

Development of Evaluation Checklist for Personal Office Furniture and Apparatus and Fact-Finding Survey

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Objective: The objective of this research is to develop evaluation checklist for personal office furniture and apparatus to shape comfortable and efficient worksite for workers' welfare improvement, productivity enhancement and labor force preservation, and to identify office work environment by applying the checklist.

Background: Because most office workers work using computers in a sitting posture, the ratio of office workers among total musculoskeletal disorders patients is forecast to increase. In this regard, an effort to prevent and manage such musculoskeletal disorders is required.

Method: This research developed evaluation checklist for personal office furniture and apparatus by examining 25 domestic and international ergonomic literature and anthropometric data. This research carried out a fact-finding survey targeting the A Office and B Office of one public agency using the checklist.

Results: Although, the checklist items on desks, chairs, computers and other goods conformed to the checklist standards, the following items did not conformed: desk height adjustment, seat board depth adjustment, lumbar support depth, foot rest, wrist rest, mouse tray, headset, speaker phone and Bluetooth.

Conclusion: The evaluation checklist for personal office furniture and apparatus and fact-finding survey results are considered to be used as basic data for office work environment and workers' welfare improvement.

Application: The information drawn from this research can be helpful to manufacturers' design and manufacture of ergonomic furniture and apparatus.

Keywords: Office ergonomics, Checklist, Table, Chair, Computer, Office furniture and apparatus

1. Introduction

Many musculoskeletal disorders traditionally developed in the manufacturing industry, and the efforts to prevent and manage the musculoskeletal disorders were focused on the manufacturing industry as well. However, new types of work, including the increase of call center consulting and the development of computer games and programs, are generated, not to mention general office work. Due to the Internet environment shaping and personal computers' diffusion, the risk of musculoskeletal

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disorders spreads to students and general users, as well as office workers. Therefore, an approach at the level of preventing the disorders in the office work or service jobs that have not relatively attracted attention is more urgent currently.

Most office workers work in sitting positions using PCs, and therefore, the ratio of office workers to develop musculoskeletal disorders is predicted to increase. The ratio of musculoskeletal disorders in the manufacturing industry gradually declined from 54.6% in 2006 to 48.3% in 2008 and to 44.7% in 2010. The reason is presumed to be that the number of office workers relatively rises, as industrial structure changes from manufacturing industry to service industry, and that work type diversely changes from manufacturing to service industry, owing to flexible work and office work automation (Korea Occupational Safety and Health Agency, 2011).

The office worker group including company employees, professionals and civil servants were 1,652 people or 72.4% of total spinal disease patients, which was about three times more than laborer group. Although, laborers using more body than office workers are thought to have more spinal disease, the reason why the reverse result has come out is that spinal disease is deeply related with office workers' one of job characteristics, namely, not moving for a long time, unlike laborers who always move waist naturally. Many office workers take a posture giving a burden to human body, as they have smaller opportunities to stretch body, while sitting for a long time. In most cases, such a posture becomes a bad habit, and diseases including backache or disk disorder develop a lot, because imbalance between muscles and ligaments occurs, and the state of spinal arrangement changes. Such pain-related diseases fix bad posture furthermore, and deteriorate spondylarthropathy, and thus vicious circle reiterates (KOSHA, 2011).

This study aims to develop and apply evaluation checklist for personal office furniture and apparatus for office workers to evaluate office work environment in order to shape comfortable and efficient workplace, and identify the reality of the office work environment.

2. Development of Checklist

This study examined a total of 25 domestic and international ergonomic literature and anthropometric data including four books related with office work, (Grandjean, 1988; Pheasant and Haslegrave, 2006; Kroemer and Kroemer, 2001; Sanders and McCormick, 1993) and 14 reports (Ministry of Employment and Labor, 2004; CAP, 2013; City of Vincent, 2013; Durant et al., 2009; MEMIC, 1995; O'Neil, 2011; OSHA, 2013a; OSHA, 2013b; Queen's Printer for Ontario, 2004; University of California, 2009; Work Safe BC, 2009; Worker's Compensation Board, 1999; Worker's Compensation Board-Alberta, 2007; Worksafe NB, 2010), seven checklists (Commonwealth of Australia, 1991; ESA, 2013; Krames Health and Safety Education, 2013; Minnesota Department of Administration, 2010; OSHA, 2013c; University of Windsor, 2013; University of Melbourne, 2012), and developed evaluation checklist for personal office furniture and apparatus. This study arranged commonly addressed items and evaluation details from the 25 pieces of literature, and extracted sizes that can consider 5 percentile of adults and 95 percentile of women by using Korean anthropometric data to fit Koreans in terms of size. The checklist divided desk, chair, computer, document holder, telephone and supplies as large scale, and divided the following as medium scale: chair was divided into seat board, backrest, armrest, wheel and footrest; computer into monitor, keyboard, mouse, wrist rest and tray. Each item was also divided into small scale, and thus the checklist was developed with 35 questions in total (Table 4).

3. Fact-Finding Survey

The fact-finding survey through the evaluation checklist for personal office furniture and apparatus was carried out targeting A Office and B Office of one public agency. This study targeted Office manager, Team leaders and Dept. managers for A Office, and targeted Team leaders, Dept. managers and Team members for B Office for evaluation.

Concerning desk, seven types of desks were examined including six types of desks for office work, one type of desk for meeting in the Office manager's room. For chair, this study investigated three types of chairs for office work and one type for meeting. This study examined computers used by Office manager, Team leaders and Dept. managers in A Office, and those used by Office manager, Team leaders and Team members in B Office. Since computers and other items can have different locations and arrangements, according to user preference, this study evaluated all the targets, despite the subjects' using the same apparatus.

3.1 Desk

The heights of desks were 720mm and 740mm, and widths were examined as 1,200mm, 1,600mm and 1800mm. The depths of the desks were 750mm and 900mm. Leg spaces were 850mm, 890mm and 1,090mm. As office space lacks, one or two auxiliary desks (600×1,200mm) were additionally used. Leg spaces showed difference, according to the location direction of auxiliary desk, and whether the drawers were used (Table 1).

Although, the height of desk could not be adjusted in all the targeted desks, they conformed to standard scope. The width, depth and leg space all met the standards. The extra space that can be actually used was remarkably insufficient, because a printer, drawers and other office supplies were located on the desk.

Table 1. Fact-Finding survey result of desks








Dept.	Subject	Item (Unit: mm)					
		Photo	Height	Width	Depth	Leg space	Others
A Office	Office manager		740	1,800	900	850	One auxiliary desk used
	Team leader		720	1,600	750	1,090	Two auxiliary desks used
	Dept. manager		720	1,600	750	1,090	One auxiliary desk used
	For meeting in the Office manager's room		720	2,385	1,200	-	-
B Office	Team leader		720	1,800	900	880	One auxiliary desk used

Table 1. Fact-Finding survey result of desks (Continued)

Dept.	Subject	Item (Unit: mm)					
		Photo	Height	Width	Depth	Leg space	Others
B Office	Dept. manager		720	1,600	750	1,090	One auxiliary desk used
	Team member		720	1,200	750	1,090	One auxiliary desk used

3.2 Chair

In Office A, two types of personal chairs were used. Concerning the two types of desks, seat board's height could be adjusted, and the heights of adjustable seat board was 450~530mm (Office manager) and 415~535mm (Team leader and Dept. manager), respectively. The seat board's depth of the chair used by Office manager was not adjustable, and it was adjustable within the scope of 460~510mm. The seat board's widths of the two types of chairs were 480mm (Office manager) and 490mm (Team leader and Dept. manager). The heights of backrest were 560mm (Office manager) and 470mm (Team manager and Dept. manager). The backrest used by Office manager was all-in-one unit, and the width was 510mm. The backrest of chairs used by Team leader and Dept. manager was divided into two parts, and the width was adjustable with 390~460mm. The angle of backrest was adjustable within the scope of 90~115° in the case of chairs used by Office manager. The chairs used by Team leader and Dept. manager were not adjustable. The heights of lumbar support were 140mm (Office manager) and 155mm (Team leader and Dept. manager), respectively. The width of arm rest was not adjustable for both types of chairs, and was 510mm (Office manager) and 465mm (Team leader and Dept. manager). The height of two types of chairs' arm rest was adjustable, and the adjustment scope was 180~240mm (Office manager) and 190~250mm (Team leader and Dept. manager). The chairs used for meeting in the Office manager's room were all non-adjustable (Table 2).

Table 2. Fact-Finding survey result of chairs





Dept.	Subject	Item (Unit: mm)									
		Photo	Seat board			Backrest			Lumbar support	Arm rest	
			Height	Depth	Width	Height	Width	Angle	Height	Width	Height
A Office	Office manager		450~530	470	480	560	510	90~115	140	510	180~240

Table 2. Fact-Finding survey result of chairs (Continued)

Dept.	Subject	Item (Unit: mm)									
		Photo	Seat board			Backrest			Lumbar support	Arm rest	
			Height	Depth	Width	Height	Width	Angle	Height	Width	Height
A Office	Team leader, Dept. manager		415~535	460~510	490	470	390~460	-	155	465	190~250
	For meeting in Office manager's room		400	480	460	470	480	-	120	470	215
B Office	Whole		380~480	410	490	560	490	-	100~150	480 500 530	200~270

In B Office, one type of personal chair was used. The height of seat board was adjustable in the scope of 380~480mm, and the depth of seat board was 410mm, and was not adjustable. The width of seat board was 490mm. The height and width of backrest were 560mm and 490mm, and the angle was not adjustable. The height of lumbar support was adjustable within 100~150mm. The width of arm rest was adjustable within the scope of 480mm, 500mm and 530mm. The height of arm rest was adjustable within 200~270mm.

The four types of seat boards provided cushion that can disperse pressure to the material with appropriate friction. The adjustment of seat board's height was possible only for three types of chairs, and the depth of seat board was adjustable for only one type of chair. The width of seat board was included in the standard scope. The slope of seat board was adjustable only in three types of chairs, and the front edge of seat board was a round (waterfall) shape in all four types of chairs. The height of backrest was located under the user's shoulder height, and the width of backrest was all included in the standard scope. The backrest angle was adjustable only in one type of chair, and the height of lumbar support was all lower than standard scope. The cushion pressed-depth was not applied. Arm rest was attached to all four types of chairs, and only one type's arm rest was adjustable. The height of arm rest belonged to standard scope in all four types of chairs. There were no wheels for meeting, and five wheels were attached to three types of personal chairs. A Office and B Office did not use foot rest.











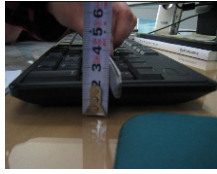





3.3 Computer

The front and rear locations of monitor were located at 700mm and 800mm, and the locations of keyboard were 170mm,

230mm and 400mm, according to survey subjects' preference. The thickness of the keyboard used was 20mm, and the two types of slopes of keyboard adjustable with the scope of 2~10° and 5~15° were used (Table 3).

Although, the items related with monitor location were all included in the standard scope, the monitors for Office managers and Team leaders were arranged in the same direction as the window or sunshine. All items related with keyboard and mouse were included in the standard scope, but not all wrist rests used together with mouse were provided. Keyboard was used on the desk without the use of tray.

Table 3. Fact-Finding survey result of computers

Dept.	Subject	Item (Unit: mm)			
		Monitor		Keyboard	
		Location	Location	Thickness	Slope
A Office	Office manager				
		700	230	20	2~10
A Office	Team leader, Dept. manager				
		700	170	20	5~15
B Office	Office manager				
		800	400	20	2~10
B Office	Team leader, Team member				
		700	400	20	2~10

3.4 Others

Although, A Office did not use document holders, B Office used document holders. Headsets, speaker phones and Bluetooth that can be used for phone call were not all provided. And half the survey subjects were located at the spaces, where users could not easily reach them.

4. Discussion

Table 4 shows the evaluation checklist for personal office furniture and apparatus and fact-finding survey results. It was judged that the heights of desks were.

Inappropriate, and it was identified that auxiliary desks were used to supplement insufficient personal space, deriving from using a printer and other office supplies on the desk. It was revealed that the adjustment of seat board's depth and backrest angle, and the height of lumbar support, arm rest angle and foot rest did not meet standards. It was grasped that supplementation was required for adjustment of seat board's height and slope, and for the rotation and number of wheels. Computer items conformed to the standards, but the location of monitors was inappropriate, and the offering of wrist rest and tray was needed. In addition, office supplies for office workers' convenience including document holders, headsets, speaker phones and Bluetooth were required to be provided.

Table 4. Evaluation checklist for personal office furniture and apparatus and fact-finding survey result

Large scale	Medium scale	Small scale	Item	Evaluation	
				Yes	No
Desk	Whole	Height	1) Is the height of desk adjustable (526~824mm)?	0	6
		Width	2) Does the width of desk offer enough space (635mm and more)?	6	0
		Depth	3) Does the depth of desk offer enough space (750mm and more)?	6	0
		Leg space	4) Is there enough leg space (480mm and more) under the desk offered?	6	0
Chair	Seat board	Quality of material	5) Is it a material having good air permeability and appropriate friction, and does the material offer cushion dispersing pressure?	5	0
		Height	6) Is the height of seat board adjustable (350~466mm)?	3	2
		Depth	7) Is the depth of seat board adjustable (380~515mm)?	1	4
		Width	8) Is the space of the width of seat board (450mm and more) enough?	5	0
		Slope	9) Is the slope of seat board adjustable?	3	2
		Shape	10) Does the front edge have a round (waterfall) shape?	5	0
	Backrest	Height	11) Is the height of backrest located under the user's shoulder height (516~645mm)?	5	0
		Width	12) Does the width (324~428mm) of backseat support user's back?	5	0
		Angle	13) Is the angle of backrest adjustable (90~120°)?	1	4
		Lumbar support	14) Is there lumbar support at appropriate height (200~250mm)?	0	5

Table 4. Evaluation checklist for personal office furniture and apparatus and fact-finding survey result (Continued)

Large scale	Medium scale	Small scale	Item	Evaluation	
				Yes	Yes
Chair	Arm rest	Yes/No	15) Is there arm rest?	5	0
		Location	16) Can the arm rest be adjusted to close to body (365~565mm)?	1	4
			17) Is the height of arm rest parallel to or slightly under the arm (210~305mm)?	5	0
	Wheel	Rotation, movement	18) Are rotation (360°) and movement possible?	3	2
		Number	19) Does it have five wheels?	3	2
	Footrest	–	20) Does it offer footrest, if your feet do not touch the floor?	0	5
Computer	Monitor	Location	21) Is the monitor located at the center of a user, and is it adjustable to the left and right (within 20° to the left or right)?	6	0
			22) Is the forward and rear locations of monitor adjustable (400mm and more from eye)?	6	0
			23) Is the up and down locations of monitor adjustable (within 60° based on horizontal level)?	6	0
		Arrangement	24) Is the monitor located in the opposite direction of window or sunshine?	1	5
	Keyboard	Quality of material	25) Is keyboard surface is dull luster surface and does it have heat conductivity?	6	0
		Location	26) Is the keyboard location appropriate (150mm and more from the end of work table)?	6	0
		Thickness	27) Is the keyboard thickness (30mm and less) thin?	6	0
		Slope	28) Is keyboard slope adjustable (5~15°)?	6	0
	Mouse	Location	29) Is mouse beside the keyboard, and are the heights of the two same?	6	0
			30) Is your wrist in a neutral posture, when you use mouse?	6	0
	Wrist rest	–	31) Is there a wrist rest?	2	4
Tray	–	32) Is there a tray to put and take out?	0	6	
Document holder	–	Location	33) Is it adjustable to put at the height of eye or monitor?	3	3
Telephone	–	–	34) Does it supply headset, speaker phone and Bluetooth that can be used in the case of phone call?	0	6
Supplies	–	Location	35) Are the supplies used often within the space easily reachable?	3	3

This study developed the evaluation checklist by reflecting domestic and international ergonomic standards and Koreans' anthropometric data related with personal office furniture and apparatus. Based on the checklist, the reality of office work environment was surveyed by visiting a public agency. The checklist developed in this study and the fact-finding survey results are conjectured to be used as basis for office work environment and workers' welfare improvement.

The limitation of this study is that experts' opinion gathering or verifying stage is needed, although this study sought differentiation of the Koreans' anthropometric data to be used in Korea. For fact-finding survey, the suitability review is required by conducting a fact-finding survey on various types of office work environments, in addition to the public agency in this study.

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