EXTENDED ABSTRACT

INDOOR ENVIRONMENTAL QUALITY AND ITS IMPACT ON THE HEALTH: A CROSS-SECTIONAL STUDY

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Abstract

University student enrollments have recently increased in Sri Lanka. Accordingly, with the growing number of students and low land space in the university, planners try to develop a very tight buildings as residential buildings. Modern students spent more than 90% of their time indoors. It may have affected the health of the students. Therefore, this study aimed to examine the association between indoor environment quality in university hostels and respiratory health problems. The questionnaire survey was conducted in May 2020, and Rajarata University students from the second year to fourth years were selected to find the association. a stratified random sample method was applied. Data were calculated using percentage values and nonparametric statistical analysis such as significance testing and Spearman's correlation. 2234 students voluntarily completed the questionnaire. Among them, females were 71.2 %, and male percentages were 28.80 %. 25.00 % (± 0.91%, z = 1.96) of students reported wheezing in the chest at any time in the past. 7.90 % (± 0.57%, z = 1.96) of students living in the hostel were reported doctor-diagnosed asthma. Students were also written about 36.00 % (± 1.01 %, z = 1.96) for sneezing and a runny nose. Indoor environmental factors such as the number of students in the room and occupied low student space were strongly associated with University student's health in the Rajarata University of Sri Lanka ($p < 0.1$). Therefore, policymakers need to pay more attention to the indoor environmental quality of the university dormitories.

Keywords: Indoor environment, health, respiratory diseases, asthma

1. Introduction

The indoor environment has been a major source of concern in the last two decades because people spend most of their time indoors, mostly at home, workplace, or school. It contains over 900 different pollutants, significantly associated with human health(Tran Park, 2020). According to World Health Organization in 2018 (WHO) reported that indoor air pollution (IAP) is responsible for the deaths of over 3.8 million in the world annually (WHO, 2018). However, scientists have performed many attempts in the field of indoor environmental studies from a broad perspective (Air et al., 2012; Bornehag et al., 2004; Dong et al., 2008; Hägerhed-engman, 2006 and Harving et al., 1993). In recent years, the number of students in higher education has been increased in Sri Lanka. Accordingly, Student enrollment rose slightly over 19% in 2018/2019 (UGC, 2019). Thus, expenditure as a percentage of government expenditure for university education increased by 2.49% (UGC, 2019). As a policy, many Sri Lankan Universities have given hostel facilities to

students freely, but these buildings have more students. For example, four undergraduates share one room with a room density of 17.82 m^2, and ten students share one room with a room size of 29.9 m^2 in the Rajarata University of Sri Lanka. Accordingly, the average space per person is 4.56m^2 to 2.99 m^2, respectively. Generally, hostel environments are excessively crowded compared to home environments. When there is more than one person in a room, it is called crowding; when there are more than 1.5 people in a room, it is called severe crowding (World Health Organization, 2018; Sun et al., 2011). The standard room capacity for one person is more than 7m^2 (C. P. Guidance, 2011; Homes Communities, 2007). Therefore, the indoor environment is becoming a poor environmental quality. Other than this, most students can be exposed to adverse indoor environmental pollutants. According to the World Health Organization (WHO), a poor indoor environment is linked to many respiratory diseases (World Health Organization, 2008). Moreover, many previous studies have recognized that indoor environmental pollutions are an intensive factor for most respiratory symptoms (Lanthier-Veilleux et al., 2016; Sun et al., 2019; Kausar et al., 2016). Based on this context, the indoor environment caused many health problems. Some of these associations can often be complicated, and they can have both acute and chronic impacts on individuals. (Kaushik et al., 2016; Babisch, 2008). Consequently, research on indoor environmental quality (IEQ) in schools and universities is becoming interesting. For this study, Rajarata University students were selected to find the association between indoor and students' health. Rajarata University is a national university which is situated in a dry zone in Sri Lanka. The total number of students at the university is about 6648 (2019). But accommodated students in the university are approximately 5473 and nearly 90% of the total student population. However, to our best knowledge, research related to the university's indoor environment and health has not been studied in Sri Lanka. This study aimed to examine the associations between indoor environment quality in university hostels and respiratory health problems.

2. Methods

This current study was a cross-sectional study conducted at the Rajarata University of Sri Lanka, including 2234 undergraduate students from the second year to the fourth year only. The response rate was 76.00%. Participants were recruited using a stratified random sampling by the age of the dormitory building, type of the building (single floor or multi-storey), an allocated number of students for one room. The stratified units were the age of the dormitory building first stage, the type of hostels in the second, and the allocated number of students for one room in the third stage. A self-administered questionnaire was used to collect the information; the survey was conducted in May 2020. Volunteer students facilitated to complete questionnaires and submitted them to officers of the hostels. The questionnaire was mainly similar to earlier used in Sweden, Bulgaria, and China for homes (Bornehag et al., 2004; Engman et al., 2007; Sundell et al., 2013) with minor changes to reflect the Sr Lannken environment, building characteristics, and dormitory environment. Data were analyzed using descriptive statistics and a nonparametric test procedure; Spearman's Rank Correlation. Statistical Package for Social Sciences version 21 (SPSS 21) was used for data analysis.

The ethical clearance was obtained from the Research Ethical Committee of the Rajarata University of Sri Lanka.

3. Results and discussion

Of students who lived in the seven hostel buildings, 2234 students completed and returned the questionnaire. 71.2 % were female, and 28.80 % were male. The university, one-room allocated to 3 to 10 students (Table 1). Most of the rooms were allocated to 4 students (45.73). Nearly 32.66 % of students lived 10 students in one room. Living in a shared space with low ventilation may help develop respiratory health problems (Sun et al., 2011; Venables Allender, 2006). For example, in some hostel buildings, four undergraduates share one room with a room size of 17.82 m^2, ten

students share one room with a room size of 29.90 m^2. The average density per person was 4.56m^2 to 2.99 m^2, respectively. The standard room capacity per person is 7m^2 or more (C. P. Guidance, 2011; Homes Communities, 2007).

Table 1. The number of students in a room and the amount of space occupied by one student (m^2)

Numbers of students in one room (n %)	Space for one student in the room m^2
3 student (4.00)	5.94
4 student(45.73)	4.46
5 student(2.88)	3.90
6 student(14.73)	3.25
10 student (32.66)	2.99

Source: Field survey data 2020

Furthermore, the research asked from the student TV and PC usage; The students watched TV/ playing on PC for less than two hours was 72.00 % from Monday to Friday. However, 1.40% of students were not watching TV or playing PC. Not only those but 25.00% of students were watched and played PC for more than 2 -10 hours. However, a previous study in China reported that the students who watched TV/ playing on PC for less than two hours were 18%, while 36 % spent 2–10 hours per day, and 46% spent more than 10 hours per day (Sun et al., 2011). Accordingly, students were spending more time indoors than outdoors. In addition, 25.00 % (± 0.91 %,z=1.96) of students

Table 2. Self-reported symptoms of the student and correlation with the number of students in a room

Symptoms (n=2234)	Number of Students (Yes)	Student % (margin of error%, z = 1.96)	Spearman's correlation	p-value
Wheezing in the chest at any time in the past	554	25.00(± 0.91)	0.089*	0.000
Wheezing or whistling in the chest in the past 12 months	525	24.00(±0.90)	0.079*	0.000
Dry cough at night	452	20.00(±0.84)	0.041**	0.057
Asthma diagnosed by a doctor	171	7.90(±0.57)	-0.012	0.575
Sneezing, or a runny, or a blocked nose	801	36.00(±1.01)	0.033	0.126

*significant at the 0.01 level, **significant at 0.1 level of significance.
Source: Field survey data 2020

were reported wheezing at any time in the past (Table 2). And they had mentioned around 24.00 % (± 0.90 %, z=1.96) for wheezing or whistling in the chest in the past 12 months. 7.90 % (± 0.57 %, z=1.96)of students living in the hostel were reported doctor-diagnosed asthma. Students were also informed about 36.00% (±1.01%, z=1.96) for sneezing, a runny, or a blocked nose. Among the students, reported Wheezing and sneezing or runny nose was a higher percentage. According to the correlation analysis (Table 2), three self-reported health conditions have been positively correlated with students in a room. The reason for these positive correlations could be due to crowded students in the room(World Health Organization, 2018), poor ventilation, and airborne infectious diseases can be spread among the student through common space. Previous studies were also reported that crowded areas have more respiratory symptoms (Sun et al., 2011; Jaakkola Heinonen, 1995).

4. Conclusion

Most universities have allocated hostel facilities for university students in Sri Lanka with insufficient room space. Crowdedness makes students unhealthy 25.00 % (± 0.91% z = 1.96) for wheezing in the

chest, 7.90 % (±0.57 %, z = 1.96) reported doctor-diagnosed asthma, and 36.00 % (±1.01 %, z = 1.96) for sneezing and a runny nose). Indoor environmental factors such as the number of students in the room and occupied low student space were strongly associated with University student's health in the Rajarata University of Sri Lanka ($p < 0.1$). Thus, policymakers need to pay more attention to indoor environment quality and ventilation when allocating students' accommodation. Further research is required to find our primary findings and increase our understanding of respiratory diseases among the university student community.

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