Ghana, 2015.
- [19] N.A. Shaheen, A.A. Alqahtani, H. Assiri, R. Alkhodair, M.A. Hussein, Public knowledge of dehydration and fluid intake practices: variation by participants' characteristics, *BMC Publ. Health* 18 (1) (2018) 1346.
- [20] Jennifer C. Veilleux, et al., Examining the links between hydration knowledge, attitudes and behavior, *Eur. J. Nutr.* (2019) 1–10.
- [21] L.E. Armstrong, E.C. Johnson, Water intake, water balance, and the elusive daily water requirement, *Nutrients* 10 (12) (2018) 1928.
- [22] Centers for Disease Control and Prevention, General Physical Activities Defined by Level of Intensity. Adapted from US Department of Health and Human Services, Promoting Physical Activity: A Guide for Community Action, 2005.
- [23] C. Bhanu, C. Avgerinou, K. Kharicha, Y. Bauernfreund, H. Croker, A. Liljas, J. Rea, M. Kirby-Barr, J. Hopkins, K. Walters, 'I've never drunk very much water and I still don't, and I see no reason to do so': a qualitative study of the views of community-dwelling older people and carers on hydration in later life, *Age Ageing* 49 (1) (2020) 111–118.
- [24] S.K. Riebl, B.M. Davy, The hydration equation: update on water balance and cognitive performance, *ACSM's Health & Fit. J.* 17 (6) (2013) 21.
- [25] N.A. Masento, M. Golightly, D.T. Field, L.T. Butler, C.M. van Reekum, Effects of hydration status on cognitive performance and mood, *Br. J. Nutr.* 111 (10) (2014) 1841–1852.
- [26] L. Varvil-Weld, M. Marzell, R. Turrisi, K.A. Mallett, M.J. Cleveland, Examining the relationship between alcohol-energy drink risk profiles and high-risk drinking behaviors, *Alcohol Clin. Exp. Res.* 37 (8) (2013) 1410–1416.
- [27] E. Faris, Patterns of caffeinated energy drinks consumption among adolescents and adults in Hail, Saudi Arabia, *Food Nutr. Sci.* 5 (2) (2014).
- [28] L.N. Sharwood, J. Elkington, L. Meuleners, R. Ivers, S. Boufous, M. Stevenson, Use of caffeinated substances and risk of crashes in long distance drivers of commercial vehicles: case-control study, *BMJ* 346 (2013) f1140.
- [29] R. Mora-Rodriguez, J.G. Pallares, Performance outcomes and unwanted side effects associated with energy drinks, *Nutr. Rev.* 72 (suppl\_1) (2014) 108–120.
- [30] J.C. Veilleux, A.R. Caldwell, E.C. Johnson, S. Kavouras, B.P. McDermott, M.S. Ganio, Examining the links between hydration knowledge, attitudes and behavior, *Eur. J. Nutr.* 3 (2019), 1–0.
- [31] M.T. Wittbrodt, M. Millard-Stafford, Dehydration impairs cognitive performance: a meta-analysis, *Med. Sci. Sports Exerc.* 50 (11) (2018) 2360–2368.
- [32] V.A. Vij, A.S. Joshi, Effect of excessive water intake on body weight, body mass index, body fat, and appetite of overweight female participants, *J. Nat. Sci. Biol. Med.* 5 (2) (2014) 340.
- [33] S.M. Gursten, Can Driving Dehydrated Be as Dangerous as Driving Drunk? Michigan Auto Law, 2017. <https://www.michiganautolaw.com/blog/2017/06/08/driving-dehydrated-dangerous-as-driving-drunk/>.
- [34] E.K. Tannor, F.S. Sarfo, L.M. Mobula, O. Sarfo-Kantanka, R. Adu-Gyamfi, J. Plange-Rhule, Prevalence and predictors of chronic kidney disease among Ghanaian patients with hypertension and diabetes mellitus: a multicenter cross-sectional study, *J. Clin. Hypertens.* 21 (10) (2019) 1542–1550.
- [35] W.F. Clark, J.M. Sontrop, S.H. Huang, L. Moist, N. Bouby, L. Bankir, Hydration and chronic kidney disease progression: a critical review of the evidence, *Am. J. Nephrol.* 43 (4) (2016) 281–292.