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# Predicting the Adoption of COVID-19 Public Health Preventive Measures in Ethiopia: Application of Health Belief Model

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***Abstract***

*In the face of coronavirus disease pandemic, adherence to public health measures largely influences their effectiveness in containing the spread. Four specific objectives guided this study: (i) Assess whether individuals are adhering to the COVID-19 preventive measures promoted by Ethiopian government; (ii) Examine the heterogeneity in adoption of preventive measures in Ethiopia; (iii) Identify the factors affecting adherence to preventive measures-based health belief model; and (iv) Examine the moderating effects of socio-economic factors on the relationship between adherence to preventive measures and HBM factors. The study relied on a nationally representative cross-sectional survey commissioned by the World Health Organization in 2021 for Ethiopia. Data was collected from 895 individuals aged 18 years of age or older. Analysis applied several methods including the Multiple Correspondence Analysis, Univariate analysis, hierarchical cluster analysis, cluster analysis and multiple regression analysis. Using face masks and washing hands were the most frequently practiced preventive measures. The regression analysis indicated that perceived severity, perceived barriers, and cues to action showed a significant association with adherence at p >0.05. Furthermore, socio-economic factors have a moderating role on adherence to preventive measures and HBM factors. Effective promotion and adoption of preventive measures require addressing individuals' perceptions of severity and benefits while minimizing barriers and providing clear cues to action. Additionally, specific preventive measures that require ongoing effort and habit development may face challenges in adoption. Tailoring interventions can help overcome these challenges and encourage the widespread adoption of preventive measures to curtail the spread.*

***Keywords:*** *Coronavirus disease - 2019, Prevention, Health belief model.*

## Introduction

The emergence of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and its subsequent spread across the globe was a public health and economic crisis. On 30 January 2020, the WHO Director-General determined that the outbreak of coronavirus disease (COVID-19) constituted a Public Health Emergency of International Concern and confirmed its continuation on 30 April 2020 [1, 2]. The novel virus transmits mainly through respiratory droplets or aerosols dispersed through talking, coughing, and sneezing, etc, and close human contact with infected persons. The droplets penetrate the host human body especially into the lungs via inhalation through the nose or mouth. Individuals can also be infected by touching their face, especially eyes, nose, and

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mouth after touching surfaces contaminated with the virus [3, 4].

The COVID-19 outbreak was a significant threat to public health and an emerging infectious disease. Since COVID-19 posed such severe threats and there was no COVID-19 vaccine available for most countries at the time of the spread, preventive measures were necessary to decrease infection rates and stop the spread of the disease [5]. As recommended by WHO and governments, public health measures were introduced. As an example, the World Health Organization recommends avoiding contact between infected and non-infected individuals, implementing early detection and case isolation, and adopting general hygiene measures both individually and collectively to prevent COVID-19 from spreading. A community-level disease prevention measures may include lockdowns, curfews, isolation of infected populations, prohibitions of social gatherings, and mandatory home quarantine, while individual-level DPM may involve wearing face masks in public, frequent hand washing, and social isolation [6].

Against COVID-19, Ethiopia implemented strict preventative measures to control its spread, protect its citizens, and ensure their well-being [5]. Several initiatives were taken by the Ethiopian Ministry of Health and Public Health Institute since the first case of COVID-19 was confirmed in March 2020. Government communication through various media platforms emphasized hand hygiene, facemasks, and social distancing as the primary three preventive measures. In addition, schools were closed, major gatherings were restricted, and even lockdowns were imposed [7]. There is no doubt that public health measures that include hand washing with soap and water or sanitizer, wearing face masks and social/physical distancing are best suited to address the prevention and control of the COVID-19 pandemic at individual and community level in many countries [8].

However, evidence shows that the effectiveness of DPM to control the spread of COVID-19 depends heavily on the public's adherence [6].

Unfortunately, the public's adherence to different DPM varies to a great extent across countries. For example, Yan and colleagues (2021) demonstrate that there is a lot of variations in adherence to COVID-19 public prevention measures [6]. For instance, the adherence rates range from 22% (Uganda) to 96% (Macau) for wearing face masks; from 79% (Macau) to 98% (Brazil) for frequent hand washing; and from 58% (the Democratic Republic of Congo) to 85% (Japan) for social distancing. Past pandemic experiences show that health pandemic should trigger high levels of adherence to DPM. Surprisingly however, in many developing countries including Ethiopia, adherence to COVID-19 public preventive measures has been slow and low. Despite the importance of compliance with COVID-19 preventive measures to minimize the pandemic's burden, Ethiopians have demonstrated a reluctance to engage in these measures [7]. Evidence indicates that Ethiopians were not adhering to mitigation measures for COVID-19 [7, 9]. Temesgen and Abute found, for example, that nearly half of Hossana residents in Ethiopia did not follow the COVID-19 prevention measures [10]. According to Desalegn et al (2021), a study conducted in the capital of Ethiopia, Addis Ababa, revealed that almost 40% of the community failed to follow COVID-19 prevention practices [11]. In another study from Oromia region of Ethiopia by Abeya and colleagues (2021), it was found that less than 10% (8.3%) of the community adhered to COVID-19 safety measures, demonstrating just how poor adherence can be in developing countries in Africa [12].

Considering the non-adherence to COVID-19 preventive measures, public health professionals and other stakeholders must determine the best way to encourage the public to adopt and maintain the full extent of DPM during the

pandemic, including understanding the mechanisms behind one's motivation to adhere to guidelines [6]. To better understand the mechanisms behind people's adherence to public health prevention measures, this study adopted the Health Belief Model (HBM). Throughout the past five decades, the model has been widely used as a conceptual framework for studying health behavior. As a guiding framework for health behavior interventions, the HBM has been used to explain both change and maintenance of health-related behaviors [13]. The main elements of the HBM, which focuses on one's beliefs on health conditions and the related health behaviours, include: (i) perceived susceptibility, which is the perceived risk of contracting the disease; (ii) perceived benefits, the positive consequences of adopting the needed behaviours; (iii) perceived barriers, the tangible and psychological costs of adopting the behaviours; (iv) self-efficacy, the perceived ability to perform the behaviours; and (v) cues to action, the external stimuli triggering the adoption of the behaviours. Indeed, evidence shows that people will take action to prevent or control ill-health conditions like COVID-19 if they regard themselves as susceptible to the COVID-19; if they believe it would have potentially serious consequences; if they believe that a course of action like stay home, keep social distance, wear face mask, etc available to them would help reduce either their susceptibility to the disease or the severity of the condition; and if they think that the likely barriers (or cost) of taking the actions outweighed by its benefits [6]. Nevertheless, although the model has been tested repeatedly in western countries, the empirical studies adopting the model in context of developing countries and COVID-19 pandemic are still few.

Hence, this study aims to understand the factors affecting the people's adherence to COVID-19 public health preventive measures which is key to the successful promotion of behaviors that help control the spread of COVID-19 and future health pandemics.

## Materials and Methods

### Study Design and Population

A nationwide cross-sectional survey of Ethiopian adults was conducted in May - June 2021 using telephone interviews. This study was part of a multi-country knowledge, attitudes, and practices survey to Understand the drivers of non-adherence towards COVID-19 preventive measures in eastern and southern Africa using computer-assisted telephone interviews.

### Sampling

The target sample for completed interviews was 895 adults 18 years and older, with sample stratification by gender, age, and location participated in the survey. The participants were recruited first using a stratified sampling strategy, which was done at the first administrative level. Following the stratification, a simple random sample was used drawn from potential respondents using a list of random mobile numbers from the identified database of active mobile phone users. Using the available mobile database of mobile numbers of respondents were contacted randomly and, in the event, a non-response, they were usually called back after 4 hours, this gave everyone an equal chance of being sampled. To achieve randomness, from the robust database, a pool of mobile numbers were randomly extracted e.g., 10,000 who could be called randomly until the desired set quotas was achieved. If from the first round the quotas were still not achieved, another pool of the 10,000 contacts was extracted and they were randomly reached out once more until the pre-determined quota was achieved. This process helped in ensuring that there was randomness in the sampling.

### Data Collection

The qualitative survey data was collected using a structured questionnaire administered using computer assisted telephone interviews (CATI) method. The questionnaire captured data on sociodemographic characteristics, knowledge and perceptions of COVID-19 preventive

measures, and uptake of COVID-19 preventive measures. In addition, data on perceptions of safety and efficacy of the available COVID-19 vaccines and intention to take the COVID-19 vaccine were collected. Knowledge of COVID-19 was assessed by dichotomizing a knowledge score based on Bloom's cut-off using four questions [14, 15]. Each correct response was given 1 point and the wrong answer was given 0. Providing four correct responses to the four questions meant good knowledge, otherwise it would mean poor knowledge.

Perceptions of the relevance of COVID-19 preventive measures were assessed on a Likert scale with four questions. Each of these was dichotomised with strongly agree/agree coded 1 while not sure, disagree or strongly disagree coded 0. Responding appropriately to three of the four perception questions was considered satisfactory, otherwise it would be considered unsatisfactory. Questions on how participants adhered to five COVID-19 guidelines were assessed with options: 'always', 'sometimes' and 'never'. The five questions were based on guidelines including mass gathering, physical distancing, mask-wearing, respiratory etiquette, and hand hygiene. Perceptions of the safety and efficacy of COVID-19 vaccines were measured on a Likert scale with the options: 'strongly agree', 'agree', 'not sure', 'disagree' or 'strongly disagree'. Intention to take the COVID-19 vaccine was measured using a one-item question: 'If a vaccine against COVID-19 becomes available, would you take it?' whose response was categorised as 'definitely yes', 'probably yes', 'probably no' and 'definitely no'. This was later dichotomized to 'definitely yes' (coded 1) and otherwise 'no' (coded 0). Data were collected on covariates such as participant age, gender, level of education, income and occupation. Perceived risk of COVID-19 as well as perceptions of the safety and efficacy of the COVID-19 vaccine were also obtained.

The questionnaire was translated into English, Amharic, Afan Oromo, and then programmed and uploaded to the Kobo Collect software installed on a tablet computer used for data collection.

### Statistical Analysis

Data were checked for completeness and inconsistencies. Descriptive and inferential analysis were conducted using Stata software. To establish the correlations between the HBM subscales and adoption of COVID-19 preventive measures that were recommended to prevent the spread of COVID-19, a non-parametric Mann–Whitney test was used. Variables with a P-value $< 0.20$ in the bivariate binary regression analysis were entered into the final multivariable model. To identify the HBM scales that are associated with adherence to COVID-19 prevention measures, a multivariable linear regression analysis was used, Coefficient (Coef.) and 95% confidence intervals (CIs) were calculated, and a P value of less than 0.05 was considered a statistically significant factor.

## Results

### Sociodemographic Characteristics of Participants

In total, a sample of 895 adults participated in study drawn from different cities and regions of Ethiopia including Addis Ababa, Afar, Amhara, Benishangul-Gumuz, Dire Dawa, Gambela, Harari, Oromia, Sidama, Somali, Tigray, and Southern National Nationality and People's Regions. More than half of the sample population (57%) are between the ages of 18 and 34, according to the survey results. Approximately 19% of the sample is between the age groups of 35-44 years old, while approximately 24% of the sample is older than 45 years old. The average age of the participants in the survey was 34, which indicates that Ethiopians are generally young people. In respect to gender, more than half of the sample population (56%) were male (Table 1).

**Table 1.** Socio-demographic Characteristics of Survey Participants

| **Characteristics** | **Freq/Mean** | **Percent/Std Dev.** |
|---|---|---|
| Average age | 34.4 | 11.2 |
| **Age Group** | | |
| 18-24 | 188 | 21.01 |
| 25-34 | 320 | 35.75 |
| 35-44 | 173 | 19.33 |
| 45+ | 214 | 23.91 |
| **Gender** | | |
| Female | 391 | 43.69 |
| Male | 504 | 56.31 |
| **Education** | | |
| No schooling | 34 | 3.8 |
| Primary | 69 | 7.6 |
| Secondary | 207 | 22.8 |
| Post-secondary | 584 | 65 |
| **Marital Status** | | |
| Married | 571 | 63.8 |
| Unmarried | 286 | 31.9 |
| Divorced/Widowed | 38 | 4.2 |
| **Income** | | |
| Rich | 52 | 5.8 |
| Average | 456 | 51.0 |
| Poor | 387 | 43.2 |
| **Occupation** | | |
| Craftsman/shopkeeper/business owner | 110 | 12.29 |
| Employee | 409 | 45.7 |
| Farmer | 50 | 5.59 |
| Industrial worker | 12 | 1.34 |
| Middle manager/team leader | 25 | 2.79 |
| Retired | 17 | 1.9 |
| Senior manager/self-employed profession | 77 | 8.6 |
| Unemployed | 195 | 21.6 |
| **Household Characteristics** | | |
| Number of females | 3.1 | 8.0 |
| Number of males | 2.9 | 8.9 |
| Total household size | 4.4 | 2.1 |
| **Children less than 5 years** | | |
| No | 542 | 60.56 |
| Yes | 353 | 39.44 |
| **Others persons older than 60 years** | | |
| No | 730 | 81.56 |
| Yes | 165 | 18.44 |

## Practice of COVID-19 preventive measures

Among COVID-19 preventive measures, using face masks and washing hands were the most frequently practiced preventive measures. Interestingly, one in two people frequently practiced not shaking hands to protect themselves and prevent the spread of the virus. While staying at home, keeping social/physical distance, and limited unnecessary traveling were the least frequently used preventive measures and people used them occasionally or sometimes (Figure 1).

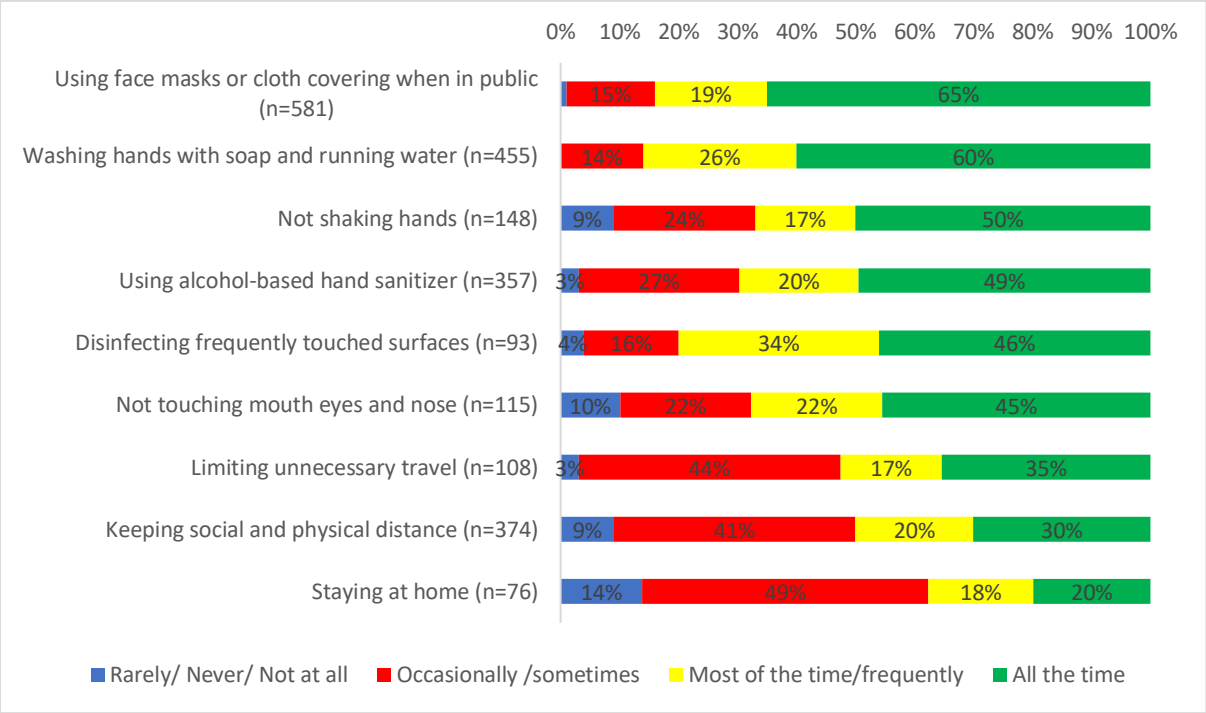


**Figure 1.** Frequency of Population Practice of Recommended COVID-19 Preventive Measures to Protect the Public and Prevent the Spread of COVID-19

## Effectiveness of COVID-19 Prevention Measures

Table 2 presents respondents' perceptions on the effectiveness of public health initiatives for COVID-19 outbreak prevention. In Ethiopia, nearly four out of five respondents agreed that washing hands with soap and running water on a frequent basis, as well as wearing a face mask or cloth always covering when out in public, were effective ways to limit the spread of infections. Simultaneously, a quarter of respondents believed that using alcohol-based hand sanitizers was moderately effective. Similarly, one-fifth of research participants stated that staying at least 1 meter away from other individuals when out in public is a moderately effective public health precaution for preventing COVID-19 transmission.

## Relationship between HBM Constructs and Adoption of COVID-19 Preventive Measures

To establish the correlations between the HBM subscales and adoption of COVID-19 preventive measures that were recommended to prevent the spread of COVID-19, a non-parametric Mann–Whitney test was used. Table 2 presents Health Belief Model scales of selected COVID-19 preventive measures, and a summary description is given as follows.

**Table 2.** How Effective is Public Health Measures for Preventing the Spread of COVID-19

| COVID-19 preventive measures | Not effective at all | Slightly effective | Moderately effective | Very effective |
|---|---|---|---|---|
| Washing hands regularly with soap and running water | 15(2%) | 34(4%) | 139(16%) | 704(79%) |
| Using alcohol-based hand sanitizer | 19(2%) | 41(5%) | 212(24%) | 616(69%) |
| Wearing a face masks or cloth covering at all times when in public | 16(2%) | 37(4%) | 130(15%) | 708(79%) |
| Staying at least 1 metre away from other people when out in public | 40(4%) | 62(7%) | 199(22%) | 593(66%) |
| Not shaking hands with others | 31(3%) | 45(5%) | 134(15%) | 681(76%) |
| Disinfecting frequently touched surfaces | 26(3%) | 49(5%) | 184(21%) | 629(70%) |

## Washing Hands with Soap and Running Water

The Mann–Whitney U-test results indicated that perceived severity ($p < .05$) and perceived barriers ($p < .001$) are significantly related with the frequency of handwashing. Perceived barriers are negatively related to the frequency of handwashing. The results also show a positive relationship between perceived severity and the frequency of handwashing. The relationship between perceived susceptibility and benefits and the frequency of handwashing was not significant (Table 3).

## Using Alcohol-based Hand Sanitizer

Similarly, the result indicated that perceived susceptibility ($p <0.05$) and perceived severity ($p < 0.05$) are positive and significantly related with using alcohol-based hand sanitizer. The other statistically significant HBM scale is Cues to action ($p <0.05$). This would imply that respondents with higher cues to action are less likely to use alcohol-based sanitizer than those with lower cues to action. Moreover, the results revealed that perceived benefits, barriers and self-efficacy relationship with using alcohol-based hand Sanitizer are not statistically significant at 95% confidence level (Table 3).

## Using Face Masks or Cloth Covering when in Public

The result indicated that perceived susceptibility ($p <0.05$), perceived severity ($p < 0.05$) and perceived barriers ($p <0.05$) are positive and significantly related with using face masks or cloth covering when in public COVID-19 preventive measure. Moreover, the results show that perceived benefits scale had statistically negative significant relationship ($p <0.05$) with using face masks or cloth covering when in public COVID-19 preventive measure (Table 3).

## Not Touching Mouth Eyes and Nose

The result revealed that perceived severity ($p < 0.05$), perceived benefits ($p<0.05$), and cues of action ($p <0.05$) are positive and significantly related with not touching mouth eyes and nose COVID-19 preventive measure. The positive relationship between perceived severity, perceived benefits, and cues of action with not touching mouth eyes and nose COVID-19 preventive measure indicate that respondents with higher scores in these scales are more likely to not touch their mouth eyes and nose than those with lower scores. However, the results show that self-efficacy scale (personal belief in the ability to do something) had negative statistically significant relationship ($p <0.05$) with not touching mouth eyes and nose. This would imply that respondents with higher self-efficacy scores are less likely to not touching mouth eyes and nose than those with lower self-efficacy scores (Table 3).

**Table 3.** Relationship between HBM Constructs and Adoption of COVID-19 Preventive Measures

| **COVID-19 Preventive Measures** | **HBM scales** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Perceived Susceptibility** | | **Perceived Severity** | | **Perceived Benefits** | | **Cues to Action** | | **Self-efficacy** | | **Perceived barriers** | |
| | **Z** | **P-value** | **Z** | **P-value** | **Z** | **P-value** | **Z** | **P-value** | **Z** | **P-value** | **Z** | **P-value** |
| washing hands with soap and running water | 0.783 | 0.434 | 4.098 | 0.000 | -0.184 | 0.854 | -4.137 | 0.000 | 2.318 | 0.021 | -3.274 | 0.001 |
| Using alcohol-based hand Sanitizer | 1.968 | 0.049 | 6.010 | 0.000 | 0.438 | 0.661 | -4.883 | 0.000 | 0.037 | 0.970 | -1.266 | 0.206 |
| Using face masks or Cloth covering when in public | 2.221 | 0.026 | 3.068 | 0.002 | -5.905 | 0.000 | -0.349 | 0.727 | 1.338 | 0.181 | 4.590 | 0.000 |
| Not touching mouth eyes and nose | 0.983 | 0.326 | 5.101 | 0.000 | 2.026 | 0.043 | 2.026 | 0.043 | -10.504 | 0.000 | 0.967 | 0.333 |
| Not shaking hands | 0.162 | 0.871 | 6.280 | 0.000 | 1.999 | 0.046 | -9.664 | 0.000 | 0.688 | 0.491 | -4.470 | 0.000 |
| Keeping social and physical distance | 1.365 | 0.172 | 6.477 | 0.000 | -0.957 | 0.339 | -4.136 | 0.000 | -2.827 | 0.005 | -2.000 | 0.046 |
| Staying at home | 0.379 | 0.705 | 4.966 | 0.000 | 2.112 | 0.035 | -8.991 | 0.000 | 0.530 | 0.596 | -4.520 | 0.000 |
| Limiting unnecessary travel | 1.396 | 0.163 | 7.576 | 0.000 | 1.435 | 0.151 | -11.127 | 0.000 | 0.926 | 0.355 | -3.890 | 0.000 |
| Disinfecting frequently touched surfaces | -0.143 | 0.886 | 7.206 | 0.000 | 1.258 | 0.209 | -10.304 | 0.000 | 0.773 | 0.440 | -3.750 | 0.000 |

## Not Shaking Hands

The Mann–Whitney U-test results presented in Table 3 revealed that perceived severity ($p < 0.05$) has a positive and significantly relationship with not shaking hands. The positive relationship between perceived severity and not shaking hands indicates that respondents with higher perceived severity scores are more likely to not shake hands than those with lower scores. However, the results show that cues to action and perceived barriers ($p < 0.05$) have statistically significant relationship not shaking hands COVID-19 preventive measure. This would imply that respondents with higher cues to action and perceived barriers scores are less likely to not shake hands than those with lower cues to action and perceived barriers scores.

## Keeping Social and Physical Distance

Respondents were asked whether they keep social and physical distance during COVID-19. The Mann–Whitney U-test results presented in Table 3 revealed that perceived severity ($p < 0.05$) has a positive and significant relationship with keeping social and physical distance during COVID-19 pandemic. The positive relationship between perceived severity and keeping social and physical distance indicates that respondents with higher perceived severity scores are more likely to keep social and physical distance than those with lower scores.

However, the results show that cues to action, self -efficacy, and perceived barriers ($p < 0.05$) have statistically significant relationship keeping social and physical distance COVID-19 preventive measure. This would imply that respondents with higher cues to action, self-efficacy, and perceived barriers scores are less likely to keep social and physical distance than those with lower cues to action, self-efficacy, and perceived barriers scores.

## Staying at Home

Respondents were asked whether they stayed at home to prevent the spread of COVID-19.

The Mann–Whitney U-test results presented in Table 3 revealed that perceived severity ($p < 0.05$) and perceived benefits ($p < 0.05$) have a positive and significantly relationship with staying at home during COVID-19 pandemic. The positive relationship between perceived severity and perceived benefits and staying at home preventive measure shows that respondents with higher perceived severity and benefits scores are more likely to stay home than those with lower scores.

However, the results show that cues to action and perceived barriers ($p < 0.05$) have statistically significant relationship with staying at home COVID-19 preventive measure. This would imply that respondents with higher cues to action and perceived barriers scores are less likely to stay home than those with lower cues to action and perceived barriers scores.

## Limiting Unnecessary Travel

The Mann–Whitney U-test results presented in Table 3 revealed that perceived severity ($p < 0.05$) has positive and significant relationship with limiting unnecessary movement during COVID-19 pandemic. The positive relationship between perceived severity and limiting unnecessary movement COVID-19 preventive measure shows that respondents with higher perceived severity scores are more likely to limit unnecessary movements than those with lower scores.

However, the results show that cues to action and perceived barriers ($p < 0.05$) have statistically significant relationship with limiting unnecessary movement COVID-19 preventive measure. This would imply that respondents with higher cues to action and perceived barriers scores are less likely to stay home than those with lower cues to action and perceived barriers scores. The other HBM scales such as perceived susceptibility, benefits and self-efficacy did not reveal statistically significant relationships with the limiting unnecessary movements COVID-19 preventive measure.

## Disinfecting Frequently Touched Surfaces

Respondents were asked whether frequently they disinfected touched surfaces as one of COVID-19 preventive measures. The Mann–Whitney U-test results presented in Table 3 revealed that perceived severity ($p < 0.05$) has positive and significantly relationship with disinfecting frequently touched surfaces during COVID-19 pandemic. The positive relationship between perceived severity and disinfecting frequently touched surfaces COVID-19 preventive measure shows that respondents with higher perceived severity scores are more likely to disinfect frequently touched surfaces than those with lower scores. However, the results show that cues to action and perceived barriers ($p <0.05$) have statistically significant relationship with disinfecting frequently touched surfaces COVID-19 preventive measure. This would imply that respondents with higher cues to action and perceived barriers scores are less likely to disinfect frequently touched surfaces than those with lower cues to action and perceived barriers scores. The other HBM scales such as perceived susceptibility, benefits and self-efficacy did not reveal statistically significant relationships with the disinfecting frequently touched surfaces COVID-19 preventive measure.

## Regression Results

To identify the predictors of COVID-19 public health preventive measures based on Health Belief Model, a regression analysis was conducted by setting health belief, and resource factors scale variables against the preventive measures. Dependent variable is score generated through multiple correspondence analysis for nine preventive actions described in Table 4. The bivariate analysis indicated that perceived severity, perceived barriers, and cues to action showed a significant association with adherence to COVID-19 preventive measures at $p >0.05$. However, perceived susceptibility, perceived benefits, and self-efficacy were not significantly associated with adherence to COVID-19 precautions measures.

**Table 4.** Regression Analysis Results

| **Adherence to COVID-19 Preventive measures** | **Coef.** | **Std. Err.** | **t** | **P-value** |
|---|---|---|---|---|
| Perceived susceptibility | 0.038 | 0.027 | 1.38 | 0.169 |
| Perceived severity | 0.211 | 0.030 | 7 | 0.000 |
| Perceived benefits | 0.024 | 0.028 | 0.87 | 0.384 |
| Perceived barriers | -0.122 | 0.028 | -4.38 | 0.000 |
| Cues to action | -0.440 | 0.030 | -14.57 | 0.000 |
| Self-efficacy | 0.033 | 0.028 | 1.21 | 0.227 |
| Constant | 3.167 | 0.720 | 4.4 | 0.000 |
| Number of obs | 895 | | | |
| F(6, 888) | 76.27 | | | |
| Prob > F | 0.000 | | | |
| R-squared | 0.3401 | | | |

In the multivariate regression results presented in Table 5, the researcher controls for the moderating effects of socio-economic factors in the adoption of COVID-19 public health preventive measures in Ethiopia. The results show that whereas the included socio-economic factors were not statistically significant at 95% confidence level, their inclusion in model changed the influence of HBM variables. The two variables; perceived susceptibility and perceived severity which were not statistically significant in bivariate model (table 4) turned out

significant after controlling for socio-economic factors. This is a demonstration that socio-economic factors have a moderating role it plays as far as adherence to COVID-19 measures and HBM factors. The change in R-squared also demonstrate the contributory role of socio-economic factors.

**Table 5.** Moderating Role of Socio-economic Factors

| Adherence to COVID Measures Index | Coef. | Std. Err. | t | P>t |
|---|---|---|---|---|
| Perceived susceptibility | 0.062 | 0.029 | 2.12 | 0.034 |
| Perceived benefits | 0.029 | 0.028 | 1.02 | 0.306 |
| Perceived barriers | -0.118 | 0.028 | -4.22 | 0.000 |
| Cues to action | -0.430 | 0.030 | -14.14 | 0.000 |
| Self-efficacy | 0.026 | 0.028 | 0.91 | 0.363 |
| Perceived severity | 0.208 | 0.030 | 6.89 | 0.000 |
| Age | -0.002 | 0.003 | -0.66 | 0.510 |
| Household size | 0.010 | 0.013 | 0.75 | 0.455 |
| Gender (base: female) | | | | |
| Male | -0.024 | 0.056 | -0.42 | 0.672 |
| Educ level (base; No education) | | | | |
| Primary | 0.059 | 0.175 | 0.34 | 0.738 |
| Secondary | 0.117 | 0.156 | 0.75 | 0.455 |
| Post secondary | 0.224 | 0.152 | 1.48 | 0.140 |
| Marital status (Base: unmarried) | | | | |
| Married | -0.049 | 0.062 | -0.8 | 0.425 |
| income level (base: high income earners) | | | | |
| Average | -0.109 | 0.120 | -0.91 | 0.365 |
| Low-income earners | -0.175 | 0.124 | -1.41 | 0.158 |
| Constant | 3.251 | 0.743 | 4.38 | 0.000 |
| Number of obs | 895 | | | |
| F(15, 879) | 31.4 | | | |
| Prob > F | 0.000 | | | |
| R-squared | 0.3489 | | | |

## Discussion

The government of Ethiopia recommended (put in place) certain public health measures and guidelines to be followed to protect the public and prevent the spread of COVID-19. These include using face masks in public, washing hands with soap, and running water, keeping social/ physical distance, and using alcohol-based hand sanitizer are among other prevalent preventive measures were adopted in Ethiopia [16, 17]. This is the first study of its kind to analyze the extent of adoption of COVID-19 preventative measures at the national level during the peak epidemic season in the country. Our study further indicated that using face masks and washing hands were the most frequently practiced preventive measures than physical distance and others adopted methods. Our findings are consistent with those of a previous study conducted in Southwest Ethiopia, where regular hand washing (77.3%) and avoidance of shaking hands (53.8%) were the most common behaviors among respondents [18]. Similarly, handwashing was identified as the most generally practiced preventive intervention

against the virus in the Philippines, whereas social distancing and avoiding crowds were indicated as the least frequently practiced [19].

Concerning the effectiveness of public health measures to halt the spread of COVID-19 outbreaks, more than 60% of study participants believed that all public health measures proposed by the Ethiopian government are effective, particularly regular hand washing with soap and running water and wearing a face mask or cloth always covering when out in public. This agrees with a finding of a systematic and metal-analysis conducted by Talic et al (2021) which indicated a reduction in incidence of COVID-19 associated with handwashing, mask wearing and physical distancing [20]. Similarly, other systematic reviews support our findings and recommend additional COVID-19 mitigating measures such as travel restrictions, border measures, quarantine of travelers arriving from affected countries, city lockdown, restrictions on mass gathering, isolation and quarantine of confirmed cases and close contacts, social distancing measures, mandatory mask wearing, contact tracing and testing, school closures, and personal protective equipment [21]. Due to economic concerns, Ethiopia, unlike other countries, did not undertake absolute or rigorous lockdown measures. Ethiopia, on the other hand, has implemented other WHO-recommended preventive guidelines to protect human-to-human transmission of COVID-19, such as social distancing, a ban on public gatherings and religious gatherings, regular personal hygiene, the use of face masks, covering the mouth and nose while sneezing or coughing, one per seat in public vehicles, and the temporary closure of schools, colleges, and universities [16, 17].

In this research, we use the health belief model to assess relation of COVID-19 preventive behavior of individuals in Ethiopia. This study further indicated that perceived severity (>0.05) was significantly and positively related with the frequency of handwashing, using alcohol-based hand Sanitizer, using face masks or Cloth covering when in public, not touching mouth eyes and nose, not shaking hands, keeping social and physical distance, staying at home, limiting unnecessary travel, and disinfecting frequently touched surfaces. While Perceived barriers ($p<0.05$) are negatively and significantly related with all these preventive measures except with using face masks or Cloth covering when in public and not touching mouth eyes and nose. Thus, respondents with higher perceived severity scores are more likely to implement public health measures than those with lower scores. For instance, Dwipayanti et al (2021) reported that perceived susceptibility and effectiveness are important predictors of hand hygiene practices in Indonesia [22]. This high perceive severity scores in our study could be related to the seriousness of COVID-19 infection and high rate of community transmission [23-25]. Furthermore, research in Egypt and China found that most participants believed COVID-19 was a life-threatening condition that put any member of the family at risk of infection and badly harmed health [26, 27]. In contrast, perceive susceptibility ($p<0.05$) has no strong and significant relation with most COVID-19 measures except with using alcohol-based hand Sanitizer and using face masks or Cloth covering when in public. The positive relationship between perceived susceptibility with using face masks or cloth covering when in public indicate that respondents with higher perceived susceptibility scores are more likely to use face masks or cloth covering when in public than those with lower scores. However, the results show that perceived benefits scale had statistically negative significant relationship ($p <0.05$) with using face masks or cloth covering when in public COVID-19 preventive measure. This would imply that respondents with higher perceived benefits are less likely to use alcohol-based sanitizer than those with lower perceived benefits. This is surprising results because it was expected that people who are familiar with health benefits of face masks in context of COVID-19 would be more likely to use them.

This perhaps may be attributed to beliefs people have about masks irrespective of their health benefits. For example, evidence shows that individuals with high (vs. low) self-perceived attractiveness were less willing to wear a mask, due to a weaker endorsement of the belief that mask-wearing enhances their perceived attractiveness i.e., mask attractiveness belief [28].

The regression results shows that health belief model predictive variables explain 34% of the variance in COVID-19 preventive actions. This is consistent with evidence that shows that the majority (87.5%) of the studies health belief model has a good predictive ability of COVID-19-related behavior [29]. Out of the six HBM predictors, three predictors are statistically significant (p-value <0.05). These are perceived severity (coeff=0.211, p=0.000), perceived barriers (coeff=0.122, p=0.000), and cues to action (coeff=0.439, p=0.000). The results show that perceived severity has positive significant influence on adoption of COVID-19 preventive measures. This relationship is plausible because if individuals perceive that a disease is severe as was the case with COVID-19, they tend to adopt all the possible measures that prevent them from contracting the disease. However, the results show that perceived barriers and cues to action (factors that trigger behavior change) have negative significant influence on adoption of COVID-19 preventive measures. The negative relationship between perceived barriers and adoption of COVID-19 preventive measures is plausible and fits a priori expectations because if more perceived barriers exist, the adoption of preventive practices will be lower. This was expected because of the many misinformation and uncertainty that was associated with COVID-19 pandemic that would hinder adoption despite known benefits of the measures [30, 31]. Cues to action related to COVID-19 included people experience with COVID-19, Government, health workers, religious leaders, friends and colleagues, media and social media recommendations, and the health status of family members. Evidence shows that these experiences form relevant risk perception which ultimately affect adoption of the measures [32, 34]. Media interventions were significant across many African countries in disseminating COVID information as well as social media platforms and other sources including health workers, friends, and family. Empirical evidence shows that Cyberchondria, defined as obsessive online searching for health-related information (typically about specific symptoms) and information overload indirectly affects the intention to self-isolate [35]. while exposure to media campaigns has been found to negatively affects compliance with recommended behaviors [36]. The combined effects of these influences are expected to affect adoption of recommended preventive behaviors depending on how they affect the entire motivation process [34]. These meant that cues to action in context of Ethiopia as was the case in many African countries negatively affected adoption of COVID-19 preventive measures particularly the numerous conspiracy beliefs and propaganda that surrounded COVID-19 pandemic.

## Conclusion

The general adherence level of the community to the recommended COVID-19 safety measures, particularly regular hand washing with soap and running water and wearing a face mask, was relatively higher in this study. However, compliance with other public health initiatives is relatively low. As a result, it is critical to examine the communities' self-efficacy, perceived benefits, perceived hurdles, and perceived vulnerability to COVID-19 to improve community adherence to the suggested COVID-19 safety measures.

## Conflict of Interest

We declare that there is no conflict of interest.


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