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Urban nature exposure, physical activity, sleep quality and the search for meaning in life of university students in Japan -a natural solution to maintain health and implications for reducing depression during the COVID-19 pandemic

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Abstract Objective: This study examined the associations between urban nature exposure and three study variables that include physical activity, sleep quality and the search for meaning in life.

Methods: Data were collected from 386 Japanese university students using measures of exposure to urban nature, physical activity, sleep quality and the meaning in Life Questionnaire-Short Form (MLQ-SF) search subscale. χ^2 tests and *t*-test were performed to examine physical activity, sleep quality and the search for meaning in life differences between two statuses of urban nature exposure. Binomial logistic regression analyses were also conducted to further assess the effects of urban nature exposure on the likelihood that participants are actively engaged in physical activity, have good sleep quality and possess high levels of search for meaning in life. In addition, gender difference in

relation to urban nature exposure was examined using the χ^2 test.

Results and discussion: We found that urban nature exposure is positively related to physical activity, sleep quality and the search for meaning in life among university students in Japan. Students who were exposed to urban nature were 1.5 time more likely to report more engagement in physical activity and good sleep quality, 2.4 times more likely to report high levels of search for meaning in life compared to those who had no exposure to urban nature. Also, fewer female students were found to visit urban nature sites compared to male students. Such behaviors make female students loss opportunities to use urban nature exposure to counter stress.

Conclusion: During the coronavirus (COVID-19) pandemic, leaving the urban areas and visiting forests become an uneasy thing. A natural solution that can substitute for forest bathing is necessary. The findings of this study indicated that developing intervention programs that promote students' visits to urban nature sites is meaningful to maintain health and reduce depression during the COVID-19 pandemic. Since gender differences in habits and perception of stress can be observed, special attention should be paid to female students when making intervention programs that promote students' visits to urban nature sites.

Keywords: Mental health, well-beings, urban nature exposure, physical activity, sleep quality, the search for meaning in life, depression, the COVID-19 pandemic.

Introduction

A large literature indicated that mental health is a global concern as mental illnesses link to loss of productivity, disability, mortality and unexplained immune diseases (Akhtar et al. 2020; Ibrahim et al. 2013; Lei et al. 2016; Kessler et al. 2007; Prince et al. 2020; World Health Organization, 2005;

World Health Organization, 2008). Specifically, mental illnesses have been found to contribute to 31.7% of all-years-disability and 1.4% of all years-of-life lost (Wang et al. 2007). Past studies indicated that mental illnesses are the second leading causes of Disability Adjusted Life Years (DALYs) among people aged 20-24 years (Akhtar et al. 2020; Kandola et al. 2020; Mokdad et al. 2016). In 2005, the WHO endorsed that there are “no health without mental health” (World Health Organization, 2005).

Despite young and late adolescence are important time periods for building healthy lifestyles and developing psychological strengths, approximately one-third of mental health issues has the first onset before the age of 24. (Akhtar et al. 2020). Compared to the general population, university students have higher depression (Ibrahim et al. 2013; Lei et al. 2016).

Different from other stages in one’s life, the stage of university studies is a significant period that can shape and change a person’s cognition, value, lifestyle and the thinking habit. The formed cognition and habit not only affect the person’s living habit, but also affect his or her lifetime cognition, thinking pattern and stress management. Thus, establishing rational cognition and healthy habits, as well as improving them during the stage of university studies, are extremely important.

As the public awareness of health and healthy choices has grown, increasing students’ healthy behaviors and enhancing their positive thinking during their college years have become more important than ever. Since many behaviors, lifestyles and problem-solving skills developed before the age of 25 remain unchanged throughout a lifetime, developing a healthy lifestyle and positive thinking could have significant implications for maintaining health and reducing depression over the course of one’s lifetime.

Accumulating evidences so far have shown that active engagement in physical activity, good sleep quality and a high level of search for meaning

in life are associated with positive mental health outcomes and well-beings (Jacob et al. 2020; McDowell et al. 2019; Steger 2005; Schuch et al. 2018; Yu et al. 2020). For example, regular physical activity was found to link to an improvement in cognitive outcomes and a decrease in depressive symptoms (Thomas et al. 2002; Jeong et al. 2005; Nabkasorn et al. 2006; Tsai et al. 2012). Schuch et al. (2008) and McDowell et al. (2019) found that physical activity contributes to an improvement in health and could become a protection factor against the emergence of anxiety symptoms and depression.

With respect to sleep quality, past epidemiologic studies have found that sleep quality is negatively correlated with mental health in different populations (Lin et al. 2012; Miller-Graff and Cheng 2017; Shamshri et al. 2014; Zou et al. 2020). Despite the importance of sleep to the health, many college students were found to suffer from various degrees of psychological stress symptoms under multiple pressures such as learning and environmental changes. As a result, poor sleep quality is a common issue among university students (Eisenberg et al. 2007; Leung 2017; Zou et al. 2020).

In general, the search for meaning in life refers to one's effort to understand and to increase the meaning in life (Bear et al. 2014; Dezutter et al. 2014; Steger et al. 2008). It is a significant developmental issue for university students, as the stage of university studies involves the formation of identity, values and cognitive consciousness (Ho et al. 2010; Kiang and Fuligni 2010; To 2016). With respect to this variable, previous studies indicated that it could also be an important protective factor against depression (Fischer et al. 2020; To 2016; Yu et al. 2020). Pargament and Sweeney (2011) found that the boost of the sense of search for meaning in life links to an increase in psychological resilience.

In addition to active engagement in physical activity, good sleep quality and high levels of search for meaning in life, exposure to nature has also been

proved to be beneficial to physical and mental health. Past studies indicated that natural killer (NK) cells are important innate effector cells in the immune system that can control and kill microbial infections and tumors (Tsunetsugu et al. 2010; Li et al. 2008; Li 2010; Lee et al. 2011; Vivier et al. 2008). Thus, increasing the number of NK cells and their activities could enhance human immune functions. A typical example of nature exposure, for example, forest bathing or “Shinrinryoku” in Japanese, has been proved to increase natural killer (NK) activity and reduce depression (Li 2010, Lee et al. 2011). According to Li (2010), the increased NK activity could last for more than a month after a trip to a forest.

Although forest bathing has many positive effects on health, leaving the urban areas and going to a forest may not be an easy thing during the coronavirus (COVID-19) pandemic. In most cases, the forest is far away from the urban areas. Furthermore, the (COVID-19) pandemic occurred since the end of 2019 has changed our lifestyles and personal communication styles, making the movement of people difficult. Thus, a natural solution that substitutes for forest bathing is necessary.

In the urban areas, many city parks are available, where trees are planted. In addition, natural settings such as rivers and seas are also available in many urban areas. Thus, it is interesting to put a focus on urban nature. Since the changes in lifestyles and working conditions since the end of 2019 have worsened the physical and mental health of many people, understanding whether the urban nature exposure is associated with healthy behaviors and more positive thinking has significant implications for maintaining health and reducing depression during the COVID-19 crisis.

Thus, this study addresses these gaps using survey data collected from students in Chiba university, Japan, comparing the differences in physical activity, sleep quality and the search for meaning in life under two statuses of

urban nature exposure and analyzing the effects of urban nature exposure on these variables. Since gender difference in habits can be observed in different populations, it is also interesting to know whether female students are less likely to visit urban nature sites than male students.

Objective

2. Materials and methods

2.1 Participants and procedures

To understand the relationships of interest, survey data were collected from several classes at Chiba University, a large national university in the Tokyo metropolitan area of Japan. Selection criteria of participants were: (1) ages between 18 and 30 years; (2) being able to understand the description explained and written in Japanese; (3) enrolment as a university student. All survey responses were collected in the daytime class-setting during the second half of 2019 academic year. A total of 386 complete responses were used in the present study. Of the total survey responses, 50% of them (N=193) had habits to expose to urban nature, and 50% of them (N=193) had no habits to expose to urban nature (**Figure 1**).

Before conducting surveys, we provided participants a clear explanation of survey' s objectives, the way to process data, and the rights of participants such as the right of withdrawal and voluntary participations. Consents to participation were obtained from each participant and data were collected immediately after the completion during the class hours.

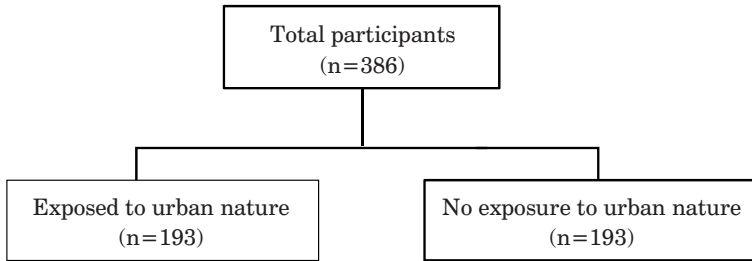


Figure 1. Participant selection (n=386)

2.2 Measures

2.2.1 Assessment of demographic and socioeconomic measures

With respect to socioeconomic status (SES), we asked participants to report the highest level of education attained by their parents. Three options were provided, including high school or lower, undergraduate degree or equivalent, and graduate degree. In addition to parental education attainment, participants were also required to provide information about their gender and ages.

2.2.2 Assessment of exposure to urban nature

To understand the degree to which participants were exposed to urban nature, we first conducted interviews with students and asked them to provide information about the sites they perceived to be urban nature. Following the interviews, we conducted a questionnaire survey using site information collected from interviews. We asked students to answer whether they have the habits of going to urban nature sites and the frequencies of their visits to those sites. For example, “Do you visit urban parks for more than 30 minutes each time, at least once a week?”. Similar questions were asked for other urban nature sites, including riverside, seaside parks, and green rice paddy

fields in the city. Participants who responded yes more than once in any of listed sites were classified to be exposed to the urban nature. Otherwise, they were considered as having no exposure to urban nature.

2.2.3 Assessment of physical activity

Self-reported physical activity was determined with the following question: “Do you exercise for more than 30 minutes each time, at least once a week?”. Participants who responded yes were classified as actively engaged in physical activity. Otherwise, they were considered as lack of physical activity.

2.2.4 Assessment of sleep quality

Self-reported sleep quality was determined with the following question: “Is your average sleep quality good?”. Participants who responded yes were classified as good sleep quality. Otherwise, they were considered as not good sleep quality.

2.2.5 Assessment of the search for meaning in life

Meaning in Life Questionnaire-Short Form (MLQ-SF) was used to measure the extent to which the respondents evaluated the search for meaning of their lives (Steger et al. 2006; Steger and Samman 2012). Three items from the MLQ search subscale were “I am seeking a purpose or mission for my life”, “I am always looking to find my life’s purpose” and “I am searching for meaning in my life” (Steger and Samman 2012). Each item was rated from 1 (not at all true) to 4 (completely true) and the final score was estimated by summing scores of three items. In this study, Cronbach’s α was .84. Mean and standard deviation of the MLQ search subscale were 7.7 and 2.6, and one standard deviation above the mean was 10.4. For the later assessment of the effect of urban nature exposure on the search for meaning in life, the search for

meaning in life variable is further divided into two levels: high level of the search for meaning in life (MLQ search score \geq 10.4) and low level of the search for meaning in life (MLQ search score $<$ 10.4).

2.3 Statistical analyses

Characteristics of participants that include means, standard deviations, numbers, and percentages were estimated at first. Additionally, χ^2 tests were performed to examine physical activity and sleep quality differences between two statuses of urban nature exposure. A t -test was also used to examine the search for meaning in life difference between two statuses of urban nature exposure. We followed the χ^2 tests and the t -test with binomial logistic regression analyses to further assess the effects of urban nature exposure (no exposure to urban nature as ref.) on the likelihood that participants are actively engaged in physical activity, have good sleep quality and possess high levels of the search for meaning in life. The estimated results were described as odds ratios (OR) with 95% confidence intervals. Adjusted odds ratio (OR) with 95% confidence intervals were also estimated after controlling the effect of parental education attainment (SES). Gender difference in relation to urban nature exposure was examined using the χ^2 test. All statistical analyses were conducted using version 15.1 of STATA software.

3. Results

3.1 Descriptive statistics

Descriptive statistics of participants in the survey were summarized in **Table 1**. Of the total 386 completed survey responses, 153 participants were female (39.6%) and 223 participants (60.4%) were male. Ages of participants range from 18 to 26, with the mean age of 20.2 years ($SD=1.3$). Parental

Table 1. Descriptive statistics of participants in the survey (n=386).

Characteristics of participants	n (%) or Mean \pm SD
Gender	
Female	153 (39.6)
Male	223 (60.4)
Age	20.2 \pm 1.3
Parental education attainment	
High school or lower	85 (22)
Undergraduate degree or equivalent	269 (69.7)
Graduate degree	32 (8.3)
Physical activity	
No	188 (48.7)
Yes	198 (51.3)
Sleep quality	
No	215 (55.7)
Yes	171 (44.3)
Search for meaning in life	7.7 \pm 2.6

education attainment of most participants was undergraduate degree or equivalent (269 participants; 69.7%), with 32 participants (8.3%) at the advanced graduate level, and 85 participants (22%) at the high school or lower level. With regard to physical activity, 198 participants (51.3%) were actively engaged in physical activity, and 188 participants (48.7%) participants were lack of physical activity. With regard to sleep quality, 171 participants (44.3%) had good sleep quality, and 215 participants (55.7%) participants did not have good sleep quality. With regard to the search for meaning in life, its score ranges from 3 to 12, with the mean search for meaning in life of 7.7 ($SD=2.6$).

3.2 Difference in physical activity under two statuses of urban nature exposure

A χ^2 test was run to examine the difference in physical activity under two statuses of urban nature exposure. Compared to participants with no exposure to urban nature, participants with urban nature exposure were more engaged

Table 2. Physical activity, sleep quality and search for meaning in life under two statuses of urban nature exposure in the survey [n (%)] or Mean± SD.

Variables	n (%)	Urban nature exposure		$\chi^2/$ t-test
		No exposure to urban nature (n=193) (ref.)	Exposed to urban nature (n=193)	
Physical activity				4.1*
Actively engaged	198 (51.3%)	89 (46.1%)	109 (56.5%)	
lack of physical activity	188 (48.7%)	104 (53.9%)	84 (43.5)	
Sleep quality				4.6*
Good	171 (44.3%)	75 (38.9%)	96 (49.7%)	
Not good	215 (55.7%)	118 (61.1%)	97 (50.3%)	
Mean search for meaning in life		7.4 ±2.5	8.1 ±2.7	2.7**

*p.05, ** p.01

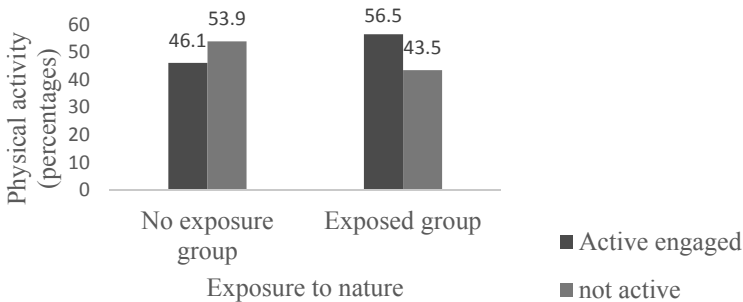


Figure 2. Physical activity under two statuses of urban nature exposure

in physical activity, $\chi^2(1) = 4.1, p = .04$. Observed numbers and percentages of participants under each status of physical activity and urban nature exposure were presented in **Table 2**. Of the total 193 participants that were actively exposed to the urban nature, 109 (56.5%) were actively engaged in physical activity, and 84 (43.5%) were lack of physical activity (**Figure 2**). Of the 193 participants that had no exposure to urban nature, only 89 (46.1%) were actively engaged in physical activity. More participants [104 (53.9%)] were lack of physical activity (**Figure 2**).

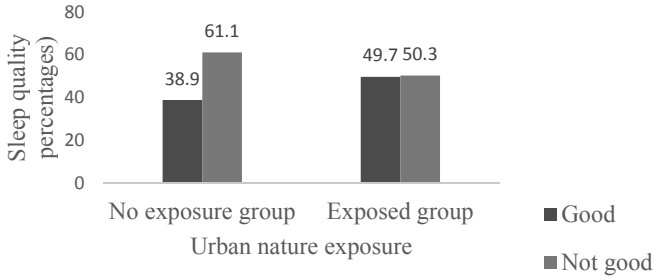


Figure 3. Sleep quality under two statuses of urban nature exposure

3.3 Differences in sleep quality under two statuses of urban nature exposure

A χ^2 test was also run to examine the difference in sleep quality under two statuses of urban nature exposure. Compared to participants with urban nature exposure, participants with no exposure to urban nature had worse sleep quality, $\chi^2(1) = 4.6, p=.03$. Observed numbers and percentages of participants under each status of sleep quality and urban nature exposure were presented in **Table 2**. Of the total 193 participants that had no exposure to urban nature, 118 (61.1%) did not have good sleep and 75 (38.9%) had good sleep (**Figure 3**). Of the total 193 participants who were exposed to the urban nature, 97 (50.3%) did not have good sleep and 96 (49.7%) had good sleep (**Figure 3**).

3.4 Differences in the search for meaning in life under two statuses of urban nature exposure

A *t*-test was run to examine the difference in the search for meaning in life under two statuses of urban nature exposure. Participants with urban nature exposure had a higher score in search for meaning in life (8.1 ± 2.7) than participants who had no exposure to urban nature (7.4 ± 2.5), a statistically

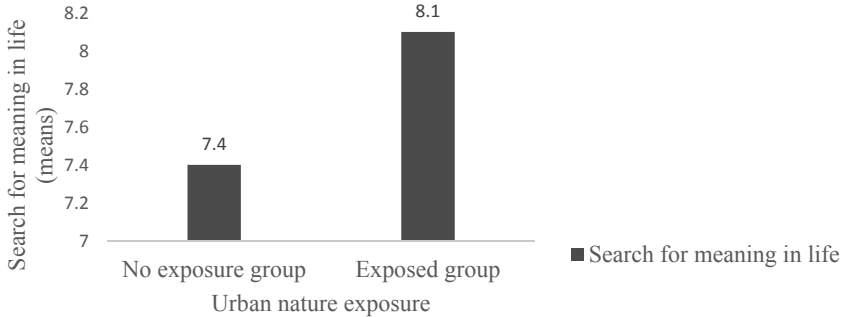


Figure 4. The search for meaning in life under two statuses of urban nature exposure

significant difference of 0.7, $t(384) = 2.7, p = .007$ (Table 2, Figure 4).

3.5 Logistic regression analyses

Effects of urban nature exposure on the likelihood that participants are actively engaged in physical activity, have good sleep quality and possess high levels of the search for meaning in life were analyzed using binomial logistic regression analyses. Table 3 summarizes the estimated results. Participants who did not expose to urban nature were classified as references in this study. In the analyses, participants who were exposed to urban nature were 1.5 time more likely (Odds Ratios: 1.5; 95% CI: 1.0-2.3) to report more engagement in physical activity compared to those who did not expose to urban nature. Adjusted Odds Ratio was 1.5 (95% CI, 1.0-2.2) after controlling the effect of parental education attainment (SES). With respect to sleep quality, participants who were exposed to urban nature were 1.5 time more likely (Odds Ratios: 1.61; 95% CI: 1.0-2.3) to report good sleep quality compared to those who had no exposure to urban nature. Adjusted Odds Ratio was 1.5 (95% CI: 1.0-2.3) after controlling the effect of parental education attainment (SES). With respect to the search for meaning in life, participants who were

Table 3. Effects of urban nature exposure on active engagement in physical activity, good sleep quality and high levels of the search for meaning in life. Odds Ratios and adjusted Odds Ratio (aORs).

	Active engagement in physical activity		Good sleep quality		High levels of the search for meaning in life	
	OR (95% CI)	aOR ^a (95% CI)	OR (95% CI)	aOR ^a (95% CI)	OR (95% CI)	aOR ^a (95% CI)
Urban nature exposure						
No exposure to urban nature (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Exposed to urban nature	1.5* (1.0-2.3)	1.5* (1.0-2.2)	1.6* (1.0-2.3)	1.5* (1.0-2.3)	2.4** (1.4-4.1)	2.4** (1.3-4.1)

*p.05, ** p.01

^a Adjusted for parental education attainment (SES).

exposed to urban nature were 2.4 times more likely (Odds Ratios: 2.4, 95% CI, 1.4-4.1) to report high levels of search for meaning in life compared to those who had no exposure to urban nature. Adjusted Odds Ratio became 2.4 (95% CI: 1.3-4.1) after controlling the effect of parental education attainment (SES).

3.6 Gender difference under two statuses of urban nature exposure

A χ^2 test was also run to examine the association between gender difference under two statuses of urban nature exposure. Compared to participants with no exposure to urban nature, participants with urban nature exposure were almost twice as likely to be males, $\chi^2 (1) = 3.9, p=.04$. Observed numbers and percentages of participants under each status of urban nature exposure were shown in **Figure 5**. Of the total 193 participants that were exposed to the urban nature, 126 (65.3%) were males and 67 (34.7%) were females (**Figure 5**). Of the 193 participants who did not expose to urban nature, 107 (55.4%) were males and 86 (44.6%) were females (**Figure 5**).

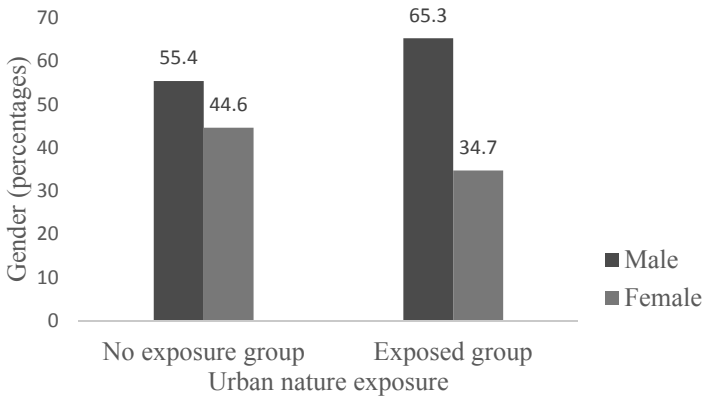


Figure 5. Gender difference under two statuses of urban nature exposure

4. Discussion

This study investigated the associations between urban nature exposure and three study variables, including physical activity, sleep quality and the search for meaning in life of university students in Japan. We found that urban nature exposure is positively correlated with physical activity. While 56.5% of participants was found to be actively engaged in physical activity in the group that was exposed to urban nature, 53.9% of participants was found to be lack of physical activity in the group that did not expose to urban nature. A binomial logistic regression also indicated that participants who were exposed to urban nature were 1.5 time more likely (adjusted Odds Ratios: 1.5, 95% CI, 1.0-2.2) to report more engagement in physical activity compared to those who did not expose to urban nature.

Adequate physical activity is a healthy lifestyle habit that is beneficial to health. However, approximately 28% of the global adult population was reported to have insufficient physical activity in 2016 (WHO 2016). The World Health Organization (2019) also indicated that the lack of physical activity is

one of the risk factors for noncommunicable diseases that increases the risk of cancer and diabetes by 20-30%. Thus, promoting physical activity is crucially important.

Visiting an urban nature site usually involves moving and walking. Those who have the habits to visit urban nature sites are more likely to engage in outdoor physical activity. The opposite phenomena observed in the two groups (urban nature exposure and no urban nature exposure) of this study indicate that visiting an urban nature site promotes physical activity. An earlier study that examined the association between green space and outdoor physical activity among preschoolers aged 2 to 5 years indicated the positive correlation between visits to green space and physical activity (Richardson et al. 2013). Another study that analyzed the effect of urban forests on the physical activity of mice also proved the promoting effect of exposure to urban forests on physical activity (Duan et al. 2019). The finding of this study corresponds with the results of these studies.

With respect to sleep quality, we found that 55.7% of participants did not have good sleep quality. In many cases, high quality of sleep contributes to better physical and mental health. People who have insufficient sleep tend to have higher risks of depression and all-cause mortality (Shankar et al. 2017). Despite the adequate sleep hour is recommended by the National Sleep Foundation, 45% of adults in 2015 was found to have less than 7 hours of sleep per night (Hafner et al. 2017).

Regarding university students, pressure from studies and human relations, anxiety about job hunting in the future, as well as the reduction of parental supervision have all contributed to the irregular sleep schedules and the poor sleep quality. As a result, not having a good sleep quality is a common phenomenon among university students in Japan. Survey data of this study show that the percentage of poor sleep quality is much higher in no urban

nature exposure group (61.6%) than exposed group (49.75%). A binomial logistic regression also indicated that participants who were exposed to urban nature were 1.5 time more likely (adjusted Odds Ratios: 1.5, 95% CI, 1.0-2.3) to report having good sleep quality compared to those who did not expose to urban nature.

In most cases, environment of urban nature sites such as city parks and seaside parks are different from the urban environment. Visiting an urban nature site could be an extraordinary experience to visitors. Such an experience not only gives pleasure to visitors, but also relaxation. Many past studies that analyzed mindfulness and mental health have proved that relaxation links to the restoration of mental peace and calm (Mace 2007; Masuda et al. 2009). In this study, the percentage of participants that did not have good sleep quality is smaller in the group that was exposed to urban nature. The result of this study indicates the contribution of urban nature exposure to better sleep quality since visiting an urban nature site may restore the mental peace and improves the mental health.

With respect to the search for meaning in life, we found that participants with urban nature exposure had a much higher score in search for meaning in life (8.1 ± 2.7) compared to participants with no exposure to urban nature (7.4 ± 2.5). A binomial logistic regression also indicated that participants who were exposed to urban nature were 2.4 times more likely (adjusted Odds Ratios: 2.4; 95% CI, 1.3-4.1) to report higher scores in the search for meaning in life compared to those who had no exposure to urban nature.

It has long been known that meaning in life is associated with positive psychology, interpersonal interactions and well-beings (Hicks et al. 2010; Ryff 1989; Stillman et al. 2009). Many actions of people have been shaped and motivated by the needs for meaning. A study that focused on Japanese people has found that the search for meaning in life is not only positively related

to positive psychology, but also future-oriented coping (Steger et al. 2008). Pargament and Sweeney (2011) also found that the meaning in life could become a protection factor against psychological distress (Pargament and Sweeney 2011). Thus, enhancing the search for meaning in life is meaningful in terms of combating depression.

As positive affect is positively associated with the meaning in life, urban nature exposure that gives pleasure to visitors, restores mental balance and reduces depression symptoms may enhance the search for meaning in life. The finding of this study supports this view.

In this study, the findings indicated that urban nature exposure is positively associated with physical activity, sleep quality and the search for meaning in life. Considering a wide range of benefits of urban nature exposure, developing intervention programs that promote students' visits to urban nature sites is meaningful to maintain health.

In this study, 65.3% of males were found in the group that was exposed to urban nature. This percentage is almost twice as likely than the percentage of females (34.7%) in the group. On the contrary, a higher percentage of females was observed in no exposure group. These numbers indicate that females are less likely to visit urban nature sites. Despite nature exposure is a natural solution to cope with depression and anxiety symptoms, fewer females chose to visit urban nature sites compared to males. Such behaviors make females lose the opportunities to use urban nature sites to counter stress. In addition to the attitude toward the use of anti-stress method, females were also reported to have higher perceived stress levels than males (Albert 2015; Li 2019). These findings indicate that planners who design intervention programs that promote students' visits to urban nature sites should pay special attention to female students.

5. Conclusion

Human beings have lived in the realm of nature. All human needs, including the air, foods and energy, come from the nature. Contacting with nature not only help people relax, reduce depression symptoms, improve sleep quality and enhance the search for meaning in life, but also boost our positive thinking. During the coronavirus (COVID-19) pandemic, leaving the urban areas and visiting forests become an uneasy thing. Thus, a natural solution that substitutes for forest bathing is necessary.

The findings of this study show that urban nature exposure is positively related to physical activity, sleep quality and the search for meaning in life among university students in Japan. Those who have the habits to visit urban nature sites are more likely to have outdoor physical activity. Compared to those people who did not visit urban nature sites, the percentage of students who had poor sleep quality is less in the group that was exposed to urban nature. In addition, students who were exposed to urban nature are more likely to have higher scores in the search for meaning in life. Since the cognition and habits developed during the stage of university studies will affect the person's living habits, lifetime cognition, thinking patterns and stress management in the future, developing intervention programs that promote university students' visits to urban nature sites has significant implications for maintaining health and reducing depression over the course of one's lifetime (Li 2019). Since gender differences in habits and perception of stress can be observed, special attention should be paid to female students when making intervention programs that promote students' visits to urban nature sites.

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