Assessment of Ergonomic Risk Factors Affecting the Musculoskeletal Discomfort of Daycare Centers Occupants in the Philippines

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Abstract
Daycare is considered as one of the places where children construct their characters and abilities and strengthen them. It is a nursery for the supervision of children between the ages of 2-6 years while parents are at work. Since daycare centers are considered as second home for children, it is very important to provide a relaxed and safe environment for both teachers and children. Physical preschool environment plays a critical role on children's cognitive, social, physical and emotional development, it affects children's comfort, health and long-term well-being. Further, children's physical environments may adversely affect their postures and postural risk. Research reveals that many school children sit in workstations that do not suit them properly. Schoolchildren who sit for long periods in uncomfortable postures may develop musculoskeletal symptoms that deteriorate with time. Yet common assumptions about what is ergonomically proper for adults may not be appropriate for children. Considering this situation, this paper aims to assess the ergonomic risk factors of the physical environment of daycare centers that affects the musculoskeletal discomfort of children and teachers. To address this, the researchers conducted surveys on the discomfort scores of children and teachers using the Corlett and Bishop body map questionnaire. Corlett and Bishop's (1976) body part discomfort scale is a subjective symptom survey tool that evaluates the respondent's direct experience of discomfort at different body parts. A total of 150 respondents were involved in the study comprised of 100 children and 50 teachers. After which, classroom facility design of daycare centers was assessed by obtaining the actual measurements of ergonomic risk factors such as light, noise and temperature level as well as actual measurements of workstations and layout. Then, statistical tools were applied to evaluate the relationship of the ergonomic risk factors to the discomfort level of occupants. Analysis of variance was used to know the significant difference in the discomfort level between children and teachers as well as significant difference between the measurements of ergonomic risk factors among the 5 daycare centers involved in the study. Then to further analyze the true significant factors contributing to discomfort scores of occupants, correlation analysis was employed.

Keywords
daycare centers, musculoskeletal discomfort, ergonomic risk factors

1. Introduction
Education for children involves providing from both kindergartens to higher academic education. Early childhood education is the key to building a solid foundation for educational success for a child (Adams, 2008). Building a strong relationship between families and teachers will enhance children's growth, enhance parental skills and self-esteem and, in some cases, lead to community building (Martin, 2001). As children begin to meet people outside their families, they need individuals who are mature, well-educated, well-trained, and highly qualified in their understanding and knowledge of child development, so that children can learn, develop, enjoy and make a contribution effectively (Bruce, 2012).

Daycare includes treatment given to young children aged from one (1) to six (6) years old, either in their very own household, in the home of a parent or other caregiver, or a center-based facility. There are three (3) common types of daycare; first is the center-based care, second is the in-home care, and lastly, the care provided by a relative, a neighbor,

or even a friend. In this study, the researchers focused on the center-based type of daycare. Center-based care can also be labeled as a daycare center.

The advancement of children's growth and development is the primary objective of daycare service and service providers. Service providers are tasked to facilitate children's progress in all aspects of development. Giving importance to child-friendliness of the facility in particular the indoor and outdoor environments of the center and ensuing quality and safety measures are critical in protecting and promoting children's holistic development (DSWD, 2011).

In the Philippines, daycare facilities and their resources are insufficient, even basic resources are lacking, and facilities are low because the facility ratio to the kids does not meet the acceptable minimum limit (Figueroa, 2016). As a result, many issues and problems are emerging in current daycare centers. Major issues that teachers encounter is mostly related to the learning resources such as furniture and fixtures in the daycare centers that cause musculoskeletal disorders (MSD). MSD may include a wide scope of fiery and degenerative conditions influencing the muscles, tendons, ligaments, nerves, bones, and joints. There are numerous studies that tackle the MSD and discomfort of users in school setting, however, there is minimal study that focuses on daycare centers. Every daycare facility in the Philippines are made with different design and specifications according to the owners' judgment and as a result, classrooms are not fitted to kids and teachers who are the primary users of the facility.

1.1 Objectives

Since there is no sufficient evidence that identifies the significant factors in the physical environment design of daycare that contributes to the musculoskeletal discomfort of users, this paper aims to address this. In this study, the researchers first identify the discomfort level of children and teachers in using the daycare facility using the Corlett and Bishop body map questionnaire. Then ergonomic risk factors were identified by measuring the physical work environment such as noise, temperature and illumination level of daycare centers as well as measurements of actual layout, workstation and fixtures used by the occupants. Then statistical analyses like anova, correlation and regression models were used to further analyze the relationship of discomfort level of occupants to the ergonomic risk factors identified in this study.

2. Literature Review

2.1. Daycare Centers

Daycare Centers were established to help the socialization and values formation of a child ranging from 3 to 6 years old, this is also to help parents prepare their children for grade school. Almost every community needs to have a daycare center since this will not only help parents but also helps children to learn and enhance knowledge. Daycare Centers needed to have improved facilities, materials, equipment, and daycare supplies (Ahdan, 2017). This is to help children to have a better quality of education and experience. This is also because children spend a lot of time in daycare centers, facilities should be a top priority for the organizations. It is also said here that Daycare Centers should follow specific guidelines for creating a space that are functional child-oriented spaces that promote child safety and health.

2.2. Ergonomic Approach

Ergonomics is a way of designing new equipment, machines, facilities, and work environments to match human capabilities, satisfactions, and limitations. This increases the efficiency and effectiveness of a person's work quality and promotes the workers' health, safety, comfortability, and satisfaction. The use of ergonomic design is said to be effective and efficient in terms of manufacturing processing time, safety, training time, and worker productivity, satisfaction, and job attitudes (Das, 2003). Ergonomic involves matching the job to the worker rather than fitting the worker to the job. The goal of ergonomics is to identify the hazardous aspects of the job and redesign it to be safer and comfortable for the worker (Owen, 2006). This could be accomplished by redesigning the overall work organization.

2.3. Ergonomics Assessment

A study demonstrated that to establish an environment that ensures the development and advancement of a child's aptitudes, the child's attributes ought to be considered in choosing offices, structure, and setting of kid-related conditions (Farahani, 2017).

General condition dramatically affects our emotions, thinking, practices, and personal satisfaction. The ecological effect can serve our necessities or act against it. Studies show that kids review their environmental factors far superior to individuals and things, subsequently, focusing on configuration subtleties in their mindful space is of unique need.

2.4. Designs of Daycare Centers Internationally

According to National Institute of Building Sciences (NIBS), there are two types of daycare center space in America and these are the "small" center which is licensed only for less than 60 children and the "large" center which is licensed only for more than 94 children. Daycare center space types include additional support and space sub-types, including toilets, food preparation and service, office space and meeting space, as well as security features required in compliance with the codes and regulations. Daycare centers must have staff and parent areas, service areas, common spaces, classrooms, and outside areas. The design objectives of the daycare center must be accessible, functional/operational, productive, secure/safe, and sustainable.

2.5. Designs of Daycare Center in the Philippines

Daycare centers in the Philippines should provide educational toys, storybooks, classroom materials like coloring pens and other school supplies, and audiovisual equipment. For children who are just starting to learn about the basic letters and writing, fun learning materials should be provided, Field day should also be provided. According to the Republic of the Philippines DSWD, there are five areas wherein Daycare centers should focus on and these are the Advancement of Children's Growth and Development, Partnership with Families, Communities and Local Government, Human Resource Development (HRD), Program Management, and Physical Environment and Safety (DSWD Guidelines, 2011). There is still no standard design for daycare centers. According to the Department of Social Welfare and Development, the only existing standard design is for Early Childhood Education—Early Childhood Care and Development (ECE-ECCD) (DSWD, 2004).

2.6. Musculoskeletal Disorders

Musculoskeletal Disorders or MSDs are wounds and scatters that influence the human body's development or musculoskeletal framework. These are wounds or dysfunctions influencing muscles, bones, nerves, ligaments, tendons, joints, ligaments, and spinal circles. A few elements have been related to work-related musculoskeletal disorder, for example, dreary movement, over the top power, unbalanced and additionally continued stances, delayed sitting, and standing. At the point when a laborer is presented to MSD hazard factors, they start to develop weakness. At the point when weariness surpasses their body's recuperation framework, they build up a musculoskeletal unevenness. After some time, as weariness keeps on surpassing recuperation and the musculoskeletal awkwardness perseveres, a musculoskeletal issue creates.

A study discussed various cases of musculoskeletal disorders that occurred on the elementary schools (Gumasing and Espejo, 2020) and childcare workers in a daycare setting (Caroline, Vinod, Balasuburamaniam, 2014). These workers reported that they experienced injuries from their work such as sprains, strains, and trauma. These injuries are the results of the occupational risks in the daycare center. Every day, they are working in an awkward posture of bending, lifting, and carrying in incorrect positions. The majority of the respondents in this study has reported experiencing back and neck pain. A study has created an intervention for musculoskeletal disorders for childcare workers (Owen, 1994).

3. Methods

3.1. Data Gathering

In this study, the researchers used different ergonomic and statistical tools to get an accurate result. The Corlett and Bishop body map questionnaire was used to evaluate the discomfort level of children and teachers in using the daycare facility. The questionnaire was administered to 150 respondents of the study comprising of 100 students and 50 teachers. Then to identify ergonomic risk factors that will be considered in the study, actual measurements of physical work environment, facility layout and workstation design were obtained from 5 selected daycare centers located in Bulacan. The ergonomic risk factors are based from related studies that proved to have significant contributions to MSD of occupants (Gumasing & Espejo, 2020). Ergonomic risk factors identified in the study were categorized into the following: (a) work environment design: noise, illumination and temperature level; (b) workstation design: seat height, seat length, seat width, seat depth, back support length, back support width, back inclination, table height, table width, table depth; (c) layout design: room length, room height, chalkboard width, chalkboard length, chalkboard height.

3.2. Corlett and Bishop Discomfort Questionnaire

To evaluate the body discomfort score of respondents, Corlett and Bishop body map questionnaire was used. This questionnaire is a subjective symptom survey tool that evaluates the respondent's direct personal experience of discomfort in various areas of the body (Corlett & Bishop, 1976). It contains an illustration of 10 body parts such as head, neck, shoulder, upper back, upper arms, mid-back, lower arms, lower back, buttocks, thighs, and legs that respondents rate based on their perception on the level of discomfort that they experience. The questionnaire uses a 5-point numerical rating scale, with 1 being 'not uncomfortable' and 5 'extremely uncomfortable'.

3.3. Statistical Analysis

To further analyze the data gathered in the study, the researchers performed statistical analyses such as ANOVA, correlation and regression model. ANOVA with post-hoc test was used to determine significant difference in the discomfort level between children and teachers as well as significant difference in the ergonomic risk factors among the 5 selected daycare centers. Then, to determine the strength of relationship between the discomfort level of occupants to the ergonomic risk factors, correlation analysis was employed.

4. Results and Discussion

The findings of the study gathered from the survey and the actual data collection that were carried out at selected daycare centers in Bulacan were analyzed and interpreted using statistical analysis and application of ergonomic principles.

4.1. Result of Corlett and Bishop Body Discomfort Questionnaire

Discomfort questionnaire was administered to 150 respondents of the study to gather information on the musculoskeletal discomfort experienced by students and teachers in suing the daycare facility. Body parts considered were head and neck, shoulders, upper back, upper arms, mid back, lower arms, buttocks, thigh and legs. The summary of results comparing the discomfort scores of students and teachers is shown in Table 1.

Table 1. Result of Discomfort Scores of Respondents

Body Part	Students	Teachers
Head and neck	1.9	2
Shoulder	1.9	**3.25**
Upper back	**2.9**	2.7
Upper arms	**3.15**	**3.4**
Mid-back	1,95	**4**
Lower arms	1.9	2.05
Lower back	**3.35**	**4.2**
Buttocks	**3.45**	1.95
Thighs	1.85	**3.55**
Legs	1.75	2.35
Average Score	2.46	2.95

Based on the results, the highest prevalence of body discomfort for students are buttocks, lower back, upper arms and upper back while for the teachers, highest body discomfort are found on lower back, mid back, thighs, upper arms and shoulder.

4.2. Result of Analysis of Variance for Discomfort Scores

To significantly compare the discomfort scores of students and teachers, analysis of variance with Tukey's post hoc test was used using Minitab v17 software. At 95% confidence interval for mean, the result showed that there is significant difference in the discomfort score of students and teachers ($p < 0.001$). The computed mean for students is 24.1 with std. dev of 1.86 while computed mean for teachers is 29.45 with std. dev of 2.188. It can be deduced that discomfort scores of teachers are significantly higher that discomfort scores of students.

The significant difference in the discomfort scores per body part were also performed using analysis of variance to further analyze the data for both students and teachers discomfort scores. Based on the result of students, there is

significant difference in the discomfort scores per body part ($p<0.001$). The scores on buttocks, lower back, upper arms and upper back are significantly higher that scores on mid back, lower arms, shoulder, head and neck, thighs and legs. For the result of teachers, it was also found that there is significant difference in the discomfort scores per body part ($p<0.001$). The scores on lower back, mid back and thighs are significantly higher than scores on upper arms, shoulder, upper back, legs, lower arms, head and neck, and buttocks. The result of interval plot is shown in Figure 1.

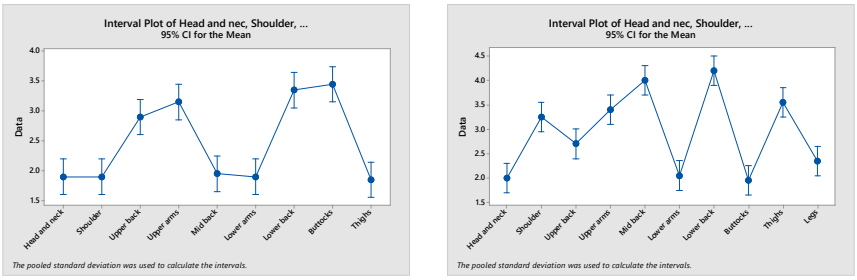

Figure 1. Interval plot of body parts of students and teachers, respectively

To further analyze the specific body parts that have significant discomfort between students and teachers, two-way ANOVA was performed. The result showed that factors that have significant difference in discomfort scores between teachers and students are shoulders, mid back, lower back, buttocks and thigh. For shoulders mid back, lower back and thigh, it was proved that discomfort scores of teachers are significantly higher ($p < 0.001$) that of students, while for buttocks, discomfort scores of students are significantly higher ($p < 0.001$) than teachers.

4.3. Assessment of Facility and Workstation Design of Day Care Centers

An actual measurement of daycare workstation and layout were obtained in the study as part of ergonomic factors contributing to discomfort of occupants. The workstation analyzed in the study included students' and teachers' chairs and tables. As shown in Figure 2, the students' chair used in daycare centers differ in terms of material, color, size and weight.

Figure 2. Types of students' chair used in daycare centers

When it comes to the students' table, each daycare center used different types of tables. They also differ also in the type of materials used, color, size, and weight as shown in Figure 3.

Figure 3. Types of students' tables used in daycare centers

Similarly, based on observation, the teacher's workstations were not also uniform in design. The commonly used material is made of wood but there are also tables that are made of plastic and metal as shown in Figure 4. For the teachers' chair, plastic chairs are commonly used which are not adjustable and not compatible with the desk height.

Figure 4. Types of teachers' table used in daycare centers

A. Measurement of Workstation

Table 2 summarizes the dimensions of the students' and teachers' chairs and tables including seat height, seat width, seat depth, back support height, back support width, back support inclination, writing pad height, writing pad height, writing pad length, writing pad width, writing pad width, writing pad inclination, footrest height., table height, width, and length.

Table 2. Actual Measurements of Students' Chairs and Tables

DIMENSION OF STUDENTS' CHAIRS & TABLES					
SUB-FACTORS	ACTUAL MEASUREMENT (cm)				
Chairs:	Daycare 1	Daycare 2	Daycare 3	Daycare 4	Daycare 5
Seat Height	68.5	55	43.18	62	53
Seat Length	45.7	33.5	28.5	40	38
Seat Width	37	30	25.4	35	30
Seat Depth	36	32	27	35	32
Back Support Length	39	30	24.13	40	26
Back Support Width	37	30	21.6	38	24
Back Inclination (°)	90	90	90	90	90
Table height	46	49.5	56	54	51
Table width	46.5	59	57.2	52	48
Table length	52	119	63.5	56	61

The following workstations for teachers, including chairs and table, were supported by ergonomic design measures such as seat height, seat width, seat depth, backrest height, backrest height inclination, hand rest height, table height, table length, table width, table width, footrest height can be seen on Table 3.

Table 3. Actual Measurements of Teachers' Chairs and Tables

DIMENSION OF TEACHERS' CHAIRS & TABLES					
SUB-FACTORS	ACTUAL MEASUREMENT (cm)				
Chairs:	Daycare 1	Daycare 2	Daycare 3	Daycare 4	Daycare 5
Seat Height	35	37	36	35	36
Seat Length	30	43	27.9	30	33
Seat Width	30	43	27.9	30	33
Seat Depth	38	46	10.16	38	48
Back Support Length	37	46	30.5	37	48
Back Support Width	90	90	90	90	90
Foot Rest Width	35	37	36	35	36
Table height	76	70	77.4	69.5	73.5
Table width	51.5	60.5	62.23	63	57
Table length	106	120	95.2	108	98.6

B. Measurement of Layout

The measurement of facility layout such as room length and width as well as chalkboard dimensions were also gathered to determine if these design factors significantly contributes to the discomfort level of occupants in the daycare centers. The summary of measurement is shown in the Table 4.

Table 4. Actual Measurements of Classroom Layout

Layout Factor					
Sub-Factor	Actual Measurement (cm)				
Room Dimension	Daycare 1	Daycare 2	Daycare 3	Daycare 4	Daycare 5
Room Length	682.5	609	434.34	564.5	474.5
Room Width	260.5	263	546.1	362.5	596. 5
Chalk board width	124	122	96.52	110	99.5
Chalk board length	488	245	182.88	251	190
Chalk board height from the floor	81	56.5	69.85	75	76.5

C. Analysis of Variance for Workstation and Facility Measurements

To compare if there is significant difference in the facility design among the 5 daycare centers, analysis of variance was used. Based on the result of analysis, it was proved that there is no significant difference in the measurements of students' workstation, teachers' workstation and facility layout from among 5 daycare centers having p value of 0.865, 0.950 and 0.951 respectively. Shown in Figure 2 is the interval plot of 5 daycare centers at 95% confidence interval for mean.

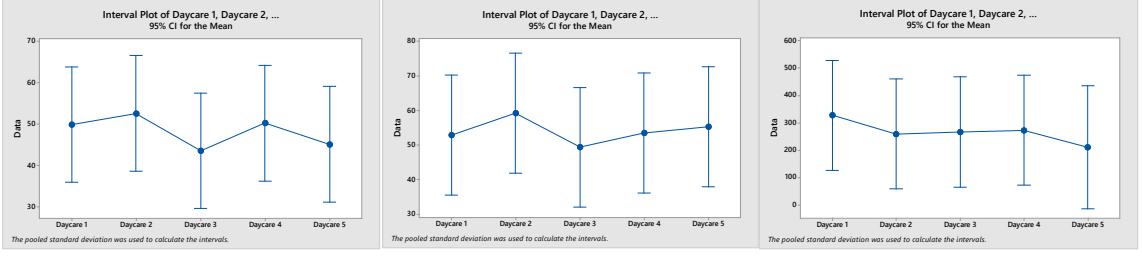

Figure 2. Interval plot of daycare centers for students' workstation, teachers' workstation and facility design respectively

4.3. Assessment of Work Environment Design of Day Care Centers

A. Measurement of Work Environment

Table 5 summarized the average measurements of physical work environment data on noise level, illumination level, and temperature level obtained from the 5 daycare centers. The researchers gathered 5 measurements for each time of the day (morning, noon, afternoon) for each daycare facility having a total of 75 data for each sub factor (noise, temperature, illumination).

Table 5. Average Measurement of Physical Environment of Day Care Centers

PHYSICAL ENVIRONMENTAL FACTORS						
Sub Factors	TIME	Daycare 1	Daycare 2	Daycare 3	Daycare 4	Daycare 5
Average Illumination (fc)	Morning (7:00am-10:00am)	30	28	29	31	33
	Noon (10:00am-12:00pm)	40	36	41	39	40
	Afternoon (12:00pm-3:00pm)	25	21	27	26	25
Average Noise (dbA)	Morning (7:00am-10:00am)	69.5	68	68.5	67.5	69
	Noon (10:00am-12:00pm)	70.5	72	70	69.5	71.5
	Afternoon (12:00pm-3:00pm)	73.5	73	73	73.5	71.5
Average Temperature (C)	Morning (7:00am-10:00am)	30	28	30.3	28	29
	Noon (10:00am-12:00pm)	30	31	30.1	29	30
	Afternoon (12:00pm-3:00pm)	33	32	31	30	33

Based on the data gathered, the average illumination level in the noon shift has the highest range. It was because of the broken and open windows at noon where it allows light to enter the classroom. As seen on the table above, daycare center 2 has the lowest level of illumination during the afternoon shift while daycare 3 has the highest level of illumination at noon. The highest range of average noise level in each daycare centers were determined at the afternoon shift. It ranges from 71 dbA to 73.5 dbA. For the temperature, each daycare center varies from 28 degrees to 33 degrees. Since all the daycare centers are using electric fans, the hottest temperature is in the afternoon which ranges from 30 degrees to 33 degrees.

The measurements of noise, temperature, and illumination per daycare are different. For noise, the five daycare centers have a different number of windows and that is made of different materials. Some daycare centers are located near the highway causing a higher noise level. The same goes for the illumination, different types of light sources are being used and windows that lead to different illumination level. When it comes to temperature, other daycare centers only use old electric fans and others use A/C units.

B. Analysis of Variance for Work Environment

To compare if there is significant difference in the work environment exposure of occupants among the 5 daycare centers, analysis of variance was used. Based on the result of analysis, it was proved that there is no significant difference in the exposure level of occupants with respect to noise, illumination and temperature level among 5 daycare centers having p value of 0.985, 0.949 and 0.620 respectively. Shown in Figure 3 is the interval plot of 5 daycare centers at 95% confidence interval for mean.

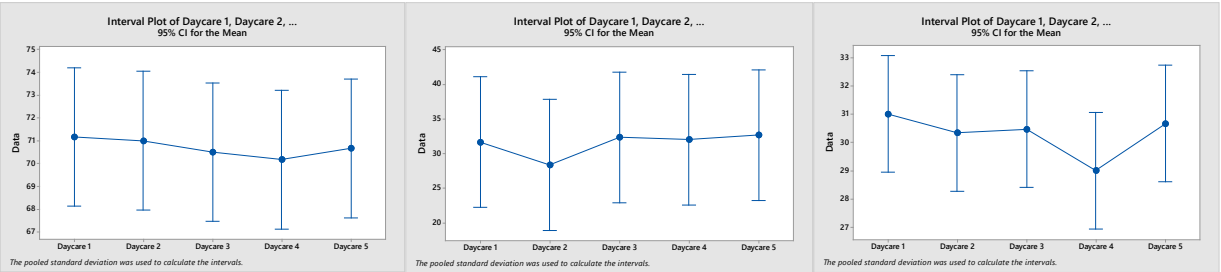

Figure 3. Interval plot of daycare centers for noise, illumination and temperature level respectively

4.4. Result of Correlation Analysis

The correlation analysis was utilized to determine the strength of relationships between the discomfort scores of occupants to the ergonomic risk factors in the daycare facility. The result of the correlation analysis helped the researchers to identify in which specific design factor is needed to improve to lessen the discomfort of occupants in daycare centers. Results of correlation analysis revealed that for students' discomfort scores, ergonomic risk factors that have significant relationship are: temperature (r=0.732, p=0.012), student seat height (r=-0.884, p=0.001), student seat width (r=-0.619, p=0.016) and student table height (r=0.674, p=0.021). On the other hand, for teachers' discomfort scores, ergonomic risk factors that have significant relationship are: illumination (r=0.694, p=0.018), chalkboard height (r=0.737, p=0.011), teacher seat height (r=-0.792, p=0.011), and teacher table height (r=0.774, p=0.009).

The results of correlation analysis support the finding in the musculoskeletal discomfort that was evident in the occupants of daycare centers. The results have proved that temperature level, seat width and table height have strong positive correlation to the discomfort scores of students while seat height has strong negative correlation to discomfort score. This means that as the temperature level increases, discomfort level of students also increases, same with seat width and table height, as the dimensions of seat width and table height increases, the discomfort scores of students also increases, this means that the current design of seats is too wide and table is too high for the students. On the other hand, since table height has strong negative correlation, it means that as the height of the seat decreases, the discomfort scores increases. We can say that the current design of seat is too low for the students that is why they experience discomfort in their buttocks, lower back and upper back.

Moreover, the results of correlation on teachers' discomfort scores revealed that illumination, chalkboard height and table height have strong positive correlation to the discomfort scores, this means that as the level of illumination increases, discomfort score of teachers also increases, at the same time, as the height of chalkboard and table increases, the discomfort scores of teachers also increases. We can infer from this analysis that the illumination level of daycare centers is too high for the teachers, and the chalkboard height and table height are also too high for them that is why they experience discomfort on their upper arms and shoulders. On the other hand, since seat height has strong negative correlation to the discomfort scores of students, this means that as the height of seat decreases, the discomfort score increases. We can infer from this analysis that the current design of seat height for teachers is too low for them that is why they experience discomfort in their lower back, mid back and thighs.

4.5. Result of Regression Analysis

The data were further analyzed and treated using regression analysis. This was used to verify true predictors for discomfort of teachers and students in daycare facility. The result of the regression equation is shown below.

A. Workstation Design Factor:

(1)

$$\textit{Discomfort Score (teachers)} = 66.00 + 0.722\ \textit{teacher seat width} - 0.1376\ \textit{teacher back support length} - 1.000\ \textit{teacher back support width} - 2.000\ \textit{teacher table width}$$

$$\textit{Discomfort Score (students)} = 21.4 + 4.503\ \textit{Student Seat length} + 0.674\ \textit{Student back support length} - 6.76\ \textit{Student table height} - 0.472\ \textit{Student table width}$$

B. Work Environment Factor:

(2)

$$\textit{Discomfort Score (teachers)} = 26.38 - .578\ \textit{Illumination level} + 4.140\ \textit{Noise level} + .1619\ \textit{Temperature level}$$

$$\textit{Discomfort Score (students)} = 35.42 - .5127\ \textit{Illumination level} + 5.551\ \textit{Noise level} + 18.68\ \textit{Temperature level}$$

C. Layout Design Factor:

(3)

$$\textit{Discomfort Score (teachers)} = 55.2 + 2.471\ \textit{Chalkboard width} + 0.1739\ \textit{Chalkboard length} - 0.4320\ \textit{Room length}$$

$$\textit{Discomfort Score (students)} = 19.9 - .1356\ \textit{Chalkboard width} + 0.1924\ \textit{Chalkboard length} - 0.902\ \textit{Chalkboard height}$$

The result showed that for workstation design, factors that have significant effect to the discomfort of teachers are seat width, back support length, back support width and table width. On the other hand, factors that have significant contribution to the discomfort of students are seat length, back support length, table height and table width.

For the work environment, factors that have significant contribution to the discomfort of both teachers and students are illumination, noise and temperature.

For layout design, factors that have significant contribution for teachers are chalkboard width, chalkboard length and room length while for students are chalkboard width, chalkboard length and chalkboard height.

6. Conclusion

The results of the study from 150 respondents have revealed that occupants in daycare centers have experienced musculoskeletal discomfort when using the current workstation and facility of daycare centers. Using the Corlett and Bishop body map questionnaire, the highest prevalence of body discomfort for students are buttocks, lower back, upper arms and upper back while for the teachers, highest body discomfort are found on lower back, mid back, thighs, upper arms and shoulder. Results from analysis of variance have proved that discomfort scores of teachers (mean=29.45, std.dev=2.19) are significantly higher than discomfort scores of students (mean=24.1, std.dev=1.86) having p value < 0.001. Results of two-way anova also showed that there is significant difference in discomfort scores of teachers and students based on body part. For shoulders, mid back, lower back and thigh, it was proved that discomfort scores of teachers are significantly higher ($p < 0.001$) that of students, while for buttocks, discomfort scores of students are significantly higher ($p < 0.001$) than teachers.

The measurements of ergonomic risk factors considered in the study were also gathered from the selected daycare centers located in Bulacan. Measurements of workstation dimension, layout dimensions and work environment were obtained in order to determine their relationship to the discomfort scores of occupants. Using correlation analysis, it was proved that temperature level (r=0.732, p=0.012), seat width (r=-0.619, p=0.016) and table height (r=0.674, p=0.021) have strong positive correlation to the discomfort scores of students while seat height (r=-0.884, p=0.001) has strong negative correlation to discomfort score. On the other hand, results of correlation on teachers' discomfort revealed that illumination (r=0.694, p=0.018), chalkboard height (r=0.737, p=0.011) and table height (r=0.774, p=0.009) have strong positive correlation to the discomfort scores, while seat height (r=-0.792, p=0.011) has strong negative correlation.

We can infer from the analysis that the current design of seat is too low for the students that is why they experience discomfort in their buttocks, lower back and upper back. Similarly, the chalkboard height and table height are too high for teachers that is why they experience discomfort on their upper arms and shoulders while seat height is too low for teachers that is why they experience discomfort in their lower back, mid back and thighs.

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