Materials and methods

**Participants**

This study was designed as a cross-sectional online survey. Because of the implementation of social distancing due to the COVID-19 pandemic, as well as our limited resources, we used an online survey method. The online survey was conducted using the Google Forms web survey platform. The link to the online survey questionnaire was distributed through social media platforms such as Facebook, Kakao talk, email, and the personal contacts of the research group members. We also asked participants to share the questionnaire link to increase the number of persons who received the invitation to participate in the study and therefore increase the number of participants in this study. The inclusion criteria for the study included: (1) community-dwelling adults aged over 20 years and (2) living in South Korea for the past year. Individuals who agreed to participate in the study checked the consent tick box on the first page of the survey form. Participants submitted their informed written consent via email. Those who participated were asked to complete online questionnaires and also answered questions regarding their general information and their lifestyle changes using the Yonsei Lifestyle Profile (YLP), which had been developed based on previous research [[19](https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0247970#pone.0247970.ref019)], mental health, and quality of life. This study was conducted between August and October 2020, with a total of 104 respondents. This study was carried out with approval for ethical procedures by the Institutional Review Board of Yonsei University Mirae Campus (1041849-202008-SB-096-01).

**Measurements**

This study measured multifaceted lifestyle factors among adults in South Korea using the YLP questionnaire, which had been developed in a previous study [[20](https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0247970#pone.0247970.ref020)]. A total of 60 items of the YLP measure three different lifestyle factors: (1) physical activity, (2) participation in activities, and (3) nutrition. Respondents are asked about frequency of their participation in certain activities, and the number of times they consumed certain foods for a week. They are asked to respond to each question twice, basing their answer on their typical routines before and after the onset of COVID-19 ([S1 File](https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0247970#pone.0247970.s001)). In addition, satisfaction with their participation in physical activities and their participation in activities, as well as satisfaction with their consumption of nutrition were assessed. For example, respondents were asked to respond to the level of their satisfaction with their participation in physical activities, participation in other meaningful activities, and consumption of nutrition (e.g., Before the onset of the COVID-19 pandemic and after) during the last week, did you engage in aerobic exercises as you wanted?). The YLP reflected high internal reliability, with a Cronbach’s alpha of 0.83. The intraclass correlation coefficient was 0.97 for the total score of the YLP regarding test-retest reliability [[20](https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0247970#pone.0247970.ref020)]. The full version of the questionnaire is available in [S1 File](https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0247970#pone.0247970.s001).

**Lifestyle indicators**

Physical activity.

A total of six items for physical activity were assessed using a five-point Likert scale to measure the frequencies of respondents’ participation in six different physical activities and their satisfaction with their participation in these physical activities. The six physical activities included aerobic physical activity; anaerobic physical activity; low-intensity physical activity equivalent to 2–2.9 metabolic equivalent of task (MET), including gardening, house cleaning, etc.; moderate-intensity physical activity equivalent to 3–5.9 MET, including swimming, doubles tennis, etc.; high-intensity physical activity equivalent to 6–9.9MET, such as running, climbing, etc.; and walking exercises. According to the American College of Sports Medicine (ACSM), physical activity can be divided into three types, based on intensity [[21](https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0247970#pone.0247970.ref021)]. To assess the impact of the COVID-19 pandemic on physical activity, questions were asked about the frequency and satisfaction regarding physical activity participation per week before and after the onset of COVID-19. The higher the score, the higher the level of participation and satisfaction with physical activity.

Activity participation.

Six items for activity participation were also assessed using a five-point Likert scale to measure the frequencies and satisfaction of diversity of participation in activities, such as activities of daily living (ADLs), leisure, social activity, work, education, and sleep during the week before and after COVID-19. A higher score indicated more frequent participation in various activities, as well as higher satisfaction with participation in activities.

Nutrition.

Finally, nine items for nutrition were assessed using a five-point Likert scale to measure nutrition during the week before and after COVID-19 in order to measure the participants’ nutritional status. The amount of carbohydrates, proteins, fats, vitamins, minerals, water, and alcohol the participants consumed, and the frequency of drinking and smoking, were measured. For example, the participants were asked, “Before the COVID-19 pandemic, how often do you consume carbohydrate-rich foods such as rice, bread and flour in the last week?” Participants answered these questions by selecting one of the choice of the five-point Likert scale: (1) never, (2) 1–2 times per week, (3) 3–4 times per week, (4) 5–6 times per week, and (5) every day. A higher score indicated more consumption of each type of nutrition.

**Mental health indicator**

Depression, the most commonly used mental health indicator, was measured using the Center for Epidemiological Studies-Depression Scale (CES-D) [[22](https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0247970#pone.0247970.ref022)], which is one of the most widely used self-reporting tools for evaluating depression in the general population [[22](https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0247970#pone.0247970.ref022), [23](https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0247970#pone.0247970.ref023)]. It consists of 20 items related to depressive symptoms. Each item is rated on a four-point scale, ranging from 0 to 3, wherein 0, 1, 2, and 3 stand for “*rarely or none of the time*,” “*some or a little of the time*,” “*occasionally or a moderate amount of time*,” and “*most or all of the time*,” respectively. The total possible score ranges from 0to 60, with higher scores indicating more symptoms of depression by frequency of occurrence in the past week. The Cronbach’s alphas were 0.91 and 0.94 before and after the onset COVID-19, respectively.

**Quality of life indicator**

The World Health Organization quality of life scale abbreviated version (WHOQOL-BREF) was used to evaluate quality of life [[24](https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0247970#pone.0247970.ref024), [25](https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0247970#pone.0247970.ref025)]. It contains 26 items rated on a five-point Likert scale and measures four domains: physical, psychological, social, and environmental. Raw domain scores were converted to a scale ranging from 0 to 100 to facilitate comparison with other instruments, with higher scores indicating a higher quality of life. The Cronbach’s alphas were 0.91 and 0.94 before and after COVID-19, respectively.

**Data analysis**

To investigate changes in lifestyle, depression, and quality of life due to COVID-19, this study calculated the descriptive statistics of indicators measured before and after the pandemic. A paired t-test was used for our analysis, and the confidence interval was set at 95%. The *p*-value was two-sided, and statistical significance was set at *p*<0.05. All statistical analyses were performed using SPSS software version 25.0 (SPSS Institute, Cary, NC, USA). Missing data was processed using pairwise deletions. Therefore, the remaining items were used in the analysis, expect for the data of those who did not respond.