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Associations between vaccination and quality of life among Taiwan general population: A comparison between COVID-19 vaccines and flu vaccines

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ABSTRACT
The COVID-19 pandemic has profoundly impacted lives worldwide and has led to global vaccination against COVID-19. However, there are concerns about the adverse effects of such vaccines on individuals' health. Therefore, it is important to investigate the association between vaccination and holistic health outcome (i.e., quality of life [QoL]). The present study analyzed data from the Taiwan Social Change Survey (TSCS), a survey conducted utilizing stratified random sampling. More specifically, data (N = 1425; 47.44% males; mean age = 50.58 y) on their vaccinations (including COVID-19 and flu vaccines) and QoL (using the Short-Form 12) were used. Participants were separated into two age subgroups for analyses (those aged below 50 y, and those 50 y or above). For participants aged below 50 y, those who received COVID-19 vaccine and those who received both COVID-19 and flu vaccines had significantly better physical QoL than those who did not receive any vaccination. Mental QoL was not significantly associated with vaccinations for participants aged below 50 y. Moreover, neither mental nor physical QoL was significantly associated with vaccinations for those aged 50 y or above. The present study showed that not having COVID-19 and flu vaccinations is associated with poor QoL. This finding should be disseminated to the public to help aid vaccination promotion.

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COVID-19; flu; influenza; quality of life; Taiwan; vaccine uptake

Introduction

The novel coronavirus disease 2019 (COVID-19), an infectious disease caused by the SARSCoV2 virus, has resulted in a long-term global pandemic.[1] During the early phase of the pandemic, countries worldwide attempted to control it by primarily focusing on preventive behavioral policies by either promoting individual-level preventive behaviors (e.g., hand washing, spatial distancing, mask wearing) or country-level regulations (e.g., border control and closures of educational organizations and workplaces).[2–7] However, such control methods could not last long given that individuals had behavioral fatigue[8,9] and some policies caused subsequent mental health or behavioral problems (e.g., long-term quarantine caused psychological distress).[2–6] However, controlling the transmission rate of COVID-19 infection is a high priority because there is much evidence showing that COVID-19 is highly associated with a variety of health problems, such as mortality, sleep disturbances, and mental health problems.[10–15]

Apart from preventive behaviors, one of the commonly proposed methods to control the spread of COVID-19 was to achieve herd immunity worldwide. Given that successful herd immunity needs to have a large proportion of a community being immune to the COVID-19 (typically 70% or higher), the most efficient way is to increase vaccine uptake.[10,16,17] Scientists and researchers were (and still are) fully aware of the importance of herd immunity. Therefore, COVID-19 vaccines have been rapidly developed with various types of approaches (e.g., whole-microbe approach, subunit approach, and genetic approach).[18–20] At the time of writing (i.e., March 2022), several COVID-19 vaccines have been developed and administered, including AstraZeneca COVID-19 Vaccine (AZ Vaccine),[21] Moderna (Spikevax) COVID-19 vaccine,[22] and Pfizer-BioNTech (BNT) COVID-19 vaccine.[23] Moreover, the COVID-19 global vaccine uptake rate at the time of writing had reached 55% for being fully vaccinated and 62.5% for those with at least one dose of COVID-19 vaccine.[24]

However, adverse effects, including some serious negative consequences (e.g., anaphylaxis), may induce individuals' worries and concerns, which subsequently lead to vaccine hesitancy.[25–28] Although such adverse effects may possibly result in poor quality of life (QoL), prior evidence shows that COVID-19 vaccination did not decrease individuals' QoL.[29,30] Instead, it is proposed that COVID-19 vaccination may be beneficial to individuals' QoL.[31] However, to the best of the

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present authors' knowledge, evidence regarding the association between COVID-19 vaccination and QoL has only been reported in Western populations. Because ethnicity is an important factor contributing to vaccine effects,[32] the association between COVID-19 vaccination and QoL should be studied in non-Western populations (e.g., a Taiwanese sample as investigated in the present study).

On the other hand, the protection mechanism in vaccines[19–21–23] may provide a sense of wellbeing for individuals who get a COVID-19 vaccine. More specifically, individuals who receive a COVID-19 vaccine may feel physically safe (i.e., they have much less chance of being infected by COVID-19), which may lead them to have positive feelings concerning their health even though there are some vaccine-induced adverse effects.[33,34] Moreover, vaccines are likely improve the immune fitness for individuals[35] and assist them in developing better physical health. Indeed, prior evidence shows that flu vaccination had positive effects on children.[36] Therefore, it is possible that a COVID-19 vaccine may have the same effect on individuals' quality of life (QoL).

QoL can be viewed as subjective (or self-reported) health from the lens of the individuals themselves, and is usually considered to be multidimensional.[37] Given its multidimensional and person-centric features, QoL has been widely used in health-related fields (including research and clinical practice) to help assess personalized and holistic health.[38] Therefore, it is important to understand if COVID-19 vaccination could contribute to better QoL during the pandemic. Moreover, the threat and hazard of influenza should not be ignored when the entire world is paying attention to overcoming the COVID-19 pandemic challenge. More specifically, healthcare systems could crash if healthcare providers need to take care of both flu-infected and COVID-19-infected individuals simultaneously.[39] Therefore, understanding the association between flu vaccination and QoL is also important.

Therefore, the present study examined the association between vaccine uptake (including two types of vaccine; flu vaccine and COVID-19 vaccine) and QoL among a representative sample of individuals residing in Taiwan. The present study hypothesized that vaccine uptake (either flu vaccine or COVID-19 vaccine) would not be significantly associated with QoL or it would be positively associated with QoL. That is, individuals who received a vaccine would have similar or higher levels of QoL than those who did not receive a vaccine.

Materials and methods

Setting, dataset, and study design

The present study used the dataset collected for the Taiwan Social Change Survey (TSCS), a research project that was launched in 1984 and which regularly surveys Taiwan residents using a stratified random sampling method (via the clusters calculated using population density, educational level, percentage of population older than 65 y, percentage of population aged between 15 and 64 y, percentage of industry workers, and percentage of commercial employees).[40] Different survey questions are asked to different surveyed respondents for each wave of the TSCS under the supervision and arrangement of the Institute of Sociology, Academia Sinica, Taiwan.[41] Since 2002, the TSCS joined the International Social Survey Programme (ISSP) to align the survey questions with 40+ countries worldwide (for details, refer to www.issp.org). Moreover, the TSCS has collaborated with East Asian Social Survey (EASS) to conduct theme-based survey every 2 y (for details, refer to www.eassda.org).

The TSCS dataset used for the present study was collected between September 2021 and February 2022, with corresponding questions in the ISSP. The TSCS data collection was approved by the IRB for Humanities & Social Science Research Academia Sinica; application no. AS-IRB-HS 02 -19,034(R5). In the present TSCS data collection period, several well-trained interviewers visited the randomly selected participants to assist them in completing the survey. All individuals who agreed to participate in the survey provided written informed consent. On average, the participants spent 52.00 minutes (SD = 18.82) to complete the survey. Details of the TSCS can be obtained from the following website: https://srda.sinica.edu.tw.

COVID-19 severity and COVID-19 vaccine coverage during the period of TSCS

During the period of the present TSCS (i.e., September 2021 to February 2022), COVID-19 severity was relatively minor. A severe community outbreak of COVID-19 was seen in May 2021[42] and was significantly under control before September 2021. More specifically, the number of new cases in the seven-day average was 597 (i.e., the peak of the outbreak) on 28 May 2021 (https://www.cdc.gov.tw/En; accessed 28 May 2021) and the number decreased to less than 10 at the end of August 2021 (https://www.cdc.gov.tw/En; accessed 31 August 2021). Between September 2021 and February 2022, the number of new cases in the seven-day average was between 0 and 70 (https://www.cdc.gov.tw/En; accessed 28 February 2022). Regarding the coverage of COVID-19 vaccine, nearly three-quarters of Taiwanese residents were fully vaccinated (74.79%) and a further 6.14% of Taiwanese residents were partially vaccinated.[24] However, the vaccination policy in Taiwan during the period of the present TSCS set the priority for older individuals (aged 50 y or above) to get COVID-19 vaccination rather than younger individuals (aged below 50 y). This is because there were not enough COVID-19 vaccines to cover the whole adult population in Taiwan during the survey period.

Measures

Quality of life (QoL)

QoL was assessed using the Short-Form 12 (SF-12). The SF-12 is a brief version of Short-Form 36 (SF-36), a well-established instrument assessing generic QoL,[43] and shares the same sub-domains of physical functioning (PF, two items); role limitations due to physical health (RP, two items); bodily pain (BP, one item); general health perceptions (GH, one item); energy/vitality (VT, one item); social functioning (SF, one item); role limitations due to emotional problems (RE, two items); and mental health (MH, two items). The eight domains can be summarized into component summary scores: physical component summary (PCS, which contains PF, RP, BP, and GH) and mental component summary (MCS, which contains VT, SF, RE, and MH). The 12 items are rated using either a three-point or a five-point Likert-type scale and then converted into a 0–100 scale for further calculation into subdomain scores and the two-component summary scores. Therefore, subdomain and component summary scores ranged between 0 and 100, with a higher score indicating better QoL.[44] In addition to the promising psychometric properties documented for the original SF-12,[45] the SF-12 has been translated into Chinese with promising psychometric properties.[46]

Vaccine uptake

Two questions were used to assess whether the participants had received vaccine(s). One question asked whether the participants had received a flu vaccine (i.e., *"Did you get a flu vaccination in the past year?"*) which was answered either 'yes' or 'no'. The other question asked whether the participants had received a COVID-19 vaccine (i.e., *"Have you had a COVID-19 vaccination?"*) answered either 'yes' or 'no'.

Covariates

Several demographic covariates were assessed. These included: (1) sex (answered male or female); (2) height (answered using number of cm) and weight (answered using number of kg); (3) educational years (answered in number of years); (4) tobacco use (answered yes or no); (5) alcohol use (answered yes or no); (6) exercise habits (answered as either once per day, several times per week, once per week, or less than once per week); (7) vegetable and fruit consumption (answered as either once per day, several times per week, once per week, or less than once per week); and (8) presence of chronic illness (answered yes or no). Moreover, engaging in exercise was dichotomized into once per day or several times per week versus once per week or less than once per week; vegetable and fruit consumption was dichotomized into once per day versus several times per week to less than once per week.

Statistical analyses

Descriptive statistics were used to analyze the participants' characteristics, including their performance in the covariates. Because prior evidence has shown that older individuals have more severe consequences as a result of COVID-19 infection,[47–49] individuals at different age groups may have different perceptions toward COVID-19 vaccine and QoL perception. Moreover, individuals aged 50 y or older in Taiwan have a higher priority than those aged below 50 y to get a COVID-19 vaccination. Therefore, the subsequent inferential statistics were conducted separately for participants aged below 50 y and those aged 50 y or above to control for this confounding issue.

The first set of inferential statistics used analysis of variance (ANOVA), which were applied to examine the QoL differences (including all SF subdomains and the two-component summary scores) between vaccinated and non-vaccinated groups. Four groups were classified according to flu and COVID-19 vaccines: non-vaccinated group (i.e., participants received neither a flu vaccine nor COVID-19 vaccine), flu-vaccinated group (i.e., participants received a flu vaccine but not a COVID-19 vaccine), COVID-19-vaccinated group (i.e., participants received a COVID-19 vaccine but not a flu vaccine), and flu and COVID-19-vaccinated group (i.e., participants received both a flu and COVID-19 vaccine). Bonferroni adjustment was used to adjust type 1 error when post-hoc comparisons were conducted in the ANOVAs.

The second set of inferential statistics used multiple linear regression models. Four regression models were constructed (two using the data on participants aged below 50 y and another two on participants aged 50 y or above) using two QoL scores (i.e., PCS and MCS). Each multiple linear regression was constructed using the same independent variable (i.e., vaccinated or not with the reference group of non-vaccinated) and covariates, including age, sex (reference group: female), body mass index, educational year (reference group: < 12 y), tobacco use (reference group: no), alcohol use (reference group: no), exercise (reference group: once per week or less), vegetable and fruit consumption (reference group: less than once per day), and chronic illness (reference group: no). All the statistical analyses were conducted using SAS 9.4 (SAS Institute Inc., Cary: NC).

Results

The present sample (N = 1425; 676 males [47.44%]) had a mean age of 50.58 y (SD = 16.53) years. The representativeness of the present sample can be shown by its distribution in the participants' residency in terms of urbanization and living area (Table 1). Slightly higher than a quarter of the participants had less than 12 y of education (n = 412; 28.91%) and over half of the participants were married (n = 786; 55.16%). Regarding the health behaviors of the present sample, most of the participants did not use tobacco (n = 1066; 74.81%) nor alcohol (n = 1079; 75.72%); slightly less than half of the participants regularly exercised (n = 684; 48.03%); and nearly 60% of the participants consumed vegetables and fruit every day (n = 839; 58.88%). Over 60% of the participants had no chronic illness (n = 880; 61.73%).

For the participants aged below 50 y, ANOVA showed that there were significant differences in PCS, PF, and RP scores between the four groups (n = 232 for non-vaccinated group, 10 for flu-vaccinated group, 337 for COVID-19-vaccinated group, and 99 for flu and COVID-19-vaccinated group). Moreover, post-hoc group comparisons with Bonferroni adjustment indicated that COVID-19-vaccinated group as compared with non-vaccinated group had better PCS (mean = 53.36 [SD = 5.39] for COVID-19-vaccinated group; 51.67 [SD = 7.09] for non-vaccinated group) and PF (mean = 95.47 [SD = 14.43] for COVID-19-vaccinated group; 89.85 [SD = 21.48] for non-vaccinated group) scores. Post-hoc comparisons showed no significant differences between the four groups in RP score (Table 2). For the participants aged 50 y or above (n = 147 for non-vaccinated group, 35 for flu-vaccinated group, 272 for COVID-19-vaccinated group, and 289 for flu and COVID-19-vaccinated group), only PF was found to be significant in the ANOVA results. However, further post-hoc analyses showed no significant differences between the four groups (Table 3).

Table 1. Participant characteristics (N = 1425).

	M (SD) or n (%)
Age	50.58 (16.53)
Sex (male)	676 (47.44)
Body mass index (kg/m[2])	24.20 (4.04)
Urbanization	
Metropolitan center	149 (10.46)
Industrial and commercial	308 (21.61)
Boomtown	325 (22.81)
Conventional industries	202 (14.18)
Underdeveloped	313 (21.96)
Aging and remote regions	123 (8.63)
Other	5 (0.35)
Area	
Northern Taiwan	569 (39.93)
Central Taiwan	323 (22.67)
Northern Taiwan	486 (34.10)
Eastern Taiwan	47 (3.30)
Education	
<12 y	412 (28.91)
12–15 y	561 (39.37)
≧15 y	452 (31.72)
Employed (yes)	898 (63.06)
Marital status	
Single	369 (25.89)
Married	786 (55.16)
Other	270 (18.95)
Religion	
Non-religious	374 (26.25)
Buddhist	311 (21.82)
Taoist	602 (42.25)
Christian/Catholic	89 (6.25)
Other	49 (3.44)
Tobacco use (never)	1066 (74.81)
Alcohol use (never)	1079 (75.72)
Exercise (several times per week or everyday)	684 (48.03)
Vegetable and fruit consumption (every day)	839 (58.88)
Chronic illness (no)	880 (61.73)

Multiple linear regressions were used to additionally show whether associations between QoL and vaccination remained after covariates were controlled for. For the participants aged below 50 y, those who received COVID-19 vaccine shot (standardized coefficient = 0.14; $p < .001$) and those who received both COVID-19 vaccine and flu vaccine shots (standardized coefficient = 0.08; $p = .048$) had significantly better PCS than those who did not receive any vaccine shot. However, vaccination (either flu vaccine, COVID-19 vaccine, or both) was not associated with MCS (Table 4). For those aged 50 y or above, vaccination (either flu vaccine, COVID-19 vaccine, or both) was not associated with PCS or MCS (Table 5).

Discussion

Based on the results of the present study, it appears that vaccination uptake did not affect QoL among the Taiwanese general population. More specifically, the present findings showed that those who received either COVID-19 vaccine, flu vaccine, or both vaccines did not have a lower QoL in all subdomains than those who are not vaccinated. These findings support the present study's hypothesis that vaccine uptake (either flu vaccine or COVID-19 vaccine) is not negatively associated with QoL. Additionally, the association between PCS and COVID-19 vaccination found and verified by the regression analyses support the hypothesis that vaccination would be positively associated with QoL, although this hypothesis was supported among those aged below 50 y only.

Table 3. Comparisons of quality of life between individuals who were vaccinated and those who were not vaccinated among individuals aged 50 y or above.

	Mean (SD)				
	Non-vaccine (N=147)	Flu vaccine (N=35)	COVID vaccine (N=272)	Flu and COVID vaccine (N=289)	F (*p*-value)
MCS	51.87 (9.48)	53.15 (9.43)	52.67 (8.72)	53.08 (8.87)	0.62 (.600)
PCS	49.07 (9.04)	46.39 (9.10)	49.39 (8.37)	48.15 (8.36)	1.93 (.123)
PF	80.54 (30.59)	71.43 (31.59)	84.49 (25.02)	78.59 (30.38)	3.33 (.019)[a]
RP	78.41 (28.32)	76.07 (31.99)	79.40 (24.19)	77.45 (26.71)	0.34 (.797)
BP	85.27 (23.97)	83.57 (21.81)	84.83 (23.47)	84.86 (22.49)	0.05 (.984)
GH	48.12 (29.08)	42.71 (24.98)	48.93 (28.14)	46.42 (28.33)	0.73 (.533)
VT	57.31 (30.01)	57.14 (29.44)	63.28 (25.62)	61.19 (29.27)	1.66 (.175)
SF	83.84 (27.73)	82.86 (25.56)	84.87 (23.31)	84.15 (23.86)	0.11 (.955)
RE	83.86 (21.20)	84.64 (19.90)	82.68 (21.18)	82.70 (20.88)	0.19 (.901)
MH	76.24 (21.40)	78.21 (21.08)	79.65 (19.53)	80.15 (20.90)	1.29 (.278)

MCS=mental component summary score; PCS=physical component summary score; PF=physical functioning; RP=physical role limitations; BP=bodily pain; GH=general health perceptions; VT=energy/vitality; SF=social functioning; RE=emotional role limitations; MH=mental health.
[a]Bonferroni adjustment shows no significant differences in post-hoc comparisons.

Table 2. Comparisons of quality of life between individuals who were vaccinated and those who were not vaccinated among individuals aged below 50 y.

	Mean (SD)					
	1. Non-vaccinated (N=232)	2. Flu-vaccinated (N=10)	3. COVID-vaccinated (N=337)	4. Flu- and COVID-vaccinated (N=99)	F (*p*-value)	Bonferroni adjustment
MCS	48.69 (8.69)	48.37 (9.34)	48.05 (8.29)	48.48 (8.37)	0.28 (.840)	
PCS	51.67 (7.09)	51.92 (5.13)	53.36 (5.39)	52.74 (5.77)	3.61 (.013)	Group 3> Group 1
PF	89.85 (21.48)	95.00 (15.81)	95.47 (14.43)	92.17 (18.78)	4.71 (.003)	Group 3> Group 1
RP	79.63 (23.29)	71.25 (25.72)	84.01 (18.94)	81.57 (19.83)	2.97 (.031)[a]	
BP	84.70 (21.52)	87.50 (13.18)	86.72 (18.40)	87.88 (16.12)	0.83 (.480)	
GH	53.10 (28.26)	51.00 (24.36)	54.84 (27.27)	55.66 (27.33)	0.32 (.814)	
VT	58.08 (25.42)	57.50 (26.48)	58.61 (21.31)	57.07 (24.50)	0.12 (.951)	
SF	80.39 (22.98)	90.00 (17.48)	80.34 (20.80)	81.31 (19.35)	0.71 (.548)	
RE	78.07 (20.76)	73.75 (17.13)	78.52 (18.55)	79.29 (18.83)	0.29 (.833)	
MH	71.34 (20.18)	70.00 (20.58)	70.88 (18.46)	71.10 (18.54)	0.04 (.991)	

MCS=mental component summary score; PCS=physical component summary score; PF=physical functioning; RP=physical role limitations; BP=bodily pain; GH=general health perceptions; VT=energy/vitality; SF=social functioning; RE=emotional role limitations; MH=mental health.
[a]Bonferroni adjustment shows no significant differences in post-hoc comparisons.

Table 4. Regression analyses results in explaining physical and mental component quality of life during COVID-19 pandemic among individuals aged below 50 y.

	PCS			MCS		
	B (SE)	β (*p*)	95% CI	B (SE)	β (*p*)	95% CI
Age	−0.08 (0.03)	−0.11 (0.005)	(−0.14–-0.03)	0.11(0.04)	0.11(0.006)	(0.03–0.19)
Sex (Ref: female)	1.70 (0.51)	0.14 (<0.001)	(0.70–2.70)	1.82(0.72)	0.11(0.012)	(0.40–3.24)
Body mass index	−0.02 (0.05)	−0.02 (0.698)	(−0.13–0.09)	−0.04(0.08)	−0.02(0.561)	(−0.20–0.11)
Educational year (Ref: < 12 y)						
12–15 y	−2.11 (0.88)	−0.17 (0.018)	(−3.84–-0.37)	−1.07(1.26)	−0.06(0.396)	(−3.54–1.40)
≧15 y	−1.96 (0.91)	−0.16 (0.032)	(−3.75–-0.17)	−1.61(1.30)	−0.10(0.216)	(−4.15–0.94)
Tobacco use (Ref: no)	−1.92 (0.60)	−0.14 (0.002)	(−3.10–-0.74)	−0.06(0.86)	−0.003(0.940)	(−1.75–1.62)
Alcohol use (Ref: no)	−0.58 (0.52)	−0.04 (0.265)	(−1.61–0.44)	−1.74(0.74)	−0.10(0.019)	(−3.20–-0.29)
Exercise habit (Ref: once per week or less)	0.28 (0.46)	0.02 (0.549)	(−0.63–1.19)	1.04(0.66)	0.06(0.117)	(−0.26–2.33)
V&F consumption (Ref: < once per day)	0.23 (0.46)	0.02 (0.610)	(−0.67–1.14)	2.88(0.65)	0.17(<0.001)	(1.60–4.16)
Chronic illness (Ref: no)	−3.57 (0.63)	−0.22 (<0.001)	(−4.80–-2.33)	−2.43(0.90)	−0.11(0.007)	(−4.19–-0.67)
Flu vaccine uptake (Ref: no)	0.01 (1.97)	0.003 (0.997)	(−3.86–3.88)	0.58(2.80)	0.01(0.835)	(−4.91–6.08)
COVID-19 vaccine uptake (Ref: no)	1.73 (0.52)	0.14 (<0.001)	(0.72–2.74)	−0.58(0.73)	−0.03(0.426)	(−2.02–0.86)
Flu and COVID vaccine uptake (Ref: no)	1.46 (0.74)	0.08 (0.048)	(0.02–2.91)	−0.29(1.05)	−0.01(0.783)	(−2.34–1.77)
F-value (*p*)		7.02 (<.001)			4.12 (<.001)	
R2		0.1227			0.0758	
Adjusted R2		0.1052			0.0574	

PCS = physical component summary; MCS = mental component summary; B = unstandardized coefficient; β = standardized coefficient; V&F consumption = vegetable and fruit consumption.

The positive associations between PCS and vaccinations (including COVID-19 vaccine only and COVID-19 with flu vaccines simultaneously) among younger individuals rather than in older individuals can be explained by how the body immunity responds to the vaccination. More specifically, evidence shows that vaccine responses diminish by age for adults.[50] In other words, older individuals might receive less benefits from vaccination than younger individuals because the immune system had little response to vaccines among older individuals. Indeed, prior evidence shows that flu vaccination was positively associated with QoL among a pediatric sample,[36] while zoster vaccination was not significantly associated with QoL among an older sample.[51] Regarding the nonsignificant association between PCS and flu vaccination, this could be due to the small sample size (n = 10) in the group aged below 50 y. Therefore, the present study's findings agree with the mechanism in vaccine responses and prior evidence that vaccination might be beneficial for individuals' QoL,[31] especially among younger individuals.

Similar to most findings in the literature,[29,30,51] MCS was not associated with vaccinations. This implies that the adverse effects did not affect mental QoL for individuals who got vaccinated. Although individuals may worry about the adverse effects of vaccines (e.g., serious effects of anaphylaxis and minor effects of nausea),[33,34] such worry seems not to be associated with mental QoL after individuals get vaccinated. A possible reason is that individuals recover from the adverse effects of vaccination[35] and therefore their worries are likely to be diminished after vaccination. Subsequently, their mental QoL is not likely to be lowered after vaccination.

Strengths, implications, and limitations

A major strength of this study is the nature of sample used. That is, a large sample size was used which covered varied cross-section of Taiwan including regions/areas, sex, educational levels, and marital status. The present study's findings have a number of implications. First, healthcare providers could disseminate the information that vaccination does no harm to individuals' QoL to facilitate vaccine motivation among those who have vaccine hesitancy. Second, healthcare providers and policymakers could consider designing programs concerning health behavior promotion, especially for those people aged over 50 y. This is because positive and significant associations were found between QoL and two health behaviors (e.g., exercise and vegetable and fruit consumption) in the present study. Third, given that the present sample was a representative sample of the Taiwanese population, the aforementioned suggestions could be applied to the entire Taiwanese population. In addition, for Asian countries that share similar living styles and cultures, the present findings might also be able to be generalized to other Asian people (e.g., those in mainland China, Hong Kong, and Singapore). However, further empirical evidence is needed to support such implementation in Taiwan and elsewhere. It should also be noted that the adjusted R^2 values in the present study's regression models were generally low (5.74% to 14.55%). This indicates that there are other important factors explaining QoL among this representative sample have not been identified or controlled for. Therefore, future studies should examine other potential factors explaining QoL (e.g., fear of COVID-19) to further investigate the relationships between QoL and vaccination; and between QoL and health behaviors.

There are some limitations in the present study. First, the present study adopted a cross-sectional design, which is subject to weak evidence concerning causal relationships. Therefore, whether COVID-19 vaccination really leads to better QoL should be corroborated by future studies with a more rigorous study design (e.g., randomized controlled trial). Second, all the data analyzed in the present study were derived from self-reports. Therefore, biases from social desirability, recall error, or common method variance could not be controlled for. Future studies may want to use different data collection methods (e.g., using medical records to collect the information on vaccine uptake) to corroborate the present study's findings. Third, the TSCS data were collected during a period with relatively less COVID-19 severity. Therefore, it is unclear if the findings would be replicated in a period during greater COVID-19 severity. That is,

Table 5. Regression analyses results in explaining physical and mental component quality of life during COVID-19 pandemic among individuals aged 50 y or above.

	PCS			MCS		
	B (SE)	β (*p*)	95% CI	B (SE)	β (*p*)	95% CI
Age	−0.21 (0.04)	−0.23 (<0.001)	(−0.29–-0.14)	0.18 (0.04)	0.18 (<0.001)	(0.10–0.27)
Sex (Ref: female)	2.25 (0.74)	0.14 (0.003)	(0.79–3.71)	−0.34 (0.83)	−0.02 (0.677)	(−1.97–1.28)
Body mass index	−0.08 (0.08)	−0.04 (0.317)	(−0.24–0.08)	0.33 (0.09)	0.14 (<0.001)	(0.15–0.51)
Educational year (Ref: < 12 y)						
12–15 y	0.61 (0.67)	0.04 (0.363)	(−0.71–1.93)	0.97 (0.75)	0.05 (0.195)	(−0.50–2.44)
≧15 y	0.28 (0.92)	0.01 (0.763)	(−1.52–2.08)	0.83 (1.02)	0.03 (0.418)	(−1.18–2.83)
Tobacco use (Ref: no)	−0.26 (0.83)	−0.01 (0.754)	(−1.90–1.38)	0.18 (0.93)	0.01 (0.844)	(−1.64–2.01)
Alcohol use (Ref: no)	0.32 (0.84)	0.02 (0.699)	(−1.32–1.97)	0.04 (0.93)	0.002 (0.964)	(−1.79–1.87)
Exercise habit (Ref: once per week or less)	1.60 (0.61)	0.10 (0.009)	(0.40–2.79)	1.29 (0.68)	0.07 (0.059)	(−0.05–2.62)
V&F consumption (Ref: < once per day)	2.37(0.67)	0.13(<0.001)	(1.07–3.68)	3.95(0.74)	0.20(<0.001)	(2.50–5.41)
Chronic illness (Ref: no)	−3.71(0.62)	−0.22(<0.001)	(−4.93–-2.48)	−1.33(0.69)	−0.07(0.056)	(−2.69–0.04)
Flu vaccine uptake (Ref: no)	1.54(1.55)	0.04(0.320)	(−1.50–4.58)	0.81(1.72)	0.02(0.640)	(−2.57–4.19)
COVID-19 vaccine uptake (Ref: no)	0.68(0.83)	0.04(0.415)	(−0.95–2.31)	0.20(0.92)	0.01(0.825)	(−1.61–2.02)
Flu and COVID vaccine uptake (Ref: no)	0.42(0.84)	0.03(0.616)	(−1.23–2.08)	−0.09(0.94)	−0.01(0.920)	(−1.94–1.75)
F-value (*p*)		10.17 (<0.001)			6.09 (<0.001)	
R2		0.1614			0.1034	
Adjusted R2		0.1455			0.0864	

PCS = physical component summary; MCS=mental component summary; B = unstandardized coefficient; β = standardized coefficient; V&F consumption=vegetable and fruit consumption.

individuals' QoL is likely to be impacted by the severity of COVID-19 and the severity could be an important confounder in the present study. Moreover, the present study was conducted in Taiwan, and the findings might not be generalizable to other countries because of the differences in COVID-19 severities, COVID-19 control policies, and culture. Lastly, given that there was a policy to give higher priority for older individuals (as compared to younger individuals) to get COVID-19 vaccination in Taiwan, this policy may bias the results in COVID-19 vaccination uptake (i.e., some younger individuals may want to get vaccinated but were restricted by the policy and unable to do so). Nevertheless, the present study separated the participants into two age groups (i.e., aged 50 y or above and below 50 y) for inferential statistics to minimize the impact of this confounding issue.

Conclusion

The present study showed that neither COVID-19 vaccination nor flu vaccination was associated with poor QoL among the Taiwanese general population. Moreover, for individuals who were aged below 50 y, COVID-19 vaccination was found to be a significant predictor in their physical QoL (i.e., those who received a COVID-19 vaccine had better PCS scores than did those who did not receive a COVID-19 vaccine). In other words, although COVID-19 vaccination or flu vaccination may induce adverse effects, such adverse effects might not lead to serious health problems as evidenced by the findings in the present study. Given that COVID-19 vaccination and flu vaccination did not decrease QoL (and on the other hand, they might be beneficial to individuals' QoL), healthcare providers and health policymakers should disseminate this finding to the public to help aid vaccination promotion.

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