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ORIGINAL RESEARCH

Changes of Health Outcomes, Healthy Behaviors, Generalized Trust, and Accessibility to Health Promotion Resources in Taiwan Before and During COVID-19 Pandemic: Comparing 2011 and 2021 Taiwan Social Change Survey (TSCS) Cohorts

Yu-Ching Lin[1,2,*], Chung-Ying Lin[3–6,*], Chia-Wei Fan[7], Chieh-Hsiu Liu[8], Daniel Kwasi Ahorsu[9], Duan-Rung Chen[10], Hui-Ching Weng[3,11], Mark D Griffiths[12]

[1]Department of Physical Medicine and Rehabilitation, College of Medicine, National Cheng Kung University, Tainan, Taiwan; [2]Department of Physical Medicine and Rehabilitation, National Cheng Kung University Hospital, College of Medicine, National Cheng Kung University, Tainan, Taiwan; [3]Institute of Allied Health Sciences, College of Medicine, National Cheng Kung University, Tainan, Taiwan; [4]Department of Occupational Therapy, College of Medicine, National Cheng Kung University, Tainan, Taiwan; [5]Biostatistics Consulting Center, National Cheng Kung University Hospital, College of Medicine, National Cheng Kung University, Tainan, Taiwan; [6]Department of Public Health, College of Medicine, National Cheng Kung University, Tainan, Taiwan; [7]Department of Occupational Therapy, AdventHealth University, Orlando, FL, USA; [8]Department of Geriatrics and Gerontology, Research Center of Clinical Medicine, National Cheng Kung University Hospital, College of Medicine, National Cheng Kung University, Tainan, Taiwan; [9]Department of Rehabilitation Sciences, Faculty of Health and Social Sciences, The Hong Kong Polytechnic University, Hung Hom, Hong Kong; [10]Institute of Health Behaviors and Community Sciences, National Taiwan University, Taipei, Taiwan; [11]Institute of Gerontology, College of Medicine, National Cheng Kung University, Tainan, Taiwan; [12]International Gaming Research Unit, Psychology Department, Nottingham Trent University, Nottingham, UK

*These authors contributed equally to this work

Correspondence: Hui-Ching Weng, Institute of Allied Health Sciences and Institute of Gerontology, College of Medicine, National Cheng Kung University, 1 University Road, East District, Tainan City, 70101, Taiwan, Tel +886-6-2353535 ext. 5986, Fax +886-6-3028175, Email hc6127@mail.ncku.edu.tw

Purpose: The present study compared two nationally representative cohort datasets concerning Taiwan residents' healthy behaviors, subjective health outcomes, generalized trust, and accessibility to health promotion resources.

Patients and Methods: The Taiwan Social Change Survey (TSCS) was conducted in two waves ten years apart: 2011 cohort (n = 1021; 48.4% males) and 2021 cohort (n = 1425; 47.4%) cohorts. Descriptive statistics were calculated to compare the two TSCS datasets. Then, multiple regression models were constructed with health outcome as the dependent variable, and demographics and other key components as independent variables.

Results: The 2011 TSCS cohort showed higher prevalence for cigarette smoking (30.8% vs 25.2%; p=0.002), alcohol drinking (52.5% vs 24.3%; p<0.001), exercise habits (52.7% vs 48.0%; p=0.02), and better fruit and vegetable accessibility (Mean=3.91 vs 3.82; p=0.04). The 2021 TSCS cohort reported higher body mass index (Mean=24.20 vs 23.63; p<0.001), less residency in urban areas (22.4% vs 31.1%; p<0.001), better jogging accessibility (4.14 vs 4.05; p=0.006), higher generalized trust (2.26 vs 2.17; p=0.001), and greater internet usage (3.43 vs 2.89; p<0.001). The regression model showed that exercise habits (standardized coefficient=0.20 and 0.10; p<0.001) and generalized trust (standardized coefficient=0.11 and 0.11; p=0.004 and <0.001) were consistently associated with health outcomes in both cohorts. Additionally, internet use (standardized coefficient=−0.07; p=0.026) and alcohol drinking behaviors (standardized coefficient=−0.07; p=0.0022) were negatively associated with health outcomes in the 2021 cohort.

Conclusion: The present study demonstrated the trends and changes over 10 years regarding multiple health-related components among Taiwan residents. The study's findings provide insight into education promotion programs to reduce unhealthy behaviors as well as enhancing generalized trust building and developing healthy behaviors for Taiwan residents.

Keywords: health behavior, health promotion, COVID-19, Taiwan, trust

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Introduction

Healthy behaviors, such as physical activity engagement and fruit and vegetable intake, are important factors contributing to individuals' overall health, including their subjective health outcomes (eg, quality of life, self-perceived health).[1–4] Subjective health outcome refers to how individuals evaluate their health status. Moreover, subjective health outcomes have become commonly used health measures because they can provide information that cannot be assessed using objective measures, such as mood states of an individual (eg, depression).[1–4] In this regard, it is important to understand the association between health behaviors and subjective health outcomes. More specifically, evidence has consistently shown that having sufficient physical activity and consuming fruit and vegetable are key factors in controlling an individual's weight.[5–8] By maintaining a healthy weight, individuals are likely to have good physical fitness and life satisfaction, which are beneficial for their overall health.[2,9–11]

Apart from engaging in healthy behaviors, not engaging in unhealthy behaviors (eg, smoking cigarettes and drinking alcohol) can be beneficial for individuals' health.[12–15] Additionally, internet use has become a pervasive and time-consuming behavior in recent years and increasing evidence shows that excessive internet use can jeopardize individuals' psychological health.[16–19] Because population health is a key element for healthy society development, it is important to understand the changes in healthy behaviors, population health, and associated factors for each society across time (eg, understanding the changes over the period of a decade). Based on these data, authorities and governments can design or modify policies to address health promotion for their citizens and improve the development of their society.

Generalized trust (aka general trust or trust) is a social capital that has been proposed to be an important societal factor for individuals' maintaining daily living.[20–22] With a high level of generalized trust, individuals can have satisfactory social interaction at both micro and macro levels. At the macro level, generalized trust has been viewed as a social lubricant that facilitates important interactions for society development (eg, business transactions).[23] At the micro level, individuals can obtain benefits of generalized trust in relation to important aspects such as health. More specifically, generalized trust helps make an individual anticipate a positive outcome from others' actions.[24–26] Subsequently, good interpersonal relationships can be built upon to improve the health of individuals. Indeed, prior evidence shows that those with higher levels of generalized trust report less psychological distress and higher levels of good mental health.[27–31] Therefore, generalized trust could be a consistent factor contributing to good health for individuals across time.

In addition to generalized trust, accessibility to health promotion resources is an important external factor for individuals to engage in healthy behaviors because accessibility provides suitable environments for individuals to engage in healthy behaviors.[32] With the increase of healthy behavior engagement, accessibility could have positive effects on individuals' health.[32,33] Consequently, the present study focused on three specific accessibilities (ie, jogging accessibility, fruit and vegetable accessibility, and public facility accessibility) because they are relevant to healthy behaviors engagement and subjective health outcomes. Jogging accessibility refers to having physical space for individuals to jog effortlessly. Fruit and vegetable accessibility refers to individuals having opportunities to purchase fruits and vegetables. Public facility accessibility refers to having facilities for individuals to engage in different healthy behaviors (eg, yoga classes sponsored by public funds) and being able to access and obtain health information (eg, government-funded health education classes). It is also important to investigate whether these different types of accessibilities have improved across time and are associated with individuals' health.

In addition to investigating the healthy/unhealthy behaviors, health outcomes, and associated factors across time, the COVID-19 pandemic began in 2019 and highlighted the importance of comparing healthy/unhealthy behaviors, health outcomes, and associated factors before and during COVID-19 pandemic. More specifically, empirical evidence has shown that COVID-19 caused changes in human behavior (eg, lockdowns restrict individuals engaging in physical activity and may facilitate excessive internet use) and psychological distress.[34–40] Therefore, the COVID-19 pandemic together with societal change (eg, technology advancement, government policy changes) are likely to cause behavior changes, affect health outcomes, and likely affect the associations between behavior changes, health outcomes, and associated factors. However, to the best of the present authors' knowledge, there is no evidence showing the changes of healthy/unhealthy behaviors, subjective health outcomes, generalized trust, and accessibility to health promotion

resources in Taiwan across a decade-long period, taking into consideration the COVID-19 pandemic. Therefore, using two datasets from representative samples a decade apart (one collected before COVID-19 pandemic and the other during COVID-19 pandemic) may provide information for Taiwanese authorities and governing bodies to evaluate relevant policies in health improvement among Taiwanese citizens. Moreover, such information may be useful in the Taiwan healthcare system. More specifically, Taiwan National Health Insurance was launched in 1993, and this healthcare system covers over 99% of Taiwan residents regarding their essential needs in health treatment in hospitals or clinics. Additionally, Taiwan launched the long-term care system in 2000 to tackle the healthcare needs of older people. The long-term care system included maid employment (ie, setting criteria for hiring domestic helpers to take care of the older people who need home care) and health promotion for older people. More recently, the Taiwan government reviewed and modified the long-term care system in 2017 (ie, Long-term Care 2.0 System).

The present study had two purposes. First, to compare healthy/unhealthy behaviors, subjective health outcomes, generalized trust, and accessibility to health promotion resources among two cohorts of Taiwanese citizens using the nationally representative data collected by the Institute of Sociology, Academia Sinica, Taiwan. Second, to investigate the associations between the aforementioned variables for the two cohorts separately. The two cohorts were collected ten years apart (2011 [before the COVID-19 pandemic] and 2021 [during the COVID-19 pandemic]) and the comparisons could therefore provide information regarding how Taiwan residents changed their healthy/unhealthy behaviors, subjective health outcomes, generalized trust, and perceptions on accessibility. The study's findings will have implications for the Taiwanese government and relevant stakeholders in helping create a better environment for health promotion among Taiwan citizens.

Materials and Methods

Data and Study Design

Two secondary datasets were used for the present study and were collected via a national research project in Taiwan (ie, the Taiwan Social Change Survey [TSCS]). The first TSCS data collection was initiated in 1984 with regular data collections afterwards. The TSCS joined the International Social Survey Programme (ISSP; www.issp.org) in 2002 to have some of the survey questions align with 40+ countries worldwide. In addition to the collaboration with ISSP, the TSCS has worked with East Asian Social Survey (EASS; www.eassda.org) to design a theme-based survey to explore important social change issues in East Asia every two years.

The target population in the TSCS is Taiwan residents (ie, those recorded in the Department of Household Registration), and the TSCS sampling adopted a stratified random sampling method. In the sampling, several clusters were considered using the following factors: percentage of commercial employees, percentage of industry workers, percentage of population aged 15–64 years, percentage of population aged 65 years or older, educational level, and population density.[41] There were more respondents in the 2011 TSCS (n = 2199) than the 2021 TSCS (n = 1425). There are a number of reasons for this. In 2011, the TSCS integrated the core questions from both EASS 2010 and ISSP 2011, and 2199 participants were randomly split into two groups to prevent them from experiencing survey fatigue (ie, one group completed the EASS 2010 core questions, and the other group completed the ISSP 2011 core questions). In contrast, the 2021 TSCS did not include core questions from EASS and all the 2021 TSCS respondents answered the same survey questions. As a result, only half of the 2011 TSCS respondents were comparable to the 2021 TSCS respondents. Moreover, due to the COVID-19 pandemic, the response rate of face-to-face interviews decreased. Therefore, the number of participants was much lower for the 2021 TSCS. However, given that the sampling method was stratified random sampling, the difference in cohort size between the 2021 and 2011 samples means it is unlikely that there would be any substantial impacts on the accuracy of present results. For each TSCS dataset collection, the Institute of Sociology, Academia Sinica (Taiwan) provided full supervision and arrangements.[42]

The TSCS datasets used for the present study were the 2011 TSCS cohort and the 2021 TSCS cohort (ie, ten years apart). Moreover, the pandemic was an unavoidable life event for most individuals globally including those living in Taiwan. Individuals' health outcomes and health behaviors may have changed between 2011 and 2021 and these

variables are likely to have been influenced by the pandemic given the period in which the data in the second wave were collected. For the 2011 TSCS cohort, in-person interviews were conducted between July 2011 and April 2012. For the 2021 TSCS cohort, in-person interviews were conducted between September 2021 and February 2022. The institutional review board (IRB) for Humanities & Social Science Research Academia Sinica (AS-IRB-HS 02-19034[R5]) approved the TSCS data collection. Moreover, only participants aged 18 years or above and who provided consent for participation were involved in the TSCS data collection. On visiting the randomly-selected participants, well-trained interviewers conducted in-person interviews and obtained written informed consent from the participants. Additional TSCS information and details are posted on the following website: https://srda.sinica.edu.tw.

COVID-19 Severity in the 2021 TSCS Cohort

The 2021 TSCS data collection period overlapped with the worldwide COVID-19 pandemic. However, such severity was relatively mild in Taiwan (ie, there were relatively minor community outbreaks between September 2021 and February 2022 in Taiwan). The highest number of the new cases in the seven-day average was 597 (the population size in Taiwan is approximately 23 million) on 28 May 2021,[43,44] which was prior to the launch of the 2021 TSCS survey. During the 2021 TSCS survey period, the numbers of new cases in the seven-day average were 70 or below. However, different degrees of restrictions were implemented in different situations and environments for COVID-19 infection control (eg, some schools used online teaching when they had outbreaks on the school campus).[43,44]

Measures

Health Outcomes

Eight items rated using a five-point Likert scale were constructed to present subjective health outcomes. The eight items are listed in Table 1. A sample item is "Does your physical pain cause you any difficulties in daily living activities?". All the item scores were coded with a higher score indicating better health outcomes, and they had very good internal consistency (α=0.84 in the 2011 TSCS cohort; 0.87 in the 2021 TSCS cohort). The item scores were then averaged to present an overall health outcome score.

Healthy/Unhealthy Behaviors

Three items rated using a frequency response were used to assess three different health-related behaviors (ie, smoking cigarettes, drinking alcohol, and exercise habits). The three items were simply rated either "yes" or "no". For smoking and drinking, "yes" indicated either being a previous or current smoker or drinker (eg, if the participant used to smoke cigarettes but was now a non-smoker, they ticked "yes" to being a smoker). For exercise habits, "yes" indicated engaging in exercise several times a week or more. The three items were treated independently in the data analysis for each health-related behavior.

Table 1 Measures for Health Outcomes Used in the 2011 and 2021 Taiwan Social Change Survey (TSCS) Cohorts

	1	2	3	4	5
1. Does your physical pain cause you any difficulties in daily living activities?					
2. Generally speaking, how would you rate your health status?					
3. How often do you experience physical pain?					
4. How often do you feel unhappy or depressed?					
5. How often do you lose confidence in yourself?					
6. How often do you feel unable to overcome the difficulties you faced?					
7. How often do you feel moody?					
8. How often do you feel calm and peace?					

Notes: 1= Extremely (item 1), Poor (item 2), Never (items 3 to 7), or All the time (item 8). 2= Quite a lot (item 1), On average (item 2), Seldom (items 3 to 7), or Most of the time (item 8). 3=Moderate level (item 1), Good (item 2), or Sometimes (items 3 to 8). 4= A little bit (item 1), Very good (item 2), Usually (items 3 to 7), or Seldom (item 8). 5= Not at all (item 1), Extremely good (item 2), Always (items 3 to 7), or Never (item 8).

Accessibility

Three items were rated using a five-point Likert scale from "strongly agree" to "strongly disagree" to assess three different accessibilities (ie, jogging accessibility, fruit and vegetable accessibility, and public health promotion facility accessibility). A higher score indicated a higher level of accessibility. The three items were treated independently in the data analysis for each accessibility.

Generalized Trust

One item was used to assess individuals' generalized trust and was rated using a four-point Likert scale from "always" to "never". The item was "Generally speaking, how much do you think that individuals are trustworthy?". A higher score indicated a higher level of generalized trust.

Time Spent on Internet

One item "On average, how much time do you spend on internet a day?" with a blank space for the participants to complete was used to assess daily time spent on internet.

Demographic Information

The participants were also asked various questions concerning demographic information: age (in years); gender (male or female); height (in centimeters); weight (in kilograms); self-perceived weight status (too thin, slightly thin, neither thin nor fat, slightly fat, or too fat); education (primary school or below, high school, or college or above); marital status (single, married, or other); residency (urban or other). Moreover, height and weight were used to calculate body mass index (BMI), which later was used to classify the participants into an overweight (BMI >24 kg/m^2) or non-overweight group (BMI <=24 kg/m^2).

Data Analysis

All the data were summarized using descriptive statistics (including means, standard deviations, frequencies, and percentages) to portray the performance of the studied variables in the two TSCS cohorts. Independent *t*-tests (for continuous data) and χ^2 tests (for categorical data) were used to examine the differences between the two cohorts. Two multiple regression models were then constructed for the two TSCS cohorts using parallel variables: the dependent variable was health outcome; the independent variables were age, gender, education, marital status, weight status, cigarette smoking, alcohol drinking, exercise habits, generalized trust, jogging accessibility, fruit and vegetable accessibility, public health facility accessibility, and daily time spent on the internet. Because multiple regression models were constructed, the continuous variables (ie, health outcome, age, generalized trust, jogging accessibility, fruit and vegetable accessibility, public facility accessibility, and daily time spent on the internet) were tested for their distribution. Skewness (−1.38 to 1.39 in 2011 TSCS; −1.60 to 1.31 in 2021 TSCS) and kurtosis (−0.94 to 4.38 in 2011 TSCS; −1.00 to 4.04 in 2021 TSCS) showed that these variables were normally distributed for regression models. All the statistical analyses were performed using SAS 9.4 (SAS Institute Inc., Cary: NC).

Results

The two TSCS cohorts' demographic information is presented on Table 2. In brief, the 2021 TSCS cohort compared with the 2011 TSCS cohort (n = 1425 in 2021 cohort; 1021 in 2011 cohort) was older (50.58 years vs 44.14 years; $p < 0.001$), had higher BMI (24.20 kg/m^2 vs 23.63 kg/m^2; $p = 0.006$), and less residency in urban areas (22.4% vs 31.1%; $p < 0.001$). No significant differences were found in gender distribution (48.4% males in the 2011 TSCS cohort; 47.4% males in the 2021 TSCS cohort; $p = 0.64$), self-perceived weight status (12.5% thin, 36.1% neither thin nor fat, and 51.4% fat in the 2011 TSCS cohort; 12.4% thin, 35.1% neither thin nor fat, and 52.6% fat in the 2021 TSCS cohort; $p = 0.94$), and educational level (17.5% at primary school or below level in the 2011 TSCS cohort; 14.0% at primary school or below level in the 2021 TSCS cohort; $p = 0.06$).

Table 3 shows the differences in healthy/unhealthy behaviors, health outcomes, accessibility, generalized trust, and daily time spent on internet between the two TSCS cohorts. The prevalence rates of cigarette smoking (25.2% vs 30.8%; $p = 0.002$), alcohol drinking (24.3% vs 52.5%; $p < 0.001$), and exercise habits (48.0% vs 52.7%; $p = 0.02$) were

Table 2 Demographic Comparisons Between 2011 and 2021 Taiwan Social Change Survey (TSCS) Cohorts

	2011 TSCS	2021 TSCS	*p*-value
	M (SD) or n (%)	M (SD) or n (%)	
Age (in years)	44.14 (15.26)	50.58 (16.53)	<0.001
Gender (males)	494 (48.4)	676 (47.4)	0.64
Height (cm)	163.95 (8.63)	163.38 (8.63)	0.11
Weight (kg)	63.59 (12.43)	64.94 (13.93)	0.013
BMI (kg/m^2)	23.63 (3.79)	24.20 (4.04)	<0.001
≥24	428 (43.5)	678 (49.2)	0.006
<24	556 (56.5)	699 (50.8)	
Self-perceived weight status			0.94
Too thin	31 (3.0)	45 (3.2)	
Slightly thin	97 (9.5)	130 (9.2)	
Neither thin nor fat	368 (36.1)	498 (35.1)	
Slightly fat	400 (39.2)	559 (39.4)	
Too fat	124 (12.2)	187 (13.2)	
Education			0.06
Primary school or below	178 (17.5)	199 (14.0)	
High school	402 (39.4)	585 (41.0)	
College or above	440 (43.1)	641 (45.0)	
Marital status			<0.001
Single	304 (29.8)	369 (25.9)	
Married	609 (59.8)	786 (55.2)	
Other	106 (10.4)	270 (18.9)	
Residency			<0.001
Urban	314 (31.1)	317 (22.4)	
Other	697 (68.9)	1099 (77.6)	

significantly lower in the 2021 TSCS cohort as compared with the 2011 TSCS cohort. Moreover, the 2021 TSCS cohort reported significantly better jogging accessibility (4.14 vs 4.05; $p = 0.006$), higher generalized trust (2.26 vs 2.17; $p = 0.001$), and more time on the internet (3.43 vs 2.89 $p < 0.001$) than did the 2011 TSCS cohort. The 2021 TSCS cohort had significantly worse fruit and vegetable accessibility than the 2011 TSCS cohort (3.82 vs 3.91; $p = 0.04$). No significant differences were found between the two cohorts in health outcomes and public health promotion facility accessibility.

Table 4 presents the results of multiple regression models. In the 2011 TSCS, males (compared to females) had better subjective health outcomes (standardized coefficient [β] = 0.12; $p = 0.01$); individuals engaging in exercise compared with those not engaging in exercise had better health outcomes (β = 0.20; $p < 0.001$); individuals having higher generalized trust had better health outcomes (β = 0.11; $p = 0.004$). In the 2021 TSCS, males as compared with females had better health outcomes (β = 0.15; $p < 0.001$); individuals engaging in exercise compared with those not engaging in exercise had better health outcomes (β = 0.10; $p < 0.001$); individuals having higher generalized trust had better health outcomes (β = 0.11; $p < 0.001$); individuals drinking alcohol as compared those not drinking alcohol had poorer health outcomes (β = −0.07; $p = 0.022$); individuals spending more daily time on the internet had poorer health outcomes (β = −0.07; $p = 0.026$).

Discussion

With the use of two nationally representative cohorts (ie, 2011 and 2021 TSCS cohorts), the present study demonstrated the changes of subjective health outcomes, healthy/unhealthy behaviors, generalized trust, and accessibility to health promotion resources among Taiwanese citizens over a ten-year period. The results showed that the 2021 TSCS cohort as

Table 3 (Un)healthy Behaviors, Health Outcomes, Generalized Trust, and Accessibility to Health Promotion Resources Comparisons Between 2011 and 2021 Taiwan Social Change Survey (TSCS) Cohorts

	2011 TSCS	2021 TSCS	*p*-value
	M (SD) or n (%)	M (SD) or n (%)	
Healthy/unhealthy behaviors			
Cigarette smoking, yes	314 (30.8)	359 (25.2)	0.002
Alcohol drinking, yes	536 (52.5)	346 (24.3)	<0.001
Exercise habit, yes	537 (52.7)	684 (48.0)	0.02
Health outcomes (5-point Likert scale)[a]	3.92 (0.68)	3.97 (0.69)	0.10
Accessibility to health promotion resources			
Jogging accessibility (5-point Likert scale)	4.05 (0.82)	4.14 (0.77)	0.006
Fruit and vegetable accessibility (5-point Likert scale)	3.91 (0.99)	3.82 (1.10)	0.04
Public health promotion facility accessibility (5-point Likert scale)	4.07 (0.83)	4.11 (0.85)	0.24
Generalized trust (4-point Likert scale)	2.17 (0.84)	2.26 (0.85)	0.001
Time on internet (in hours)	2.89(2.75)	3.43(3.33)	<0.001

Note: [a]Assessed using eight items (Cronbach's α=0.84 for 2011 TSCS cohort; 0.87 for 2021 TSCS cohort).

Table 4 Multiple Linear Regression Model Explaining Health Outcomes in the 2011 and 2021 Taiwan Social Change Survey (TSCS) Cohorts

	2011 TSCS			2021 TSCS		
	B (SE)	β (p-value)	95% CI	B (SE)	β (p)	95% CI
Age	0.01 (0.003)	0.12 (0.028)	(0.0001–0.01)	0.002 (0.002)	0.05 (0.215)	(−0.001–0.01)
Gender (Ref: female)	0.15 (0.06)	0.12 (0.010)	(0.04–0.26)	0.21 (0.04)	0.15(<0.001)	(0.13–0.29)
Education (Ref: <=primary school)						
High school	0.49 (0.21)	0.36 (0.022)	(0.07–0.91)	−0.06 (0.07)	−0.04 (0.400)	(−0.19–0.07)
College or above	0.39 (0.21)	0.29 (0.064)	(−0.02–0.81)	−0.05 (0.07)	−0.04 (0.478)	(−0.20–0.09)
Marital status (Ref: single)						
Married	0.05 (0.07)	0.04 (0.466)	(−0.09–0.19)	0.10 (0.05)	0.07 (0.053)	(0.00–0.19)
Other	−0.23 (0.13)	−0.08 (0.078)	(−0.49–0.03)	0.01 (0.06)	0.01 (0.863)	(−0.11–0.13)
Weight status (Ref: < 24 kg/m^2)	−0.01 (0.05)	−0.01 (0.832)	(−0.12–0.10)	−0.03 (0.04)	−0.02 (0.468)	(−0.10–0.05)
Smoking cigarettes (Ref: no)	0.05 (0.06)	0.04 (0.411)	(−0.07–0.18)	−0.07 (0.05)	−0.04 (0.157)	(−0.17–0.03)
Drinking alcohol (Ref: no)	−0.06 (0.05)	−0.05 (0.248)	(−0.17–0.04)	−0.11 (0.05)	−0.07 (0.022)	(−0.20 – −0.02)
Exercise habits (Ref: no)	0.26 (0.05)	0.20(<0.001)	(0.16–0.36)	0.13 (0.04)	0.10(<0.001)	(0.06–0.20)
Generalized trust	0.09 (0.03)	0.11 (0.004)	(0.03–0.15)	0.09 (0.02)	0.11(<0.001)	(0.05–0.14)
Jogging accessibility	0.01 (0.03)	0.02 (0.672)	(−0.05–0.08)	0.04 (0.02)	0.05 (0.088)	(−0.01–0.09)
Fruit and vegetable accessibility	0.01 (0.03)	0.01 (0.857)	(−0.05–0.07)	0.02 (0.02)	0.04 (0.182)	(−0.01–0.06)
Public facility accessibility	−0.02 (0.04)	−0.02 (0.630)	(−0.09–0.06)	−0.002 (0.02)	0.002 (0.944)	(−0.05–0.05)
Time on internet (in hours)	<0.001 (0.01)	<0.001 (0.999)	(−0.02–0.02)	−0.02 (0.01)	−0.07 (0.026)	(−0.03 – −0.002)
F-value (*p*-value)		5.32(<0.001)			6.43(<0.001)	
R^2		0.117			0.067	
Adjusted R^2		0.095			0.057	

Abbreviations: B, unstandardized coefficient; SE, standard error; β, standardized coefficient; CI, confidence interval.

compared with the 2021 TSCS cohort had significantly higher BMI, less residency in urban areas, lower levels of smoking cigarettes and drinking alcohol, less engagement in exercise, and more daily time spent on the internet. Additionally, engaging in exercise and generalized trust had consistent associations with subjective health outcomes in both the 2011 and 2021 TSCS cohorts; daily time spent on the internet and drinking alcohol had negative association with health outcomes in the 2021 TSCS cohort but not the 2011 TSCS cohort.

The increase in being overweight over the past decade appears to be a global trend, especially among developed countries.[45] The findings in the present study showed a similar trend (ie, increasing prevalence of being overweight during the past decade). Some discrepancies exist between self-perceived weight status and the clinical-defined weight status (ie, using BMI data). More specifically, among both TSCS cohorts, Taiwanese citizens did not appear to think they were overweight even though their BMI indicated they were. However, the prevalence rates of being overweight were high and growing (43.5% in 2011 and 49.2% in 2021). Therefore, the Taiwanese government should put efforts into initiatives concerning weight reduction and weight issue awareness.

Regarding healthy/unhealthy behaviors, the 2021 TSCS cohort had reduced smoking and drinking behaviors. However, the 2021 TSCS cohort also had decreased engagement in exercise. The reduction in smoking and drinking behaviors might due to improved health literacy[46,47] and that Taiwanese citizens have better knowledge concerning the risks and harm of smoking cigarettes and drinking alcohol. Another explanation might be due to the increased tax on cigarettes and alcohol over the past decade in Taiwan. Moreover, cigarettes have an additional health and welfare surcharge (eg, every 1000 sticks of cigarettes have a 1000 New Taiwan dollar [~33 USD] surcharge).[48]

Regarding the decreased engagement in exercise, this might be due to the COVID-19 pandemic, which forced the government to restrict Taiwan citizens' outdoor activities.[43,49] Although COVID-19 pandemic was a burden for Taiwan citizens to engage in exercise, the 2021 TSCS cohort reported better jogging accessibility than the 2011 TSCS cohort. This indicates that the Taiwanese government appears to have improved physical environments for individuals to engage in jogging (eg, increasing the number of jogging tracks). However, the 2021 TSCS cohort did not observe improvements in vegetable and fruit accessibility or public health promotion facility accessibility. Therefore, the Taiwanese government may want to allocate additional resources to improve accessibility in these two areas.

The 2021 TSCS cohort spent more time on the internet than the 2011 TSCS cohort. This may be explained by technology advancement, including improved accessibility to internet use (eg, WiFi development) and advanced user-friendly devices at affordable prices (eg, tablets and smartphones).[16–19] Also, the COVID-19 pandemic continued throughout 2021. Therefore, this provides another explanation as to why the 2021 TSCS cohort spent more time on the internet (ie, individuals were forced to engage in online activities – such as online learning and online meetings – during COVID-19 pandemic to help stop the spread of the virus). Moreover, the lower residency reported in urban areas found in the 2021 TSCS cohort than in the 2011 TSCS cohort may be due to the establishment of high-speed rail links and Metro systems in big cities that has improved and shortened the distances between urban and non-urban areas.

Both the 2011 and 2021 TSCS cohorts demonstrated that engaging in exercise and generalized trust had consistent associations with positive subjective health outcomes. These findings corroborate prior evidence that physical activity engagement is a key element in good health[2] and generalized trust being an important societal factor for good health.[27–31] Unlike the positive effects of exercise and generalized trust, the present findings showed that increased daily internet use had negative association with health outcomes in 2021 TSCS cohort, although this association was not significant in the 2011 TSCS cohort. Two reasons may explain this finding. First, internet use was not that popular in the 2011 TSCS cohort as compared with the 2021 TSCS cohort. Indeed, the present study also showed higher levels of internet use in 2021 TSCS cohort than in the 2011 TSCS cohort (Table 1). Second, the COVID-19 pandemic might have exacerbated the negative impacts of internet use on health, as there is a lot of empirical evidence demonstrating the associations between increased internet use and psychological distress during COVID-19 pandemic.[50–53]

The major strength of the present study was the use of stratified random sampling method to recruit relatively large sample sizes in two cohorts (ie, 2011 and 2021 TSCS). Because of the relatively large sample sizes, the power of the present study's findings was sufficient. Moreover, the effect sizes of the present study's regression models were small to moderate (ie, R^2=0.117 and 0.067). However, there are some limitations in the present study. First, given that the study comprised secondary data analysis, some potential and important confounders may have influenced the major outcomes of the present study (eg, exercise habits and health outcomes were not objectively assessed). Moreover, weight-related self-stigma has been found to be a significant factor contributing to low physical activity engagement.[54,55] However, this concept has only recently been recognized in Taiwan[56] and was not included as one of the survey items in the TSCS (both the 2011 and 2021 cohorts). Second, all the survey items were completed using self-reports. Therefore, commonly encountered biases in self-reports could have influenced the study's findings. For

example, social desirability might have made the participants report more healthy behaviors (eg, exercise) and fewer unhealthy behaviors (eg, cigarette smoking). Third, some important variables were not fully assessed in the survey such as the consumption rate of fruits and vegetables, dairy, and fast food. Fourth, although the comparisons between the two cohorts were based on the same items assessing on the same concepts (ie, the item content and statements were identical for items across the two cohorts), the data collection procedures were sometimes different between the two cohorts. For example, the interviewers were different between the two cohorts. Moreover, the COVID-19 pandemic occurred during 2021 may have caused some restrictions in data collection (eg, interviewers could not do home visits in severe outbreak areas). Lastly, the two cohorts were completely different in composition. Therefore, individual differences might be a potential reason for the significant differences found in the present findings between the two cohorts.

Conclusion

The present study showed that Taiwanese citizens appeared to have some behavioral and belief changes between 2011 and 2021. More specifically, as compared with the 2011 cohort, the 2021 cohort (i) were more likely to be overweight, (ii) were less likely to be living in urban areas, (iii) had lower levels of cigarette smoking, alcohol drinking, and exercise engagement, (iv) had better perceptions concerning jogging accessibility, (v) had worse perceptions concerning fruit and vegetable accessibility, (vi) had greater generalized trust, and (vii) spent more time on the internet. Moreover, engaging in exercise and generalized trust were found to be consistently significant factors associated with positive health outcomes in the two cohorts. In addition, increased daily internet use and drinking alcohol were negatively associated with poorer health outcomes in the 2021 TSCS cohort. Therefore, health promotion activities to improve exercise uptake and education programs to enhance generalized trust are suggested for the Taiwanese government to elevate the health of its citizens. Moreover, the governments and healthcare authorities should consider how to reduce the harms caused by alcohol overconsumption and internet overuse.

Data Sharing Statement

The information of data and materials could be obtained from the TSCS website, https://srda.sinica.edu.tw.

Compliance with Ethical Standards

The institutional review board (IRB) for Humanities & Social Science Research Academia Sinica (AS-IRB-HS 02-19034 [R5]) approved the TSCS data collection. All methods were performed in accordance with the Declaration of Helsinki and participants could withdraw consent at any time. Also, the participants' right to data confidentiality is considered and protected in the TSCS data collection, which adheres to the compliance with the Declaration of Helsinki.

Consent

Informed consents were obtained for every participant.

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Disclosure

The authors report no conflicts of interest in this work.

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