

Effects of Physical Environmental Design Attributes on Psychological Well-being of College Students in University Dormitory During the Covid-19 Pandemic Period

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Abstract During pandemic period, college students lost lots of such academic opportunities as extra-curriculum social activities, contact classes, and friendly socializing in university campus area, etc. Previous many studies have shown that physical environment has certain relevance on the well-being of human-beings. Recent public statistics on mental health had shown an increase in psychological distress and a decrease in college students and people's well-being during the lockdown in response to the Covid-19 pandemic. However, there were little evidence on what the college students in dormitory suffered from COVID-19 incident in relation with their physical environment. The purpose of this study is to investigate the relationship between environmental factors and psychological well-being of dormitory students in university campus. In order to explore the impact of physical environment on students' psychological well-being, survey instrumentation consisted of 25 indices were employed to measure the level of awareness to each index. A Chi-square analysis on individual characteristics of 200 students found that number of students living in single dwelling unit was statistically significant to maintain their psychological well-being, except for number of students living in each dwelling unit ($\chi^2 = 128.92$, $p = .004$). Pearson correlation analysis also found that there exists statistically significant relationship between psychological well-being of students and environmental factors. Further, stepwise multiple regression analysis revealed that the most prime predictor for psychological well-being of students residing in dorm was "use of furniture" ($\beta = .281$), implying careful design, lay-out and easy-access to interior furniture by facility planner. The study also demonstrated that as the level of positive perception of physical environmental features rose, overall psychological well-being of students also responded positively at specified rate. Finally, the findings reinforce a solid evidence that carefully well-coordinated physical environments play an important role in maintaining emotional stability of college students in dorm even in pandemic period.

keywords : IEQ, University Dormitory, Covid_19, Pandemic, Physical Environment, Psychological Well-being

1. INTRODUCTION

The building of a dormitory is an area, requiring consideration and attention like other various spaces of the university since it

can affect the quality of life of the students and consequently their academic progress. Most of the students living in the dormitory experience such separation from their families for the first time, and they encounter different challenges upon they arrive the dormitory which could be somewhat stressful.

As approved in plenty of articles in the world, it is known that environmental stress could emerge from spiritual, emotional and physical problems for people. For instance, Arif, M., et al., (2016) argued that problems with indoor environmental quality (IEQ) (thermal, acoustic, visual and air quality) of a building has a direct effect on the comfort, health and productivity of the occupants. Furthermore, Kamaruzzaman, et al., (2017), similarly reported substantial research findings in their paper which is about the impact of indoor environmental quality (IEQ) on occupants' well-being and comfort.

According to the study of indoor environmental quality (thermal, acoustic, visual and air quality), it is maintained that a building has a direct effect on the comfort, health and productivity of the occupants. Also, in another study it has been contended that the architecture of residential halls has a significant impact quality of

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their education (Daliri Dizaj, M., et al., 2022).

Notwithstanding the fact that poor IEQ might have an effect on residents' mental health, various factors including limited budget, unawareness of designers and authorities of the university have given more priority for the efficient environment in satisfying the primary needs of the students than making a safe built environment and considering quality-oriented physical, social and psychologically stable environments for students. In other words, investigation on behavioral architecture and more awareness about the design and well-being standards in built environment and continuously upgrading them in line with the problems of the society could be great resource for educational facility designers in providing more proper environment for quality-oriented life of residents in the dormitory.

Some studies have already shown about the influence of architecture of the environment on the patient's recovery progress in health-care facilities, the apartment residents' health issues, and the employees' productivity at work place. In a study by Salonen, H., et al., (2013), it appeared that several environmental characteristics such as environmental safety, indoor air quality, sound and noise, light, colors, unit lay-outs and the placement of furniture etc., affected the well-being of patients, staffs, and family/visitors in health-care facilities.

Another study pointed out the fact that issues such as sick building syndrome (SBS), building related illness, and pollutants had an impact on the overall productivity of the occupants. SBS is a group of health problems that are caused by the indoor environment such as an office building or a dwelling. Symptoms experienced by people with SBS include irritation of the eyes, nose, and throat, headache, cough, wheezing, cognitive disturbances, depression, light sensitivity, gastrointestinal distress and other flu-like symptoms (Arif, M., et al., 2016).

Despite the existence of plentiful studies on how environment can positively or negatively affect human well-being, few have focused on the well-being issues happening due to the lack of proper knowledge related to the dormitory area design. Although the results of the previous investigations could be applied to other building types such as dormitories, there is a need for more in-depth approach. Moreover, the issue that affects the design factors can be related to mental health stability of people more than ever before during the incident of pandemic of Covid-19.

Pursuant to this condition during the lockdowns around the world and holding online classes, the individuals had to remain in indoor of house drastically more than before, and such condition became a new challenge for the students, especially those who reside in dormitories. Although the most countries are dropping Covid-19 related restrictions, its psychological impacts on people has still been remained and needs time to be completely disappeared. Therefore, it is necessary to enhance our living environments to be more adaptable and prepared to handle other future pandemics that might happen one day.

The recent research demonstrated that mental problems and amount of stress of people during this term are increased more than before the pandemic. Preceding the COVID-19 pandemic, psychological and social problems among college students were already being considered a serious challenge to endure. Elmer, T., Mepham, K., & Stadtfeld, C. (2020) examined student's mental health during COVID-19 pandemic and the results proved that this pandemic crisis had a negative impact on social network and mental health of students and students experienced more depression and anxiety under lockdowns. A recent study on 917

students from 8 universities in Germany also showed that the pandemic poses a risk for student's short- and long-term physical health and gender has a significant effect on mental health distress due to COVID-19 (Gewalt, S. C., et al., 2022). Therefore, there is a great need to expand our knowledge about the effects of the built environment on the occurrence of mental problems.

As a result of that, this study is aimed at investing the effects of physical factors of the built environment used on the psychological wellbeing of the residents at university dormitory during the pandemic period. The results will play an important role in providing useful design guidelines for relevant facility planners and provide more physically and emotionally stable environment for dormitory students. For this purpose, survey instrumentation was contrived to measure the level of student's residential experience and mental health during the pandemic in the dormitories of University A in Seoul. For proper analysis, statistical test such as Chi-square and multiple regression analysis were performed by using SPSS software.

2. REVIEW OF LITERATURE

2.1 Influence of physical environment on psychological health and well-being

Frontczak, et al., (2012), pointed out that people spent almost 90% of their time in indoors and indoor conditions have serious implication for their general well-being. Several elements such as high-rise living, graffiti, damp, and noise exposure of the physical environment are linked to poor mental well-being (Guite, H. F., et al., 2006). Wright, P. A., & Kloos, B., (2007) claimed that a housing environment have physical, social and psychological attributes. Environmental psychology of human behavior in a physical environment and architectural space not only has a great impact on creating a friendly and lively environment, but also it can positively affect learning of students and energize them (Mosharraf, H. M., & Tabaeian, S. M., 2014).

According to Salonen, H., et al., (2012) environmental characteristics influencing wellbeing included environmental safety, indoor air quality, sound and noise, premises and interior design (e.g. construction materials, viewing nature and experiencing nature, windows versus no windows, light, colors, unit layout and placement of the furniture, the type of room, possibilities to control environmental elements, environmental complexity and sensory simulations, cleanliness, ergonomics and accessibility, art and music and Indoor environments that incorporate healing elements can reduce anxiety, lower blood pressure, lessen pain and shorten hospital stays.

World Health Organization (2022) has asserted that the COVID-19 pandemic has had a severe impact on the mental health and wellbeing of people around the world while also raising concerns of increased suicidal behavior. A study done by Lee, H., et al., (2021), on the middle and high school students in Daegu city in South Korea revealed that students during this period are affected psychologically by COVID-19, and the number of students who experienced unbearable stress almost doubled at the peak time of the COVID-19 contagion compared to before the COVID-19 pandemic.

Also, compared to domestic students, international students are more vulnerable to overcoming mental health problems (Kim, H. R., & Kim, E. J., 2021). Future layout and provision on all such places as domestic, medical, working space and industrial places needed to be healthy with fresh air and natural light, but also be an environment that creates mental and psychological relief (Pocock, L., & Shams, R. 2020). Thus, it is necessary to analyze the environmental attributes such as

interior furniture, ventilation quality, view sights, noise and safety factors in dormitories that affect the students well-being, specially the changes that happened on psychological health of students during the pandemic.

2.2 Previous studies during pandemic period

In recent years there has been an increasing interest in studying the factors affecting the indoor environmental quality (IEQ). Asim, F., et al., (2021) noted that built environment had long recorded history of association with mental health dating as back towards ancient civilizations.

Table 1. Previous Research on IEQ and well-being

Classification	Authors	Major research findings
Physical environmental factors & mental health	Völker, S., & Kistemann, T. (2011)	Indoor environments that incorporate healing elements can reduce anxiety, lower blood pressure, lessen pain and shorten hospital stays.
	Kim, Wonpil (2017)	Satisfaction with physical environment influenced social interaction and SOC level and it is important to emphasis on home environment in residential area rather institutional function in dormitory facility.
	Frontczak, M., Andersen, R. V., & Wargocki, P. (2012)	The main indoor environmental parameters (visual, acoustic and thermal conditions, and air quality) are considered by occupants to be the most important parameters determining comfort.
	Kadhim, L. A., & Shok, M. E. (2021)	The built environment is one of the main determinants of health, the quality of which depends on on-site planning, special attention to gathering places, increased opportunities for social interaction, noise reduction, and an increased sense of safety.
Pandemic architecture & well-being	Amerio, A., Brambilla, A., Morganti, A., Aguglia, A., Bianchi, D., Santi, F., ... & Capolongo, S. (2020).	Social isolation and living 24 h of the day in small apartments without a designated work-space available may have led to decreased productivity. Housing design strategies should be focused on larger and more livable living spaces facing green area, and a there is a strong association between poor housing and moderate-severe and severe depressive symptoms.
	Asim, F, Chani, P. S., & Shree, V. (2021).	Adverse effect on productivity related to isolation increased the risk of depressive symptoms.
	Zarrabi, M., Yazdanfar, S. A., & Hosseini, S. B. (2021)	The most critical priorities for residents during Covid-19crisis are natural light, visibility, the acoustics of interior space, and the open or semi-open space.
	Morganti, A., Brambilla, A., Aguglia, A., Amerio, A., Miletto, N., Parodi, N., ... & Capolongo, S. (2022)	Regardless of housing size, poor indoor quality is the determinant that is most associated with more moderate/severe and severe depressive symptomatology in university students.
	von Keyserlingk, L., Yamaguchi-Pedroza, K., Arum, R., & Eccles, J. S. (2022)	Students experienced an increase in study-related stress after the outbreak of the COVID-19 pandemic, the related campus closure, and online classes.
	Gewalt, S. C., Berger, S., Krisam, R., & Breuer, M. (2022)	Male students were identified to have a lower risk of moderate to high levels of distress compared to female students during COVID-19 pandemic.

Moreover, Salonen, H., et al, (2012) has contended that the positive effects of space and the environment on people were well known in the era before modern science and for many centuries in ancient Greece, and temples to the god Asklepios were designed to surround patients with nature, music, and art in order to restore harmony and promote healing in the absence of other treatment modalities.

Later, many studies concerning wellness architecture and post pandemic architecture were conducted to clarify the importance of environmental factors effects and their relation with mental health (See Table 1). Keyserlingk, L., et al., (2022) claimed that recent public statistics on mental health in the United States had shown an increase in psychological distress and a decrease in college students and people's well-being during the lockdown in response to the Covid-19 pandemic. The same results have been indicated in the analysis of Daegu city student mental health (Lee, H., et at., (2021).

Overall, since the previous research have proved the substantial relationships between IEQ and the well-being of residents, it is concluded that further studies considering resident's or dormitory student's health outcomes during the COVID-19 crisis are needed to explore useful design elements of the physical environment for improving psychological well-being of students.

3. DATA COLLECTION

Investigating the effects of the built environment on dormitory students during COVID-19 pandemic period is inevitably related with the occurrence of mental problems in some ways. For this purpose, dormitory students were randomly selected to complete a survey questionnaire. A questionnaire on a five-point Li-kert scale was constructed to evaluate the level of physical environment and psychological well-being related issues: 1 = strongly disagreed and 5 = strongly agreed. Students were free to leave the survey at any moment if they feel being uncomfortable.

The survey instrumentation was contrived by the research concept and major concepts of previous literature reviews, consisted of a total twenty questions; three survey statements regarding environmental safety, five questions including noise, light and HVAC related issues of dormitories, four questions related to interior design features of dwelling units and eight questions asking well-being conditions of dormitory student mental health during COVID-19 pandemic. Also, in order to examine the relationship between individual characteristics and physical environment, the questionnaire included items of personal profiles such as gender (male or female), age (< 20, 21~30, 31~40), currently academic status (Korean Language program, undergraduate, graduate or Ph. D degree program), residence period (1~5 semesters and over), number of persons in each unit (living alone or living with other students). One open-ended question has been added at the end of this survey to gain more qualitative feedback on environment of the dormitory from student's perspective.

Two hundred survey samples which are taking an average of 5~10 minutes, were collected from May 2020 through the end of July 2022 for an analysis through SPSS program and there were no financial incentives for completing it and the target group was made up of Korean and International students, living in A University's dormitories in Seoul. Participants were also given information on the research, such as its goals, benefits and data collection processes.

In this survey, psychological well-being as dependent variable(d.v) was measured as an average mean value of physical and mental problems such as muscle pain, headache, lethargy, sleep problems, asthma or allergies, and depression. Moreover, in order to evaluate the efficiency of interior environment of dormitory rooms during the pandemic for studying online courses, survey participants were asked to answer: "During the COVID-19 pandemic, I could listen online classes in dormitory comfortably and I did not lose concentration and enthusiasm compared to before." The participants were asked to check the form in a scale of "1 = strongly disagreed and 5 = strongly agreed."

As shown in Table 2, the survey has been carried out at five dormitory building blocks with 1,642 accommodation capacity. All the units have access to natural and artificial lights. An available furniture in each room differs from each other by the number of accommodates and type of dormitory. Each block has security desk with non-contact temperature assessment device located at the entries to check students body temperature during the spread of COVID-19 virus.

Table 2. Physical profile of university dormitory

Div.	A University in Seoul	
General information	Accommodation Capacity 1,642	Number of dormitory 5 building blocks
Overview of University Dormitory		
Environmental Safety features		
Interior view of Dormitory rooms		

4. DISCUSSIONS

4.1 Personal characteristics by Psychological Wellbeing

As shown in Table 3, a total of 200 randomly selected students indicated demographic profile of population with 97 male students (48.5%), 103 female students (51.5%) and the majority of students were aged 21~30 years. Regarding educational attainment, 121 students (60.5%) of the participants were bachelor degree holder

and the most resided in dormitory for 1 semester (30.5%).

In order to examine the relationship between personal characteristics and psychological wellbeing, χ^2 analysis were performed (presented in Table 3). A Chi-square analysis (χ^2) revealed that each group's individual characteristics was not statistically significant except for number of students living in each unit at the level of $p = .05$; gender, age, grade, residence period. A χ^2 analysis of Table 3 indicated that number of students living in one unit was only statistically significant component ($p = .004$). As shown in Fig. 1, it is notable that double dwelling unit provides higher psychological well-being score ($M = 2.76$) at their physical environment than single units and quads.

Table 3. Chi-Square analysis on personal characteristics and psychological well-being (n=200)

Personal Characteristics	N	%	P.W.*	χ^2	
Gender	- Male	97	48.5	2.65	27.95 (p= .573)
	- Female	103	51.5	2.75	
	Total	200	100	2.70	
Age	--20	32	16	2.63	67.91 (p= .226)
	- 21-30	147	73.5	2.66	
	- 31-40	21	10.5	3.10	
	Total	200	100	2.70	
Grade (Academic standing)	- Korean Lang.	29	14.5	2.63	83.90 (p= .661)
	- Bachelor	121	60.5	2.67	
	- Master	39	19.5	2.92	
	- Ph.D	10	5	2.41	
	Total	200	100	2.70	
Residence Period	- 1 semester	61	30.5	2.59	124.96 (p= .360)
	- 2 semester	36	18	2.56	
	- 3 semester	48	24	2.92	
	- 4 semester	26	13	2.92	
	- 5 semester~	29	14.5	2.54	
	Total	200	100	2.70	
No. of Students living in oneroom	- 1 person	21	10.5	2.51	128.92*** (p= .004)
	- 2 persons	167	83.5	2.76	
	- 3 persons	1	0.5	-	
	- 4 persons	11	5.5	2.23	
	Total	200	100	2.70	

* P.W. indicates the level of psychological well-being based on 5 point Likert Scale.
** $p < .05$, *** $p < .01$, **** $p < .001$

This means that students residing in high density level tend to experience more psychological stress than other type of unit. Moreover, it is somewhat notable that student residing in single unit presents report lower level of well-being than double roommate unit type, implying there exists appropriate combination of density level.

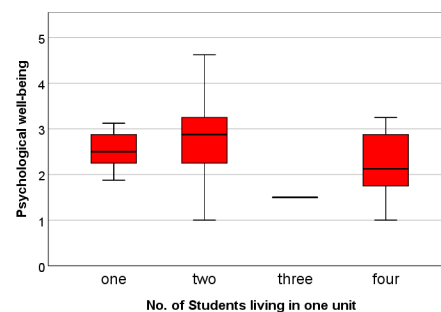


Figure 1. Number of students residing in single unit and their psychological Wellbeing

4.2 Physical environmental factors related to psychological well-being

As indicated in Table 4, each index regarding the psychological well-being in university dormitory showed mid-range average mean score from 2.00 to 3.20. Among four major factors, students assessed interior design of dormitory as the most desirable part (M = 2.95). On the other hand, environmental safety is perceived as least desirable elements (M=2.36), indicating students' low acceptance of security to the dormitory (M = 2.47). Specifically in open-ended question of the survey, it was reported by some students that the double units in dormitory were not safe enough to prevent the spread of COVID-19, meaning more active separation between students during Pandemic period.

Table 4. Level of agreement with each survey index (n=200)

Factor	Survey index	M	SD
Environmental safety (M=2.36)	Q1-The security of the dormitory is acceptable.	2.26	1.13
	Q2-Dormitory area is safe against fire from spreading.	2.32	.965
	Q3-The dormitory environment can prevent the spread of infectious diseases, including the virus that causes COVID-19.	2.51	1.04
	Q4-Dormitory rooms are well soundproofed.	2.72	1.07
Noise, light and HVAC (M=2.67)	Q5-Daylight enters the dormitory room satisfactorily.	2.70	.96
	Q6-The lighting in the dormitory is not uncomfortable for studying.	2.72	1.13
	Q7-The size and operation of the dormitory windows are well designed for ventilation.	3.20	1.15
	Q8-Cooling and heating system in rooms of the dormitory is acceptable.	2.00	.88
Interior design feature (M=2.71)	Q9-It is convenient to use the furniture in the dormitory room.	2.71	1.05
	Q10-There is no inconvenience in using the bathroom.	2.50	1.07
	Q11-The interior colors such as walls/floors in the dormitory are stylish and satisfying.	3.01	1.09
	Q12-There are plenty of plants and decorations in the dormitory room space.	2.60	1.20
Psychological well-being (M=2.70)	Q13-When you stay in the dormitory for a long time, you may experience muscle pain, headache, lethargy, etc.	2.85	1.07
	Q14-During the period of residence in the dormitory, I experienced no illness such as asthma or allergies.	2.46	1.16
	Q15-During the dormitory life, the quality of my sleep did not change and I did not suffer from insomnia.	2.62	1.11
	Q16-During the COVID-19 pandemic, I could listen online classes in dormitory comfortably and I did not lose concentration and enthusiasm compared to before.	2.72	1.13
	Q17-I have psychological stability while living in the dormitory.	2.67	1.09
	Q18-During the dormitory life, my anxiety, stress, and anger were low.	2.97	1.03
	Q19-I don't feel being stressed from my roommates living with me.	2.67	1.20
	Q20-I maintained good social relations with other students in the dormitory.	2.66	1.23

* Mean value of each survey index is recorded on 5point Likert scale (1= strongly disagreed, 5= strongly agreed)

4.3 The effects of physical environment of dormitory on students' psychological well-being

In order to examine the effects of physical environmental attributes on dormitory students' psychological well-being, mean value of major Physical Environmental related component scores as i.v. (independent variables) were operationally defined to perform correlation and multiples regression analysis. As shown in Figure 2, Pearson correlation analysis provides an empirical evidence for a solid relationship between physical environmental and psychological well-being factors (p < .01). Each factor of physical environment also shows solid relationship among these factors one another.

Psychological well-being	Environmental Safety	Noise, light and HVAC	Interior Design
.448**			
.503**	.479**		
.520**	.383**	.513**	

** Correlation is significant at the 0.01 level (2 tailed)

Figure 2. Pearson correlation analysis between physical Environment and psychological well-being

As shown in Table 5, the Chi-square analysis on the relationship individual characteristics and physical environment found that some level of environment safety were statistically significant ($\chi^2 = 27.41$; p = .001) on personal characteristics (Gender) implying environment safety is more concern to female student group.

Table 5. Chi-Square analysis on personal characteristics by environmental factors (n=200)

Factor	Env. Safety	Noise, light and HVAC	Interior Design	Physical Env.
Personal				
Gender				
- Male	27.41***	21.42	14.48	144.95
- Female	(p=.001)	(p=.851)	(p=.750)	(p=.393)
Age				
--20	12.16	26.92	37.34	273.38
- 21- 30	(p=.839)	(p=.801)	(p=.167)	(p=.633)
- 31- 40				
Grade				
- Kor. Lang.	25.86	56.12	52.04	405.52
- Bachelor	(p=.526)	(p=.289)	(p=.219)	(p=.721)
- Master				
- Ph. D				
Residence Period				
- 1semester	29.79	62.81	67.23	545.28
- 2semester	(p=.980)	(p=.655)	(p=.243)	(p=.707)
- 3semester				
- 4semester				
-5semester~				
No. of Students living in one room	27.01	37.24	51.52	391.64
(-1, 2, 3, 4)	(p=.463)	(p=.925)	(p=.234)	(P=.861)

* p < .05, ** p < .01, *** p < .001

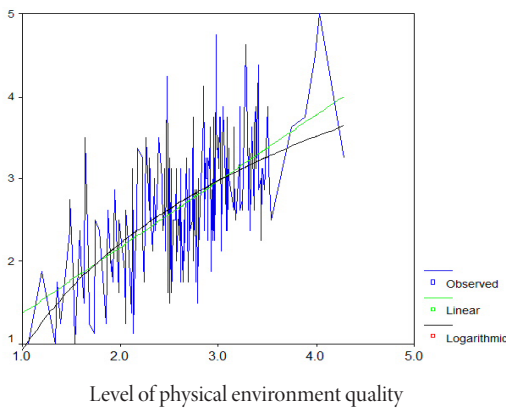
In an effort to investigate what major predictors of physical environmental attributes impacting on level of psychological well-being, linear stepwise regression analysis was performed. As presented in Table 6, Q9 ($\beta = .281$; use of furniture) was the most influencing variable impacting students' psychological well-being, followed by Q3 ($\beta = .252$; preventing the spread of virus), and Q6 ($\beta = .233$; appropriate lighting).

Table 6. Multiple regression analysis

Model	Unstandardized		Coefficients		F	Sig.
	Coefficients		Beta			
	B	Std. Error				
Constant	1.256	1.54				
Q6	.158	.045	.233		32.178	.000
Q9	.205	.046	.281			
Q3	.185	.047	.252			

df= 3 R²= .330 Adj. R²=.320
dependent variable: Mean score of psychological well-being

The linear graph in the following Figure 3 indicates that as students' perceived awareness of physical environmental attributes goes up, the level of psychological well-being of students does correspond to the rate of overall regression coefficient.



* d.v. = psychological well-being, i.v.= perception of physical environment

Figure 3. Regression analysis, showing the interrelationship between qualities of physical environmental attributes and psychological well-being

5. SUMMARY AND CONCLUSION

5.1 Summary and discussion

Recent studies on mental health had shown an increase in psychological distress and a decrease in college students and people's well-being during the lockdown in response to the Covid-19 pandemic. There was little known on how college students suffered from Pandemic incident in relation with physical environment at campus area during two years. In order to investigate the effects of physical environment of university dormitory on psychological well-being of college students, an extensive literature review found that issues such as sick building

syndrome (SBS), building related illness, and pollutants had an impact on the overall productivity and psychological well-being of the occupants.

An analysis on collected survey data of 200 samples found that when the current physical environmental attributes were operationalized for the interplay of personal characteristics, the analysis of Chi-square on the number of students residing in single dwelling unit does appear to be statistically significant on maintaining psychological well-being. It is important for research on appropriate density level in the dormitory settings to consider both such individual indicator as gender-female as well as environmental characteristics to achieve high level of emotional stability. Further, stepwise multiple regression analysis found that Q9 ($\beta = .281$; use of furniture) was the most influencing variable, impacting college students' psychological well-being, implying careful arrangement and design of indoor furniture in dorm facilities. The research also validated that as students' perceived awareness of physical environmental attributes goes up, the level of overall psychological well-being of students does correspond to the rate of overall regression coefficient of physical environment variables.

5.2 Limitations and Implication for future research

Several research limitations exist. Because of the location of survey site and subject size of target population, it may not be possible to generalize the research findings in other university dormitories. Since the study included new composite mean score of physical environmental attributes and self-reported psychological well-being, the results cannot be generalized from the standpoint of traditional psychological theory. Moreover, any conclusion concerning the measurement of psychological well-being must be limited to the survey respondents who experienced limited campus dormitory environment during COVID-19 era, based on assessable variables provided by the survey instrumentation. It is possible that those who did not reply to the survey were less supportive or keeping different views on research foundation. Notwithstanding the limitations, the study is one of few studies to examine psychological well-being at college campus in relation with physical environment during pandemic era and the research findings will pose new challenges for design of campus dorm facility with virus incident.

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