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Original Research Article

The impacts of internet and transportation access on patients' health conditions: a cross-sectional study

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ABSTRACT

Background: Use of internet and transportation to access to healthcare resources are 2 essential and effective ways to promote health outcomes and ameliorate health disparities. Despite general widespread availability of internet and transportation, disparities still exist among specific groups and regions. Little is known about the spatial patterns of extents of 2 access determinants on healthcare resources, nor for their compound effects on patient's health outcomes.
Methods: The study uses 2018 health information national trends survey (HINTS) data, geographic information techniques and multiple ordered logistic regression model were applied.
Results: The results show that States in West and Midwest tend to have higher proportions on both perspectives, where states in South and Mideast had a relatively low percentage on the healthcare access determinants. Those states had similar socio-economic patterns with underserved population and low development progress in public healthcare system. Another finding is urban people had outstripped its rural neighbors on both internet (79% vs 57%) and transport (74% vs 62%) access to healthcare resources. Furthermore, our study suggests that, when considering compound effects of internet access for healthcare information and transport access to healthcare service, people who had greater barriers tend to have decreased likelihood (-21.30%) towards their health conditions, compare to those with sufficient accesses.
Conclusions: Additional work and policy are needed to ensure that internet and public transportation resources and services are prioritized for underserved populations and areas.

Keywords: Use of internet, Transport access, Health conditions, Health disparities, Geographical variation

INTRODUCTION

Access to health care services and health information seeking are very important for promoting and maintaining health conditions, preventing and eliminating disease, conveying and educating health knowledge and ameliorating health disparities for all Americans.[1-4] Transportation and the internet, two very basic but necessary means in supporting patients' health care and health information needs, have become more valuable in the healthcare system, and their availability has increased and expanded in recent decades.[1-5] In the national healthy people 2030 report, the office of disease prevention and health promotion (ODPHP) prioritized the need to "Interventions to increase access to health care services". They also suggest that "Interventions to increase access to health care professionals and improve communication-in person or remotely-can help more people get the care they need".[6]

Transportation is one of the most important aspects in people's daily life. Adequate and reliable transportation services are crucial elements for building healthy communities. Patients with transportation issues may encounter rescheduled or missed appointments, delayed

care or medication use, increased health expenditures and exacerbated health outcomes. In its 2017 report, the American hospital association (AHA) indicate that approximately 3.6 million population have difficulties obtaining medical care due to transportation issues.[7]

Several studies on transportation and health care access have found that lack of transportation or inadequate availability of transportation service among those with certain demographic characteristics may ultimately lead to unmet health care needs and worsen health outcomes.[8] Using survey data collected from 3,897 low socioeconomic status (SES) adults in Atlanta's urban areas, Rask et al found that individuals who usually walk or use public transportation were not likely to have regular health care services. Their study also showed that patients who did not have their own transportation modes tended to delay care.[9] In a similar study conducted by Silver et al they found that, among 698 low-income adult patients, 25% of missed appointments or rescheduling care needs were attributed to transportation issues and patients who use public transportation were twice more likely to miss their appointments than car owners. A study by Probst et al found that rural patients have greater transportation barriers to health care than their urban counterparts.[10] In another analysis, Wallace et al found that older, poorer, less educated, female and minority group populations were more likely to have transportation barriers when they tend to access health care.[11] Lamont et al evaluated the association between cancer survival and distance from patient's residence to their care facility and found that patients living more than 15 miles from their site of treatment had 1/3 hazard ratio to death.[12] This study also found a survival disparity between African Americans and Whites.[12] Consistent with Lamont et al' work, Guidry et al found that Hispanics and African Americans have greater transportation barriers to cancer treatment than Whites.[13]

Patients with transportation limitations to accessing health care may also experiencing difficulties gathering information about their conditions and treatment options and communicating with their providers. The internet plays a crucial role in improving population health outcomes and health care quality, and to achieving health equity.[6] The internet could also be used in health education and information dissemination for disease prevention and treatment.[14,15] Patients in support groups can receive varying types of support through participation in online groups.[16] The internet, as an alternative resource for health care information and services, could ameliorate the health disparities for those with transportation barriers to seeing their health care providers.

According to an analysis of survey data that released by the pew research center, 90% of the total United States population used the internet, and 80% of them looked for health information online.[17] A large body of empirical studies have shown that increasing the proportion of the population that accesses health information through the Internet may result in better health knowledge, attitudes, behavior, health-related decision making and even health outcomes.[18-21] Tan et al found that internet health information seeking can improve the relationship between patients and physicians, and helps patients to be more engaged in health decision making.[22] In Nordin et al study, they found that internet -based health care programs could increase patient's participation in rehabilitation compared to traditional interventions.[23] Woolf et al in their paper emphasize that the internet provides a way for patients to obtain information necessary to evaluate their medical status and increases their participation in the decision-making process.[24]

Despite the general widespread availability of internet access, dipartites still exist among specific groups, particularly among traditionally underserved and minority population.[25] A study conducted by Jacobs et al indicates that older adults, those with lower socioeconomic status (SES), those with lower educational level, and lower internet self-efficacy were less likely to use the internet for their health information. Douthit et al found significant differences in health care information seeking between rural and urban areas. The lack of resources for seeking health care and information in rural areas was due to insufficient public transport, poor availability of broadband internet services, and cultural and financial constraints.[27]

The associations between health outcomes and (1) transportation barriers to health care access and (2) health information seeking through the internet have been studied separately in recent decades. However, the compound effects of transportation barriers and internet access on patients' health outcomes, especially for those have travel limitations and lack of resources to access to internet, is under-researched. The objectives of this study were: (1) to investigate and identified the underserved population groups who experienced both transportation barriers and lack of internet use for accessing health care information; (2) to explore the spatial distribution of underserved populations with regards to those two difficulties, and (3) to determine the association between self-reported health status, transportation to health care services, and internet access for seeking healthcare information.

METHOD

Data and sample

We used the 2018 health information national trends survey (HINTS). HINTS is a nationally representative household interview cross-sectional survey of US adults aged ≥18 years who are noninstitutionalized civilians. The sampling frame consisted of a two-stage design where the first stage involved selecting a random sample of addresses from a database of residential addresses, and in the second stage, one adult was selected within each household. Our target sample was participants with valid

responses for whether they access to the internet for seeking health information and have transport accessibility to see the doctor. A total of 3504 respondents were included for descriptive analyses and an analytic sample of 3467 with complete responses for all measures was used in the logistic regression model. The survey methodology can be viewed and downloaded from the national cancer institute (NCI) health information national trends survey (HINTS) website.[28]

Measures

Outcome variables

In this study, the outcome variables of interest are primarily the general self-reported health conditions of the respondents in the survey. The health status is captured based on the survey question, "In general, would you say your health is...". Originally, responses are classified into 7 categories: Missing data (Not ascertained), Multiple responses selected in error, excellent, very good, good, fair, and poor. The first two categories represent the missing data and were removed for modeling purposes (e.g., 137 observations with missing general health status were removed) for subsequent analysis in the study. The rest of the categories are re-classified into 3 groups as fair or poor, good, excellent or very good, and were coded as an ordinal response variable 0, 1 and 2 respectively in the following statistical modeling process.

Key independent variables

The key independent variables of interest in this study are internet access for seeking health information, and transport access to healthcare facilities when needed. internet access was captured through the survey question, "In the past 12 months have you used a computer, smart phone, or other electronic means to look for health or medical information for yourself?", and the responses are coded as 2 (Yes) and 1 (No) in the original data. Only one observation was removed due to missing data for this question. Transport access to healthcare facilities was captured through the survey question "Get help to transport to doctor", and responses are never, rarely, sometimes, often, always with some missing information for the responses to this question. The responses are regrouped into never or rarely, sometimes, often or always coded as 0, 1 and 2 in the data pre-processing steps, and 3 representing responses marked as "unknown". In addition, the internet access and transport access responses are used to create a new variable indicating whether a respondent had access to both internet and transportation. It is named as transportation and internet access, and consisted of the following six categories: Low-level transportation access and no internet access, meaning the respondent never or rarely got transport help when needed, and he/she did not have internet access; Middle-level transportation access and no internet access, meaning the respondent sometimes got transport help when needed, and he/she did not have internet access; High-level transportation access and no internet access, meaning the respondent often or always got transport help when needed, and he/she did not have internet access; Low-level transportation access and internet access, meaning the respondent never or rarely got transport help when needed, and he/she did have internet access; Middle-level transportation access and internet access, meaning the respondent sometimes got transport help when needed, and he/she did have internet access; High-level transportation access and internet access, meaning respondent often/ always got transport help when needed, and he/she did have internet access.

Other independent variables

In addition, other independent variables that were included in the modeling process are: urban or rural area, regular health care provider, most recent routine health checkup, frequency of doctor visits in the past 12 months, health care insurance coverage, gender, age, employment, marital status, education level, and income. More detailed descriptions of the above-mentioned dependent variable and the potential explanatory variables can be found in Table 1. In total, a sample size of 3,467 responses were used in subsequent correlation analysis for evaluating the general health status of the surveyed respondents.

RESUTLS

Descriptive summary

Table 1 presents the descriptive statistics of the variables collected from the data. It shows that 16.0%, 35.1%, and 48.9% of the surveyed respondents were reported in fair or poor, good, excellent or very good health condition, respectively. About 21.5% of those surveyed did not have access to the internet. About 79.5% of all the surveyed respondents did seek health information in the past 12 months from any source (e.g., internet, newspapers, television, radio, etc.). When respondents were needed transport to their healthcare providers, 86.3% of them were able to at least sometimes get transport help; however, nearly 11.5% of them said they rarely or never got help with any transport to take them to the doctor. When combining transportation and internet accessibility together, only about 59% of the respondents had high levels of access to both of them; the rest of the population had limited access to either transportation or the internet.

The majority of the respondents (about 86.1%) were from metropolitan urban areas. Approximately 94.8% of the respondents have health care insurance coverage and 70.6% of them did have a regular healthcare provider that they could often visit to get health care. About 34.6% of respondents visited their regular health care providers 1 to 2 times in the past 12 months, and 72.6% had their routine check-up within the past year. Other social demographic characteristics show that 59.6% of them were female, and a majority of them (36.3%) were 65

years old or older. 48.7% of them were employed, and 50.7% were married or living as married. Around 32.9% of them has only high school-level education or less, 73.1% were white people, and 37% of them has income of $34,999 or less.

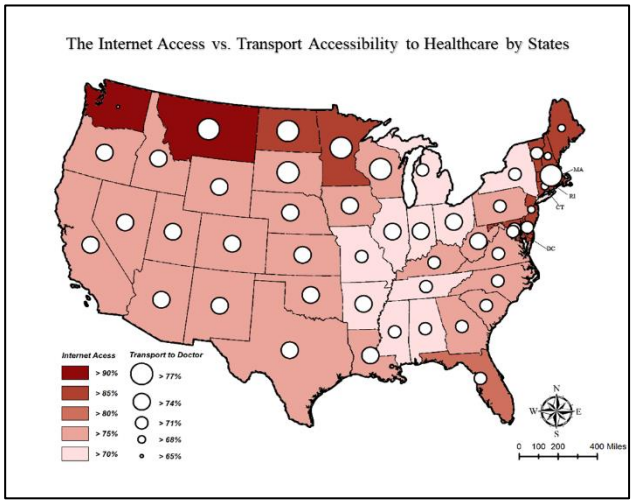

Figure 1: The proportions of estimated population who has internet and transport access to healthcare resources by states.

Figure 1 shows the geographic variations of people who have internet access for healthcare information and transport access to healthcare facilities. States in West and Midwest tend to have higher proportion of internet access and transport accessibility with respect to healthcare service. States in Northeast region tend to have higher internet access proportions but lower transport accessibility to healthcare, except Massachusetts, which had an excellent performance in both aspects. States in South and Mideast had a relatively low percentage than their counterparts, such as Missouri, Tennessee, Mississippi, and Alabama. Those States have similar demographic characteristics (remote, low-income residents are the majority population) and low development progress of healthcare facilities.

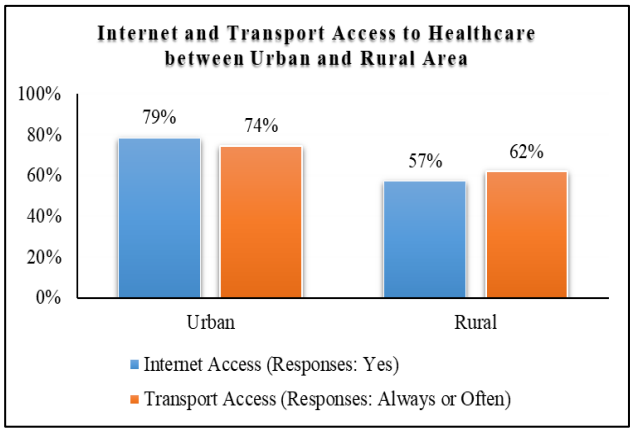

Figure 2: Internet and transport access to healthcare by urban and rural area.

Figure 2 shows that urban residents have better access to both the internet and transportation. People in urban areas had outstripped its rural neighbors on both internet (79% vs 57%) and transport (74% vs 62%) access to healthcare resources. This situation may could lead to a deteriorating health outcome for most patients in rural or remote areas.

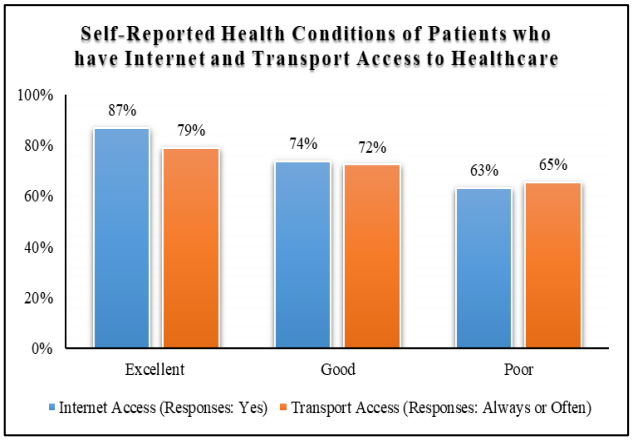

Figure 3: Self-reported health conditions of patients who have internet and transport access to healthcare.

Figure 3 shows the trend between access to the internet and transportation with health status. People who reported excellent health status had higher proportions of internet and transport access to healthcare services where people in poor health tend to have barriers to internet access and transportation which subsequently may influence their attitude of acquiring healthcare service and finally deteriorate their final health status.

Logistic regression modeling

Ordered logistic regression modeling for general health status

Table 2 presents the modeling results of general self-reported health status using ordered logistic regression based on the selected variables in Table 1. Note that not all the variables are statistically significant, so those that were insignificant were not included in the final model. The modeling results show that internet and transportation accessibility did have an influence on surveyed individuals' self-reported health status. For example, compared to people who had high-level access to both transportation and the internet, those who have limited access to either of them is associated with a lower level of self-reported health status. Specifically, those who had low-level transportation access and no internet access, their likelihood of having an excellent or very good self-reported health condition would decrease by 11.3% according to the marginal effects in Table 4. Similarly, compared to those who often or always had transport to a doctor, those who have limited transportation accessibility would have a decreased likelihood (-21.30%) of having an excellent or very good self-reported health status. Overall, such limited access to

either transportation or internet would greatly decrease the likelihood of staying in excellent or very good health status for the survey respondents.

Table 3 presents the predicted average probability of the general self-reported health status outcomes. The results show that among the surveyed respondents, the average probabilities for them to fall in fair or poor, good, and excellent or very good health status are about 0.16, 0.35, and 0.49, which is consistent with the distribution of the survey responses. Every one of respondent's probability of falling in each category of the self-reported health status was also predicted, and predicted accuracy for each observation falling into correct category (fair or poor, good, and excellent or very good) is 55.9%.

Other explanatory variables were also observed to significantly associate with self-reported health status. People who lived in a rural area were more likely to associate with fair or poor health status compared to those who lived in urban area. This is in accordance with other studies.[29,30] Respondents who were without health care insurance coverage were less likely to report excellent or very good health status. Women tended to have better self-reported health status then men, which is consistent with previous studies.[31,32] In addition, people who had employment, higher education, higher income, and of White race were more likely to have high level of self-reported health status. Table 4 presents more details of the marginal effects of those variables.

Table 1: Descriptive statistics of the response and explanatory variables used in this study (n=3,467).

Variable description		Proportion (%)	Std. dev.
Urban or rural area	Urban in metro area	86.1	0.346
	Urban in non-metro area	12.7	0.333
	Rural in non-metro area	1.2	0.108
Internet access for seeking health information	No	21.5	0.411
	Yes	78.5	0.411
Regular healthcare provider	No	28.0	0.449
	Yes	70.6	0.456
	Don't know	1.4	0.118
Most recent routine checkup	Within past year	72.6	0.446
	1-2 years ago,	13.9	0.346
	Over 3 years	10.6	0.308
	Don't know	2.9	0.167
Frequency of doctor visits in the past 12 months	None	14.4	0.351
	1-2 times	34.6	0.476
	3-4 times	27.5	0.447
	5-9 times	14.3	0.350
	10 or more times	8.1	0.273
	Don't know	1.0	0.099
Healthcare insurance coverage	No	5.2	0.222
	Yes	94.8	0.222
General health status (response variable)	Fair or poor	16.0	0.366
	Good	35.1	0.477
	Excellent or very good	48.9	0.500
Transportation accessibility	Never or rarely	11.5	0.319
	Sometimes	11.9	0.324
	Often or always	74.4	0.436
	Don't know	2.2	0.146
Transportation and internet access	Low-level transportation access and no internet access	2.9	0.167
	Middle-level transportation access and no internet access	2.5	0.156
	High-level transportation access and no internet access	15.4	0.361
	Low-level transportation access and internet access	8.7	0.281
	Middle-level transportation access and internet access	9.4	0.292
	High-level transportation access and internet access	59.0	0.492
	Don't know	2.2	0.146
Gender	Male	40.4	0.491
	Female	59.6	0.491
Age (Years)	18 ~ 34	11.9	0.324
	35 ~ 49	19.2	0.394
	50 ~ 64	32.6	0.469
	65 and above	36.3	0.481

Continued.

Variable description		Proportion (%)	Std. dev.
Employment status	Employed	48.7	0.500
	Unemployed	3.3	0.178
	Others	45.2	0.498
	Don't know	2.9	0.168
Marital status	Married or living as married	50.7	0.500
	Others	49.3	0.500
Education level	High school or less	32.9	0.470
	Some college	23.4	0.423
	College graduate	26.4	0.441
	Postgraduate	17.4	0.379
Race	White	73.1	0.443
	Black or African American	16.8	0.374
	Asian	4.6	0.210
	Others	5.5	0.228
Income	$0 ~ $34,999	37.0	0.483
	$35,000 ~ $74,999	28.9	0.453
	$75,000 ~ $99,999	17.9	0.384
	$100,000 or more	6.4	0.244
	Don't know	9.8	0.297

Table 2: Factors associated with general health status based on ordered logistic regression.

Variables	Coefficient	Std. error	95% Conf. interval	
Transportation and internet access (base: high-level transportation access and internet access)				
Low-level transportation access and no internet access	-0.955**	0.209	-0.865	-0.044
Middle-level transportation access and no internet access	-0.758***	0.217	-1.183	-0.333
High-level transportation access and no internet access	-0.548***	0.107	-0.757	-0.339
Low-level transportation access and internet access	-0.525***	0.129	-0.778	-0.271
Middle-level transportation access and internet access	-0.492***	0.122	-0.731	-0.254
Don't know	-0.325	0.228	-0.773	0.123
Urban (base: urban metro area)				
Urban non-metro area	0.069	0.105	-0.136	0.274
Rural area	-0.623**	0.300	-1.211	-0.035
Regular healthcare provider (base: no)				
Yes	-0.177**	0.089	-0.352	-0.002
Don't know	-0.244	0.362	-0.953	0.465
Most recent routine checkup-a general physical exam (base: over 3 years)				
Within past year	0.057	0.108	-0.154	0.269
1-2 years ago	-0.331***	0.125	-0.576	-0.086
Don't know	-0.277	0.235	-0.737	0.182
Frequency of doctor visits in the past 12 months (base: 1-2 times)				
None	-0.001	0.120	-0.235	0.233
3-4 times	-0.570***	0.090	-0.746	-0.393
5-9 times	-1.217***	0.109	-1.431	-1.003
10 or more times	-1.422***	0.135	-1.687	-1.158
Don't know	-0.689	0.453	-1.577	0.199
Health care insurance coverage (base: no)	-0.268*	0.159	-0.579	0.044
Gender (base: male)	0.173**	0.072	0.033	0.314
Age groups (base: 18 ~ 34) (Years)				
35 ~ 49	-0.340**	0.133	-0.600	-0.080
50 ~ 64	-0.287**	0.125	-0.531	-0.042
65 and above	-0.044	0.136	-0.311	0.223

Continued.

Variables	Coefficient	Std. error	95% Conf. interval	
Employment status (base: others)				
Employed	0.498***	0.090	0.322	0.674
Unemployed	0.224	0.201	-0.171	0.619
Don't know	-0.040	0.204	-0.439	0.359
Marital or living as married (base: other)	-0.078	0.078	-0.232	0.075
Education level (base: College graduate)				
High school or under	-0.638***	0.098	-0.830	-0.445
Some graduate	-0.521***	0.100	-0.717	-0.326
Postgraduate	0.260**	0.115	0.034	0.486
Race (base: Whites)				
Black or African American	-0.278***	0.094	-0.463	-0.093
Asian	-0.331**	0.166	-0.657	-0.005
Others	-0.417***	0.152	-0.714	-0.120
Income (base: $35,000 ~ $74,999)				
$0 ~ $34,999	-0.292***	0.090	-0.468	-0.116
$75,000 ~ $99,999	0.380***	0.110	0.165	0.595
$100,000 or more	0.642***	0.178	0.293	0.990
Don't know	-0.657***	0.136	-0.923	-0.392
Cut point 1	-3.034	0.187	-3.400	-2.668
Cut point 2	-1.000	0.179	-1.351	-0.649
Number of observations	3,467			
Log-likelihood	-3100.37			
Pseudo R^2	0.1148			
AIC / BIC	6278.74 / 6518.63			

Coef. =coefficient, Std. Err.=standard error, *p<0.1, **p<0.05, ***p<0.01.

Table 3: Predicted probability associated with general health status.

Variables	Obs.	Mean prob.	Std. dev.	Min	Max
Fair or poor	3,467	0.16	0.13	0.01	0.84
Good	3,467	0.35	0.11	0.07	0.47
Excellent or very good	3,467	0.49	0.21	0.02	0.92

Obs.=number of observations, Std. dev.=standard deviation.

Table 4: Marginal effects associated with general health status.

Variables	Fair or poor (%)	Good (%)	Excellent or very good (%)
Transportation and internet access (base: high-level transportation access and internet access)			
Low-level transportation access and no internet access	14.95	16.36	-21.30
Middle-level transportation access and no internet access	9.24	9.25	-18.49
High-level transportation and no internet access	6.17	7.39	-13.56
Low-level transportation access and internet access	5.86	7.14	-13.01
Middle -level transportation access and internet access	5.43	6.79	-12.22
Don't know	3.36	4.75	-8.11
Urban (base: urban metro area)			
Urban non-metro area	-0.72	-1.00	1.72
Rural area	8.40	6.52	-14.93
Regular healthcare provider (base: no)			
Yes	1.84	2.57	-4.42
Don't know	2.61	3.48	-6.09
Most recent routine checkup-a general physical exam (base: over 3 years)			
Within past year	-0.59	-0.85	1.43
1-2 years ago,	3.92	4.26	-8.18
Don't know	3.22	3.66	-6.88

Continued.

Variables	Fair or poor (%)	Good (%)	Excellent or very good (%)
Frequency of doctor visits in the past 12 months (base: 1-2 times)			
None	0.01	0.01	-0.02
3-4 times	5.40	8.71	-14.11
5-9 times	14.89	14.31	-29.20
10 or more times	18.73	14.63	-33.37
Don't know	6.86	10.19	-17.05
Health care insurance coverage (base: no)	3.14	3.48	-6.62
Gender (base: male)	-1.89	-2.44	4.33
Age groups (base: 18 ~ 34) (Years)			
35 ~ 49	3.65	4.83	-8.48
50 ~ 64	3.01	4.14	-7.15
65 and above	0.42	0.68	-1.10
Employment status (base: others)			
Employed	-5.37	-7.01	12.37
Unemployed	-2.66	-2.87	5.54
Don't know	0.53	0.45	-0.98
Married or living as married (base: other)	0.84	1.11	-1.95
Education level (base: College graduate)			
High school or under	7.05	8.71	-15.77
Some graduate	5.51	7.44	-12.96
Postgraduate	-2.01	-4.28	6.29
Race (base: White)			
Black or African American	3.11	3.80	-6.91
Asian	3.78	4.43	-8.22
Others	4.92	5.38	-10.30
Income (base: $35,000 ~ $74,999)			
$0 ~ $34,999	3.34	3.91	-7.26
$75,000 ~ $99,999	-3.36	-6.02	9.38
$100,000 or more	-5.13	-10.38	15.51
Don't know	8.59	7.28	-15.87

DISSCUSSION

This study sought to understand the potential impacts of internet access and transportation disparities on health status between urban and rural areas. Spatial disparities in terms of internet and transportation accessibility could negatively impact the health status of people living with limited accessibility to health care providers.[7,34] Through our study, we found that geographic variations of internet access for health information and transport access to healthcare service do exists among the States. According to our results, people living in underserved areas may suffer higher difficulties for seeking health information and transport to healthcare services when they have medical issues. Moreover, lack of the healthcare resources and unbalanced distribution of healthcare facilities, on the other hand, may also worsen the existing situations. Should this be the case, additional research will need to explore the spatial pattern of accessing disparities among this region and identify the minority groups and areas that affected by the barriers.

Additionally, this paper was designed to apply statistical analysis to investigate how internet and transportation accessibility correlate with general health status. We found that limited internet and transport access to the healthcare are more likely to the negatively influence respondent's health conditions, particularly for people living in rural or remote areas, and minority population. Thus, relevant implementing priorities should focus on such groups and regions. As expected, this study found that people who had access to the internet were more likely to report excellent or very good health status. One possible explanation for this is that if people have access to the internet, their information gathering, and lifestyle may be changed. With internet access, there exist higher possibility that people pursue healthy information in an easier and more effective way. It, in turn, could help people to maintain their health conditions and preventing disease. Also, people with internet access could use the internet to efficiently and effectively communicate with their doctors to exchanges health-related information and opinions.[35] By keeping updated with recent advancements in medication, people can have more options to choose the best treatment for their health conditions. Additionally, internet accessibility could play a strong role in securing transportation assistance needed to deal with health problems. For example, with internet use, people could make rider reservations (e.g., Uber, Lyft, etc.) to reach their destinations (e.g., healthcare facilities). This study found that there is a negative association between limited transportation access to healthcare and self-reported health status. This is consistent with the prior works.[8-10,12] Transportation accessibility might not

be a very big issue in urban metro or non-metro areas because people usually have more transportation options to get to the healthcare facilities, but it could be a big issue in rural areas since no public or demand-response transportation options available.[36] This study is a meaningful first step to figure out where are the spots that are in an urgent need for infrastructure or service improvement, and to identify strategies to provide improved healthcare service access within those areas. For example, mobile base stations could be built to expand broadband access for rural or remote residents. The government could also support demand-response transportation service in certain regions or even provide government-supported mobile healthcare facilities to serve certain areas where internet and transportation accessibility are the main concerns.

Limitation

Our study has several limitations. First, the survey design for HINTS is cross-sectional in nature. Although we observed associations between demographic characteristics with the patients' health status, definitive conclusions cannot support a causal inference. Second, the 2018 HINTS was the only source for information on both internet use and transportation choice for healthcare from random sample of US population. HINTS response rate was approximately 32%, which may lead to selection and estimation bias. We suggest that local or micro-level studies are needed to validate these findings, and to provide a better, detailed interpretation of findings. Third, survey information only collected data through relatively short period, so it may not grasp rapid change of improvements on internet use and transport accessibility.

CONCLUSIONS

Although several limitations exist, the findings of the present analysis remain valid and relevant: Internet use and transport barriers are significant factors for people with health issues, and there are disparities between urban and non-urban areas, and among the States. These barriers and disparities can influence patients' health conditions, which subsequently deteriorate their health outcomes and quality of life. To maximize the potential for internet use and transportation to improve health, additional work and policy is needed to ensure that internet and transportation resources and services are prioritized for underserved populations and areas.

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