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Adherence to social distancing and wearing of masks within public transportation during the COVID 19 pandemic

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ABSTRACT

The first two cases of COVID-19 in Ghana were recorded on March 12th 2020. As a guideline, government issued directives on physical distancing and the use of face masks to curb community spread of the disease. Given that public transport has been identified as a high-risk environment for transmission, it was of interest to ascertain user and operator compliance to guidelines for public transport operations during the period, as a measure of its risk level. A roadside observer survey, of over 850 of the most popular paratransit (trotro) buses was carried out on one of the major roads in Kumasi. Compliance to the policy on physical distancing was determined using guidelines from the Ministry of Transport, while compliance to the policy on face masks was determined by the researchers themselves based on the number of commuters with/without face masks per bus. The results suggest that majority (98.0%) of buses comply with the social distancing guidelines established by the Ministry of transport, however the policy on face masks was complied with only partially in most vehicles. About 12.6% of the vehicles had fewer than three commuters without face masks, while 21.3% of buses that had fewer than 3 people with face masks. The results suggest public transport remains an area of high risk in the fight against COVID-19. It is recommended that operators are given additional directives that restrict them from allowing commuters without face masks on board their vehicles, and as well, that police enforce the policy through fines.

1. Introduction

Ghana's first two cases of COVID-19 were confirmed nearly five months after the first identified case in Wuhan, China. Both were imported by travelers returning from countries (Pasley, 2020) that had already confirmed COVID-19 infections (Ministry of Health, 2020). Ghana at the time fell under the category of African countries that had a moderate risk of importation based on the volumes of air travel departures from China (Gilbert et al., 2020). The first confirmed cases coincided with the government's announcement that it had directed the cedi-equivalent of $100 million towards a national response plan in tackling a possible spread of the virus. The measures that followed were the implementation of a travel advisory that would culminate in the closure of all national borders, the closure of universities, and a ban on public gatherings such as religious meetings and funerals, significant aspects of Ghanaian culture and life (Adu et al., 2020). The country would enter a two-week partial lockdown, that extended to a third week, from the 30th of March 2020 to the 20th of April 2020. The government would within this time, restrict travel within and between cities, including the two biggest cities, Accra and Kumasi, which have populations of 2.5 million and 3 million each (Ghana Statistical Services, 2019).

The ministry of health would as well, focus on reducing the number of imported cases, initially by quarantining all travelers entering the country within weeks of the first confirmed cases, and gradually, adopting an intensive community and cluster-based contact tracing regime. Contact tracing was done using community surveillance and phone calls to people who had come in contact with known COVID-19 patients. The goal in contact tracing was the detection and isolation of new cases, to prevent the spread of infection. A contact was determined to be a person who interacted with a laboratory confirmed COVID 19 patient through any of the following ways: living together in the same household with the Covid-19 patient, travelling together with the Covid 19 patient in any kind of conveyance, working together with, or being in close proximity with a confirmed case without requisite PPE (World Health Organization, 2020a).

The process of contact tracing would result in the testing of some 86,000 people during the lockdown in April, and allowed the country to be first on the continent in the number of COVID-19 tests per million people. At the time the lockdown was lifted, the country was sixth in infections on the continent with 2169 cases 229 recoveries and 18 deaths, numbers which could have been significantly higher without these interventions. Fig. 1 shows the increasing number of cases in Ghana in comparison to Algeria, Australia, Cote d'Ivoire, Kenya, South Korea and Tunisia, over a 5-month period.

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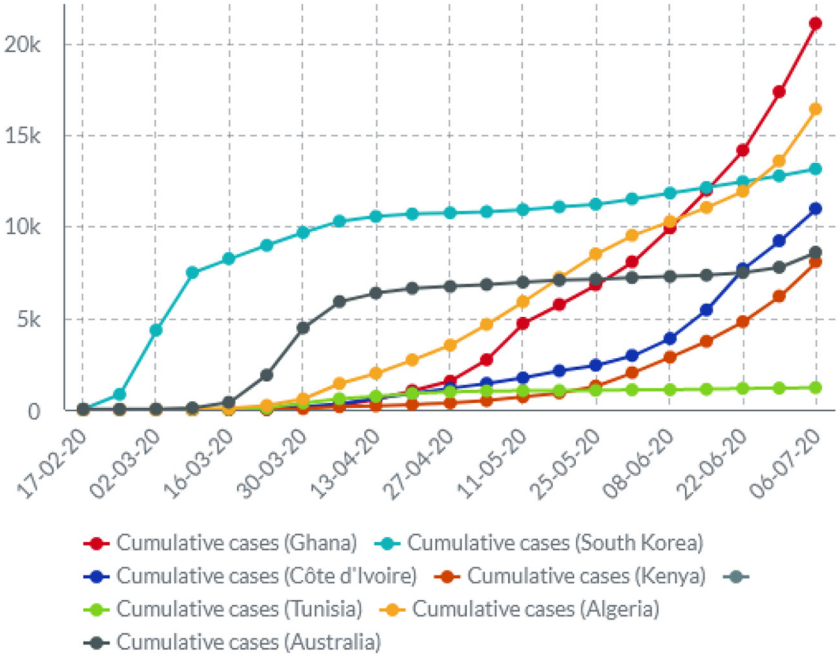

Fig. 1. Cumulative number of cases in Ghana, and 6 other countries Source; authors rendering based on case count from Worldometer.com

1.1. Face masks as a mode of preventing the transmission of SARS-CoV-2

According to Javid et al. (2020) maximal viral shedding of SARS-CoV-2 occurs early in the course of the illness. Patients may therefore be contagious before they develop symptoms or realize they are infected. Transmission of COVID-19 by individuals who do not show symptoms of the virus have been documented, and mathematical models suggest that between forty and 80% of initial transmission was due to transmission from pre-symptomatic and asymptomatic people. Available data supports the notion that the virus can spread during normal breathing, and that individuals that are seemingly well can still shed high titres of the virus for onward transmission.

Kraemer et al. (2020) using real-time mobility data from Wuhan, highlighted the role of transportation in transmission of the virus across China. They identified that early on, the spatial distribution of COVID-19 cases in China could be explained based on the patterns of human mobility. After the implementation of lockdowns, this correlation dropped and the growth rates in infection became negative in most locations, although shifts in the demographics of reported cases were still indicative of local chains of transmission outside of Wuhan.

Liu and Zhang (2020) also highlight the role of face masks in reducing the spread of COVID-19. They used an analysis of a typical case of cluster outbreak as a result of public transportation exposure in China. One individual travelling from Chongqing, China, transmitted the COVID-19 virus to five other people in the same vehicle when he did not wear a face mask, and transmitted it to no one on a second vehicle (on the second half of the same journey) after he wore a face mask. The Center for Disease Control and Prevention conducted an epidemiological investigation and close contact tracing to screen and treat all passengers that had come in contact with the suspected case. The 14-day medical observation showed that all passengers that had come in contact with the infected individual after he wore a face mask, did not have COVID-19, while 5 of the 39 passengers that had come in contact with the individual on the first bus, had contracted the disease.

Howard et al. (2020) argue that, wearing a face mask reduces the transmissibility per contact by reducing transmission of infected droplets as witnessed in both laboratory and clinical contexts. They state that the use of face masks could be most effective at stopping spread of the virus when compliance is high among larger populations. The decreased transmissibility could substantially reduce the death toll and possibly, the economic impact from COVID-19.

1.2. Availability of face masks in Ghana

It is argued that, although standardized masks such as the N95 (American standard) or FFP2 (its equivalent in Europe) are most effective in reducing risk of contracting COVID-19, these standardized masks can be expected to become scarce in the course of a global pandemic such as COVID-19 (Howard et al., 2020). According to Greenhalgh et al. (2020) however, even cloth masks, in the absence of these standardized masks, may be only marginally (15%) less effective in blocking emitted particles. They state that cloth masks are fivefold more effective than not wearing one, while offering a good measure of protection to the user.

Given the scarcity of these standardized face masks at the time, the few that were acquired by the Ghanaian government within the country and from donors, were directed mainly to frontline health workers and healthcare providers. In a 6th address to the nation, the President of the Republic of Ghana, instituted the local production of some 3.6 million face masks, at a rate of one hundred and fifty thousand a week, to ensure the availability of the personal protective equipment for ordinary citizens beyond the lockdown.

To this end, the Food and Drugs Authority (FDA) was authorized to evaluate the quality of face masks that were being locally produced, to ensure they met basic standards for use. The Ministry of Health also made known to the public, standards for manufacturing face masks as personal protective equipment (PPE). They encouraged the use of java or wax cloths sewn in a triple-layered fashion, stringed with side loops as hooks to the ear, Calico inlaid with fabric stiffener with side loops as hooks to the ear, and as well, homemade masks with strings to be tied behind the neck or head (Zurek, 2020).

Prices of these locally made face masks ranged between GHC1 (US$ 0.17) to GHC7 ($1.2) on average, while the price of surgical masks, shot to about GHC100 (US$17.48) per box from their previous GHC9 (US $1.57) before the pandemic. N95 masks that typically sold for GHC 10 ($1.75) also sold for roughly GHC 25 ($4.37) per mask. This surge in prices was attributed to the overwhelming demand for masks, particularly by foreign nationals who bought them for onward delivery to their families overseas (Alamisi, 2020) [prior to Ghana's first case].

Donations of essential items such as local wash sinks, face masks and hand sanitizers were made to some transport operators in selected parts of the country by government and other private entities. However, the vast majority of transport operators and users were expected to acquire their own face masks and hand sanitizers during the period.

1.2.1. Ghanaians' preparation towards the outbreak

In an assessment of individual preparedness for the COVID-19 outbreak in Ghana, 68% of Ghanaians thought they were at high risk of contracting COVID-19, 63% thought they were knowledgeable about the disease and its spread, 90% increased the frequency and consistency with which they washed their hands, and 73% used hand sanitizers regularly. The use of face masks also registered 33% use regularly, 43% occasional use, and 24% non-use within the first week of the outbreak (Serwaa et al., 2020).

Cheng et al., 2020b suggest that although some individuals may opt to wear face masks to protect themselves, a stronger public health rationale is to advocate for mass masking as a way of protecting others within one's community. They considered this particularly of importance because of the possible asymptomatic transmission of the virus. They argue that, mass masking is underpinned by the 'prevention paradox', that essentially brings moderate benefits to individuals, but has significant benefits for larger populations. The wearing of masks in their perspective, is as important a measure as mitigation (through handwashing), and physical distancing.

1.3. Public transport operations in Ghana during the COVID-19 pandemic

In Ghana, paratransit services ('trotros') are the primary mode of transport for intracity travel among the majority of commuters because of how relatively affordable they are (Hotor, 2016). The service which is solely run by the informal sector (Hart, 2013) seats between 15 and 21 passengers, depending on the size of the bus and number of seats fabricated for a bus by local metalsmiths (Tetteh et al., 2017). The buses are however, often overcrowded, presenting a possible health hazard for the spread of infectious diseases (Goscé and Johansson, 2018) such as Covid-19. Other forms of public transportation such as station-based and chartered taxi cabs, motorcycle taxis (Tuffour, 2014), tricycle services ('Pragya'), on-demand ride-hailing (Acheampong et al., 2020; Dzisi et al., 2020) and bus rapid transit services (Vermeiren et al., 2015) exist in most Ghanaian cities. Trotros are however most popular, because they have cheap fares, and large vehicle fleets that ply most roads across the country. In Kumasi, there are an estimated 10,000 of these vehicles (KOICA, 2016).

As a result of their informal natures, operators of trotro and some taxi cab services are unionized under the Ghana Private Road Transport Union (G.P.R.T.U), a member of the Trade Union Congress. This allows these commercial drivers to have their interests represented with the government, and allows government as well regulate their services through directives, especially in times where public transport management requires collaborative effort between government and the operators. The ministry of transport's directives for intercity travel during COVID-19, were issued on the 18th of March 2020, and included; (i) the placement of locally devised wash sinks called "veronica buckets" at all bus stations, (ii) an insistence on the washing of hands by passengers at bus stations before boarding vehicles, (iii) the regular washing of buses, (iv) a ***reduction in the number of occupants per vehicle, and a need for physical distancing in vehicles*** (v) opening of windows to allow aeration within vehicles and (v) the collection of passenger cellphone numbers to enhance contact tracing in case there was the need for it.

The transport union and road transport coordinating council subsequently put out a directive on the 29th of March 2020 stating;

- "Every passenger carrying-vehicle including taxis that typically seat between 1 and 3 people on a row should seat no more than two passengers on a row.
- All Passenger Carrying-vehicles that seat 1–4 people on a row should seat no more than three passengers on a row
- All Passenger carrying vehicles that seat 1–5 people on a row should seat no more than three passengers on a row." (Ansah, 2020).

The health ministry would as well issue guidelines, six (6) days after the partial lockdown was lifted, stating;

"The following groups or persons are required to at all times wear masks; Food vendors and sellers at markets, ***commercial vehicle drivers and attendants, commuters on public transport***, persons in public and commercial centers…".

The ministry's website also provided an illustration of the appropriate way to use the face mask, showing that users were not supposed to loosen it around their neck but to have it fully cover their nose, mouth, and chin and be snug on the side of the face. The guidelines would be in effect at the time of this study, although there were no penalties for not meeting directives at the time. The Ministry of information hosted regular press briefings during the period to update citizens on the country's situation using various media (radio, television, social media and print media) (Addo-Lartey et al., 2020).

Table 1 shows a summary of the various guidelines that were established for particularly public transport operations during the COVID-19 pandemic.

2. Materials and methods

Using the directives on physical distancing and face masks as criteria, the authors carried out a roadside observer survey of user and operator compliance to the COVID-19 guidelines for public transport, as a measure of the risk levels involved in public transport use during the period.

Roadside observer surveys, which are a technique that involves the use of trained observers to categorize road user behavior, was determined as an appropriate data collection method because it allowed a fair assessment of operator and commuter compliance in real time, without violating the WHO Ethical guidelines for research during public health emergencies (World Health Organization, 2020b). The methodology of roadside observations was as well consistent with Beutel et al. (2017) who used the approach in determining driver compliance in wearing seatbelts in Namibia.

Roadside observations in this study were carried out by two trained observers, each collecting data on one of the separate categories of compliance i.e. in-vehicle physical distancing and in-vehicle use of face masks. Observations of vehicles were tallied under compliant or non-compliant based on the established transportation guidelines. Compliance to the physical distancing guideline was determined to be a situation where the maximum number of commuters on a row was in conformance with the GPRTU and Ministry of Transport directives. Non-compliance as well was determined as a situation where there was some observed violation of this guideline.

According to the Ministry of health as well, no one should have been using public transport without face masks. However, an adjusted maximum of 2 people per bus without face masks was determined by the researchers in this study, to account for extreme economic hardships (Danquah and

Table 1
Modifications in public transport operations during COVID-19.

Actor	Guidelines	Issuing Authority
Public transport operators	(i) Placement of "veronica buckets" at all bus stations, (ii)Ensure commuters wash their hands before boarding vehicles (iii)Regularly wash buses (iv)Reduce the number of occupants per vehicle and ***ensure in-vehicle physical distancing,*** (v)Opening of windows to allow aeration within vehicles (vi)Collect commuter cellphone contacts in notebooks in case there is need for contact tracing	Ministry of Transport and GPRTU
Individual commuters	(i)Use of face masks by ***commercial vehicle drivers, attendants, and commuters*** in public transport	Ministry of Health

Table 2
Field observation data.

Survey day	Time	No. Face mask observations	No. Physical distancing observations
Monday 5th May 2020	8:40 am to 9:41 am	259	290
Tuesday 6th May 2020	7:46 am to 8:52 am	286	299
Wednesday 7th May 2020	4:33 pm to 5:33 pm	140	145
Thursday 8th May 2020	4:48 pm to 5:50 pm	174	175

Schotte, 2020; Dzansi, 2020) that could have inhibited a person from possibly owning a mask. Even though compliance to the policy was an individual responsibility, buses were categorized as compliant or non-compliant based on the number of commuters with face masks, on board a vehicle (Table 3). Measuring compliance this way allowed for the aggregation of commuter compliance per bus. The survey was carried out at Tech Junction, a major bus stop on the Accra Kumasi road where passengers alight and/or get on board vehicles towards the central business district. The activities at the stop allowed for vehicles to travel at slow speeds (< 20 km/h) or grind to a halt. These stoppings, and as well, the fact that most vehicles had their windows open, allowed for adequate observations of in-vehicle situations. Data collected from the observations were analyzed using descriptive statistics. Table 2 shows the days and times the roadside observations were carried out and the number of observations per category.

The differences in volumes could be attributed to the higher number of commuters that traveled in the morning towards the central business district, in comparison to the slightly lower traffic volumes recorded for buses in the same direction in the evening.

Table 3 shows how compliance and non-compliance for both the policy on face masks and physical distancing were categorized in this study. Larger buses such as Benz Sprinters and Ford transit buses which typically seat four or five commuters on a row were considered compliant where there was a maximum of three commuters and non-compliant where there were more than three people on any row of the vehicle. A sub-category for non-compliance in the use of face masks was as well created after the first day, and termed 'disregard for the policy', to estimate the number of vehicles that had fewer than three people wearing the face masks.

3. Results and discussion

3.1. Correlation between increased mobility and increased case counts

Prior to the field survey, an initial analysis of COVID-19 case counts and mobility trends was done using Google Mobility data and resources from Ourworldindata.com (an open access resource for tracking COVID-19). The plots were aimed at evaluating possible correlations between the rise in case counts and a change in mobility trends. Fig. 2, shows the comparison between case counts, and mobility trends at specifically transit stops. The plot suggests initial evidence of a possible correlation between the rise in cases and an increase in mobility after the lockdown. Similar correlations exist for retail, recreational areas and workplaces, confirming earlier studies (Gilbert et al., 2020; Kraemer et al., 2020).

Table 3
Categorizing Compliance and Non-compliance.

Category	Compliance	Non-compliance
Wearing of face masks	Where a **maximum of 2** people use a trotro without a face mask	Where **3 or more** commuters in a bus are without face masks
Physical distancing	Where a **maximum of 2** people were seated on a row for smaller buses, or where a **maximum of 3** people were seated on a row for larger buses	Where **more than 2** people were seated on any row of a smaller bus, or where **more than 3** people were seated on any row for larger buses

3.2. Results from observations

The results of the cross-sectional roadside observation of vehicles travelling through Tech Junction as well suggests that on average, compliance with the guidelines for wearing face masks was 12.6%, and compliance for physical distancing within vehicles was 98.0%. 21.3% of vehicles also registered complete disregard for the policy on wearing face masks, where fewer than three people wore a mask in the vehicle. On average, four commuters per vehicle did not wear face masks, even under the current ministry of health guidelines. A majority of vehicles however, were adherent to the social distancing policy, although adherence was not to suggest a particularly enhanced sense of hygiene in operations.

In terms of a total disregard for the policy on face masks, 37 vehicles (12.4%) of vehicles on Tuesday, 43 (30.7%) of vehicles on Wednesday, and 48 (27.6%) of vehicles on Thursday, had fewer than 3 people wearing a face mask and were considered in total disregard for the policy.

Table 4 shows the compliance and non-compliance levels for each of the days. Figs. 3 and 4 as well present graphical representations of compliance with the policy on masks, and the compliance with guidelines on in-vehicle physical distancing respectively.

A chi-square test of independence was additionally performed to examine the relation between period of day and the compliance to the use of face masks. The relation between these variables was significant, X^2 (1, N = 859) = 8.296., p = .003973. Higher degrees of compliance in the use of face masks were more likely to be observed in the mornings as compared to evenings. The chi-square statistic with Yates correction was also 7.6919 with a p-value of 0.005547 significant at $p < .01$.

Another peculiar observation was that, although the guidelines stated commercial vehicle drivers and their attendants were to use face masks, more drivers could be observed using face masks as compared to mates. The job of the "mate", which involves the calling out of the trotro's route to attract commuters, could perhaps have been difficult to do with a mask on, since the gear could end up muffling the sound they make in calling commuters. This however presents a concern in the management of COVID-19, since an attendant in their interactions with passengers, could unwittingly become an agent for the transmission of COVID-19, should they contract it themselves.

With the increasing body of evidence suggesting the wearing of face masks as an effective approach in curbing the spread of COVID-19 (Howard et al., 2020), particularly in public transport vehicles (Liu and Zhang, 2020), there is a need to ensure better compliance with this policy among users and operators, to potentially reduce the likelihood of increased infections in the country.

Since cloth masks have been determined to be only marginally ineffective in protecting people from COVID-19, government must direct more of the resources allocated for the country's COVID-19 response towards the production and distribution of masks among citizens. Police must as well be given the mandate to enforce the use of masks through fines to ensure there is compliance with the measure. Additional directives should be established for public transport, that discourage operators from allowing commuters without masks on board, and fines must be applied to individual commuters spotted without masks. This policy on mass masking is important since Cheng et al., 2020a attest the 96% compliance in the use of face masks in Hong Kong played a contributory role in reducing the rates of COVID-19 infections in the country, as compared to other countries such as Spain, Italy, Germany, France and the US, which had comparable population densities, health care systems and social distancing measures. The current 12.6% compliance with the use of face masks in Ghana suggests the existence of a gap in the implementation of this key preventative measure in reducing the spread of COVID-19.

Despite these findings, it is also important to mention some of the limitations of this survey. The first limitation was the fact that it used a cross sectional approach, and could therefore not capture compliance of

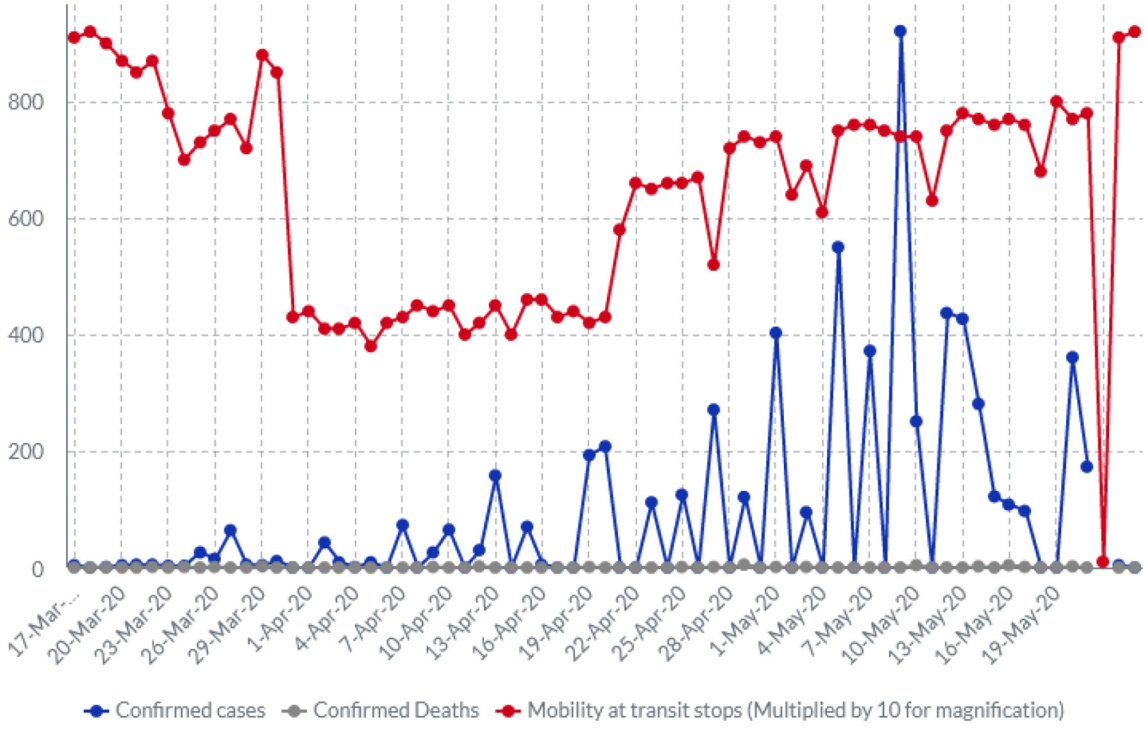

Fig. 2. Mobility trends against Covid 19 case count and confirmed deaths. Source: authors rendering based on Google mobility trends and data from OurWorldindata.org

Table 4
Compliance and Non-compliance.

	Compliance	Non-compliance
MONDAY		
Personal protective gear/Face mask	49 (18.9%)	210 (81.1%)
Vehicle spacing and social distancing	275 (94.8%)	15 (5.2%)
TUESDAY		
Personal protective gear/Face mask	33 (11.5%)	253 (88.5%)
Vehicle spacing and social distancing	294 (98.3%)	5 (1.7%)
WEDNESDAY		
Personal protective gear/Face mask	11 (7.9%)	129 (92.1%)
Vehicle spacing and social distancing	143 (98.6%)	2 (1.4%)
THURSDAY		
Personal protective gear/Face mask	15 (8.6%)	159 (91.4%)
Vehicle spacing and social distancing	169 (96.6%)	6 (3.4%)
AVERAGE		
Personal protective gear/Face mask	**108 (12.6%)**	**751 (87.4%)**
Vehicle spacing and social distancing	**871 (98.0%)**	**18 (2.0%)**

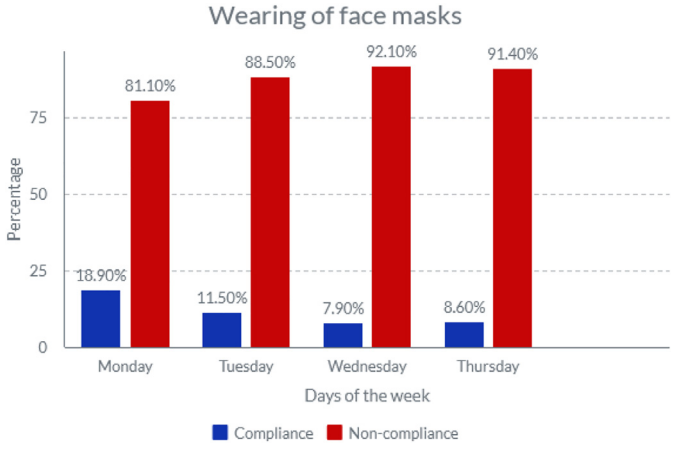

Fig. 3. Compliance and non-compliance with wearing face masks.

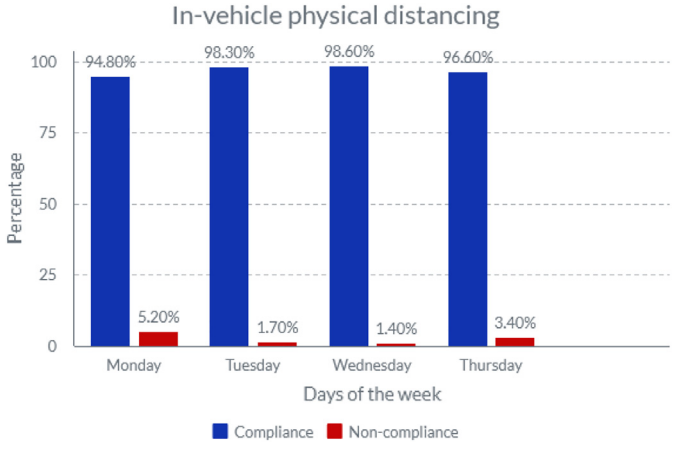

Fig. 4. Compliance and non-compliance with in vehicle physical distancing.

commuters throughout their journey. Secondly, the choice of a singular location meant that compliance levels in other parts of the city may not be accounted for particularly if attitudes towards the directives were varied in different parts of the city. Finally, the duration of the study was short, and therefore, suggestions made are based on the solutions that have been found to be effective in other places.

4. Conclusion

In conclusion, the policy on physical distancing within vehicles is adhered to, however, the policy on the use of face masks in vehicles requires stricter enforcement. The interventions (lockdowns, physical distancing and wearing of masks) during COVID-19 are designed to reduce the rate of hospitalizations that occur, particularly of critically ill patients, to allow the healthcare systems of countries cope with the disease. For a country such as Ghana that has a doctor to patient ratio of 1:84,813 (Henkens,

2020) and a current bed capacity of about 700 beds for COVID-19 (Annoh, 2020), significant rises in the number of cases can pose a challenge to the management of the disease.

The policy for physical distancing requires transport operators to reduce the number of passengers per vehicle by about 30% for most trotros, which has negative financial implications for these operators. The policy which was met initially by apprehension because of these economic loses, however registered a strong degree of compliance (98%) probably as a result of government provided buffers such as a reduction in the price of fuel, the subsidizing of electricity and water bills for all citizens, and agreements between government and the operators union.

Regarding the use of face masks within public transport vehicles however, there was complete compliance (fewer than 3 people without face masks) about 12.6% of the time, with mostly partial-compliance observed majority of the time. Complete disregard for the policy on face-masks (fewer than 3 people wearing a mask in a vehicle) also occurred about 21.3% of the time. On average, 4 people per vehicle were not wearing the face masks. These results suggest the existence of a significant gap in the implementation of the policy on face masks and the need for much more effective implementation of the policy.

It is recommended based on these findings and others (Cheng et al., 2020a; Greenhalgh et al., 2020; Howard et al., 2020) that the government directs a significant portion of its COVID-19 resources towards the production and distribution of affordable/reusable face masks for citizens. Government should as well bear the cost of providing free face masks to poorer communities (Tsifodze, 2020) who may be exceptionally vulnerable and perhaps unable to afford them at this time. Further, there should be additional directives given to discourage operators from allowing commuters without masks on board, and as well, the use of fines and policing to enforce these policies. Finally, government should continue to use media platforms to continually sensitize citizens on the benefits of using face masks, to encourage their voluntary use. Together, the implementation of these strategies can reduce the risk levels and possible transmission of COVID-19 on public transport during the period, and help the country contain the spread of the disease.

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CRediT authorship contribution statement

Emmanuel Komla Dzisi Junior: Conceptualization, Methodology, Investigation, Formal analysis, Writing - original draft, Writing - review & editing. **Oscar Akunor Dei:** Conceptualization, Investigation, Writing - review & editing.

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