

Investigating the Relation between Ergonomics and Efficiency of Hotel Kitchen Staff

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Abstract

The most valuable asset of an organization is related to its human resources. Managerial sciences have established new approaches and tools for work, to best use human actions to increase efficiency. This study concentrates on ergonomics as one of these approaches. Therefore, it investigates the awareness of kitchen staff about ergonomics. It also explores the relation between the ergonomics and the efficiency of the hotel kitchen staff. Questionnaire was developed to achieve these objectives. Correlations and regression analysis were used to analyze the returned 36 questionnaire forms collected from five-star Hotels in Cairo. The results indicated that hotel kitchen staff highly perceives the ergonomics practices. As expected, significant relationship was found between ergonomics dimensions and the work efficiency of the hotel kitchen staff. Especially, general physical activity, workplace design, and work environment (0.727^{**}, 0.672^{**}, 0.533^{**}), respectively.

Keywords: Ergonomics, Kitchen Staff, Hotels, Efficiency.

Introduction

Ergonomics from the Greek word *ergon* meaning work and *nomoi* meaning natural laws, is the science of making the design of products, equipment and spaces easy to use for human beings (Joshi, 2016). “Ergonomics (or human factors) is the scientific discipline concerned with the understanding of the interactions among humans and other elements of a system (*interrelated activities with joint purpose i.e. software, hardware, buildings, spaces, people and community*), and the profession that applies theoretical principles, data and methods to design.” (Dul *et al.*, 2012; Hollnagel, 2014).

Ergonomics as we know them now became a recognized scientific discipline in the late 1940s under the name of human factors engineering. There were of course intellectual pioneers, such as polish researcher, Jastrzebowski’s proposal for a ‘science of work’ (1857), but in more practical terms which means doing something rather than just disagreeing about it. Scientific Management theory (Taylor, 1911) from the early 20th century is as good a place to begin. The purpose of Scientific Management was very practical, namely to analyze and synthesize work flows in order to improve labour productivity. Scientific Management introduced a number of principles and techniques that are still being widely used, although their origin may have been forgotten. Examples are bottom-up task analysis, time and motion studies, and task decomposition (Hollnagel, 2014).

Although Human Factors Engineering (HFE) defines itself as being about the design of work, it can also be understood as being about ‘the human use of human beings’ as how we ‘use’ ourselves as part of society. One result of this is that HFE strictly speaking changes from being the science of work, or even the science of workplace design, to become the science of managing work of communication and control in work situations (Wiener, 1954). It analyzes the potential of machines to make larger human capabilities, and thereby release them from the monotony of manual labour (Hollnagel, 2014).

In general, ergonomics provides a means for modifying the work environment and work practices to prevent injuries before they occur. Effective ergonomic design provides work procedures, tools and equipment which are comfortable, efficient for the employee to use and creates a work environment that is healthy. Inappropriate and poor working postures, lack of task variation, poor ergonomic design of workplace and work organization (e.g long working hours, low salaries and awkward schedules, poor training and lack of promotion) are all areas where simple interventions can remarkably reduce the rate of exposure to occupational disease (Joshi, 2016).

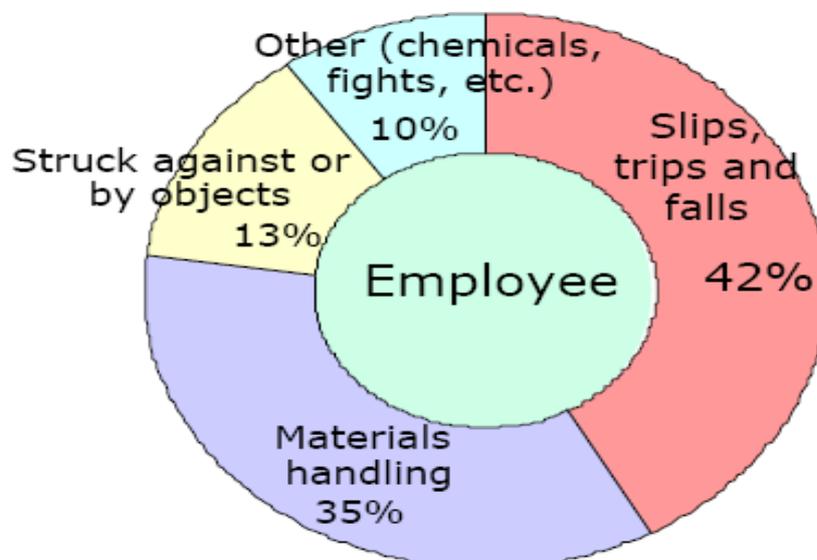
The goal of HFE is described as trying “to ensure that any designed artefact, ranging from a consumer product to an organizational environment, is shaped around the abilities and aspirations of humans” (Dul et al., 2012). The problem is no longer human interaction with machines, but rather human management of machines that strongly interact with each other (Hollnagel, 2014).

Dul et al. (2012) emphasized that HFE is “design driven” and can be involved in all stages of planning, design, implementation, evaluation, maintenance, redesign and continuous improvement of systems. These stages are not necessarily sequential; they are interdependent and dynamic. Decisions at one stage may affect or be affected by decisions at other stages.” In the established HFE perspective, the performance is related to the output or product of work, referring to such issues as quality, efficiency, or occupational safety and cost. Hotel operations work to produce something, tangible outputs in some cases and intangible outputs in other cases (Hollnagel, 2014).

Hospitality Career deals with loud noise, busy environments, heavy, awkward, sharp, and hot objects, repetitive motions, and stress, all of which can lead to fatigue, sudden accidents, and long-term musculoskeletal injury (Gentzler and Smither, 2012). Sudden accidents of slip and fall are a serious safety problem in kitchen environment (Leamon, 1992). The annual direct cost of occupational injuries due to slips, trips and falls in the USA is estimated to exceed six billion US dollars (Courtney et al., 2001). Falls on the same level accounted for nearly 53% of claim costs and 65% of claim cases in total direct workers’ compensation for occupational injuries due to slips and falls (Leamon and Murphy, 1995). Slips are likely to account to many other occupational injuries in addition to falls.

For example, Hayes-Lundy et al. (1991) reported that 11% of grease burns in fast-food restaurants were attributed to slips. Roughly 40–50% of falls on the same level in the USA and European countries are caused by slips (Courtney et al., 2001). Slippery floors, typically related to contaminants such as water and grease, are common in restaurant kitchens (Chang et al., 2003) and are a critical factor for falls on the same level (Chang et al., 2001; Leclercq et al., 2007). Within the hotel industry in the USA, slips and falls resulted in the most costly claims (Leamon and Murphy 1995; Chang et al., 2008). Common drivers of slippery floors include dishwashing overspray or run-off, leaking equipment or pipes, food debris, and spillage from transport of open containers such as those holding fryer grease and food wastes (Filiaggi and Courtney, 2003; Chang et al., 2011).

According to Kohr (1991) slips and falls was the most frequent accident type for employees working in hotels and restaurants as shown in Fig. 1. Regarding employee accidents in the present study, it was found that approximately; burns was 30%, cuts was 35%, and finally slips and falls was 1%.



Source: Kohr (1991).

Figure 1: Accident types of Hotels and Restaurants

Due to the likelihood of contamination by water and/or grease, the sink and fryer were considered critical working areas in the kitchen (Chang et al., 2003). According to Chang et al. (2008) all the kitchens visited in their study were owned by a corporation, the slip-resistant floor mats were not available in their sink areas, mats were not to cover the whole area in front of the sinks. When the area is wet, the slip-resistant mat could provide a good slip-resistant ground, while the friction on the tiles right outside of the mat could be reduced due to the water contamination. The mat could potentially create high friction reductions when walking from the mat onto the tile areas, even though the original intention of putting the slip-resistant mat in the sink, and fryer areas were to increase friction and improve safety.

Ergonomics decisions are considered not only to the food workers' environment itself but to the equipment used in that environment. "The more sophisticated equipment manufacturers are taking ergonomics into account. They are looking at anthropometry [the science of body measurements] to determine things like how much reach should a person be expected to achieve, how high to set the controls and how much effort a person should be expected to exert." (Blair, 2003).

Today's changing foodservice environment challenges both equipment manufacturers and facilities planners to place renewed attention on human factors engineering and workplace ergonomics. When work areas or equipment are higher than 36 inches, the placement of rubber floor mats can raise the employee 1 or 2 inches higher, making the work posture more comfortable. A major aspect of planning good work station, ergonomics is providing reasonable reach for items stored on shelves (Frable, 1996).

Hospitality industry has been growing as fast as general tourism industry, there is an improvement in the hotel management and work efficiency to help increase more profit for the hotels (Wattanasan, 2015). So, well designed workstations and work schedules can diminish the risks so that get work done more efficiently or effectively. Finally, the present study tries to investigate ergonomics dimensions (skill requirement, general physical activity, manual materials handling, workplace design, work posture, work environment, work time schedule, and machinery according to Laurig and Vedder (2012).

Research methodology

The study aims to answer the following questions: To what extent do hotel kitchen staff has awareness about ergonomics? Do ergonomics practices affect the work efficiency of hotel kitchen staff at five-star hotels in Cairo? In order to answer the research questions, the quantitative method was used through a questionnaire form distributed to five-star hotels in Cairo.

Instrument

The questionnaire consisted of two parts about ergonomics practices and the efficiency of hotel kitchen staff. It was adapted from (Laurig and Vedder, 2012). The questions in the two parts were measured via a 5-point Likert scale (1= completely disagree and 5= completely agree). A total of 45 questionnaires were randomly distributed to hotel kitchen staff in 15 five-star hotel in Cairo. Only 36 complete questionnaires were received, representing a response rate of 80 percent. This study utilizes the coefficient of Cronbach's alpha to compute the reliability (0.72) that agreed with (Nunnally and Bernstein, 1994). Finally, data analysis was conducted using Statistical Package for the Social Sciences (SPSS V.20).

Results and Discussion

Scale Reliability

After data tabulation had been completed and average ergonomics and work efficiency scores have been calculated, coefficient alpha was computed. Overall, each of the scales demonstrated an acceptable reliability($\alpha=0.86$). However, even this is above the minimum reliability level endorsed by Nunnally and Bernestein (1994).

Ergonomics Descriptive Statistics and Correlation Analysis

The descriptive statistics revealed that the hotel kitchen staff have known before about ergonomics in their environment, the overall average of their perception was 87.6% as shown in table 1. The study describes the main dimensions in detail as follows:

Table 1: Ergonomics Descriptive Statistics

Item	N	Mean	Std. Deviation
Skill Requirement	36	4.22	.422
General Physical Activity	36	4.50	.507
Manual Materials Handling (MMH)	36	4.33	.478
Workplace Design	36	4.39	.494
Work Posture	36	4.61	.494
Work Environment	36	4.33	.478
Work Time Schedule	36	4.36	.487
Machinery	36	4.31	.525
Work Safety	36	4.22	.422
Valid N (listwise)	36		
Average Mean		4.38	
		(87.6%)	

Work Posture, and general physical activity and workplace design represent the highest hotel kitchen staff perception of ergonomics, while MMH, skill requirement, work environment, work time schedule, machinery and work safety achieved the least score of ergonomics perception as shown in *table 1*.

Regarding the correlation between the dimensions of ergonomics and work efficiency. *Table 2* illustrates the correlation matrix. As expected, a positive correlation between Ergonomics and its dimensions exist; it ranges from (0.78**) to (0.33*). Similarly, correlations between each of the ergonomics dimensions and work efficiency were significant, ranging from (0.72**) to (0.33*). The results showed that general physical activity and workplace design have the highest positive correlation with work efficiency ($r=0.72$, $p<0.01$ and $r=0.67$, $p<0.01$), respectively.

Table 2: Correlation Analysis of Ergonomics Dimensions and Work Efficiency

	Skill Requirement	General Physical Activity	Manual Materials Handling	Workplace Design	Work Posture	Work Environment	Work Time Schedule	Machinery	Work Safety	Work Efficiency
Skill Requirement	1.000									
	.36									
General Physical Activity	.278	1.000								
	.100	.36								
Manual Materials Handling	.025	.283	1.000							
	.886	.094	.36							
Workplace Design	.184	.798(**)	.240	1.000						
	.283	.000	.159	.36						
Work Posture	.273	.798(**)	.113	.636(**)	1.000					
	.108	.000	.514	.000	.36					
Work Environment	.197	.589(**)	.285	.645(**)	.443(**)	1.000				
	.250	.000	.092	.000	.007	.36				
Work Time Schedule	.108	.403(*)	-.083	.179	.648(**)	.124	1.000			
	.529	.015	.631	.296	.000	.470	.36			
Machinery	.157	.458(**)	.073	.408(*)	.692(**)	.198	.729(**)	1.000		
	.361	.005	.673	.014	.000	.247	.000	.36		
Work Safety	.104	.535(**)	.409(*)	.396(*)	.426(**)	.331(*)	-.080	.210	1.000	
	.546	.001	.013	.017	.010	.049	.644	.219	.36	
Work Efficiency	.414(*)	.727(**)	.333(*)	.672(**)	.441(**)	.533(**)	.413(*)	.395(*)	.414(*)	1.000
	.012	.000	.047	.000	.007	.001	.012	.017	.012	.36
	.36	.36	.36	.36	.36	.36	.36	.36	.36	.36

(*) Correlation is significant at the 0.05 level (2-tailed).

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

In line with expectations, significantly and positively correlation with work efficiency was found; work environment ($r=0.53$, $p<0.01$) work posture ($r=0.44$, $p<0.01$), skill requirement ($r=0.41$, $p<0.05$), work safety ($r=0.41$, $p<0.05$) work time schedule ($r=0.41$, $p<0.05$), machinery ($r=0.39$, $p<0.05$) and MMH ($r=0.33$, $p<0.05$).

Regression Analysis

Table 3: Regression Matrix to identify the Coefficients

Ergonomics Dimensions	Coefficients
General Physical Activity	0.522
Workplace Design	0.503
Work Environment	0.413
Work Safety	0.354
Skill Requirement	0.354
Work Posture	0.327
Work Time Schedule	0.325
Machinery	0.280
Manual Materials Handling	0.238

Regression analysis was conducted to explore the predictive power of ergonomics dimensions for work efficiency of hotel kitchen staff. Table 3 identifies the Coefficients, where general physical activity, workplace design and work environment were the most effective dimensions on the efficiency of workers (0.522, 0.503 and 0.413), respectively. It was noticed also that the other dimensions significantly affected the work efficiency in little scores ranging from 0.238 to 0.354).

Conclusion and Recommendations

It was concluded that general physical activity, workplace design and work environment are the most correlating and influencing dimensions on work efficiency of hotel kitchen staff. So, involving people in planning and controlling a significant amount of their work with sufficient knowledge and power to achieve desirable goals, is a must for such a strenuous industry. Applying ergonomics practices can help transform the culture of an organization into one that values collaboration and harmony in the workplace.

Food production operations are generally standing workplaces. So, workers in this type of area should be able to stand up straight while working, their arms close to the body, hands just below the elbow, rotate tasks especially that require the same motion, working with shoulders in relaxed position, as much as possible push carts instead of pulling them. It would be beneficial to have the load at a higher level, and workplace must have anti-fatigue mats to relieve pressure on feet, legs and backs. Also, arrangement of workplace so, it is easier to reach for supplies used routinely and prevent awkward back, shoulder and rest posture, and limit walking distance between fryers and sinks and pick up area in the central kitchen.

Finally, scientific research has pointed that workers' movements (frequency, intensity, duration, posture, vibration, temperature, etc. are a major concern for kitchens nowadays, so sprains, strains injuries could be limited by applying good ergonomic techniques.

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**Appendix
“Questionnaire”**

Please identify to what extent you agree or disagree with the following statements on a scale of 1 to 5 as follows:

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

Item					
Skill Requirement					
Job requires knowledge and skillful ability.	1	2	3	4	5
Job demands training for skill acquisition.	1	2	3	4	5
Worker makes frequent mistakes at work.	1	2	3	4	5
General Physical Activity					
Job implies frequently repeated movements.	1	2	3	4	5
Job demands high muscular strength exertion.	1	2	3	4	5
Job (operation of handle, steering wheel, pedal brake) is predominantly static work.	1	2	3	4	5
Job requires fixed working position (sitting or standing).	1	2	3	4	5
Manual Materials Handling (MMH)					
Mode of work (pull).	1	2	3	4	5
Mode of work (push).	1	2	3	4	5
Mode of work (turn).	1	2	3	4	5
Mode of work (lift).	1	2	3	4	5
Mode of work (lower).	1	2	3	4	5
Mode of work (carry).	1	2	3	4	5
Subject load height (Ground).	1	2	3	4	5
Subject load height(knee).	1	2	3	4	5
Subject load height(waist).	1	2	3	4	5
Subject load height(chest).	1	2	3	4	5
Subject load height (shoulder level).	1	2	3	4	5
Workplace Design					
Work distance is away from normal reach in the horizontal or vertical plane.					
Height of work desk/equipment is fixed or minimally adjustable.	1	2	3	4	5
No space for subsidiary operations (e.g., inspection and maintenance).	1	2	3	4	5
Workstations have obstacles, protruding parts or sharp edges.	1	2	3	4	5
Work surface floors are slippery, uneven, cluttered or unstable.	1	2	3	4	5
Sufficient auxiliary support is available for safety at the workplace.	1	2	3	4	5
Doorways, entrance/exit routes, or corridors are restricted.	1	2	3	4	5
Limited use of gloves/footwear to work and operate equipment controls.	1	2	3	4	5

Work Posture					
Working with arms above shoulder and/or away from the body.	1	2	3	4	5
Hyperextension of wrist and demand of high strength.	1	2	3	4	5
Back bent and twisted.	1	2	3	4	5
Work Environment					
Noise level is below the maximum sound level recommended.	1	2	3	4	5
Climate is comfortable.	1	2	3	4	5
Temperature sensation is suitable.	1	2	3	4	5
Workers do not wear heat protective/assistive clothing.	1	2	3	4	5
Workplace/machine(s) are sufficiently illuminated at all times.	1	2	3	4	5
Visual displays (warning signals) are easy to read.	1	2	3	4	5
Displayed information is not easily understood.	1	2	3	4	5
Environment is free from excessive dust fumes and toxic substances.	1	2	3	4	5
Workers are effectively protected against radiation exposure.	1	2	3	4	5
Machine can be operated without vibration transmission to the operator's body.	1	2	3	4	5
Work Time Schedule					
Job requires night work.	1	2	3	4	5
Job involves overtime/extra work time.	1	2	3	4	5
Heavy tasks are unevenly distributed throughout the shift.	1	2	3	4	5
Machinery					
Tools and methods of work are specialized to the purpose of the job.	1	2	3	4	5
Steering wheels/handles are operated, from standing position.	1	2	3	4	5
Operating mechanisms hamper body movements in the workspace.	1	2	3	4	5
Risk of injury due to lack of machine guarding.	1	2	3	4	5
Work Safety					
Machine accessories cannot be fastened and removed easily.	1	2	3	4	5
Dangerous points, moving parts and electrical installations are not adequately guarded.	1	2	3	4	5
Work Efficiency					
Ergonomics are used for improving the efficiency of your work in the kitchen.	1	2	3	4	5

دراسة العلاقة بين الإرجونوميكس وكفاءة طاقم المطبخ الفندقى

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الملخص العربى

الإرجونوميكس Ergonomics لفظ مشتق من كلمتى Ergon, Nomoi اليونانيتين بمعنى القوانين الطبيعية للعمل، ويعتبر الإرجونوميكس علم ومنظومة امتدت أخيراً إلى جميع الإعتبارات المتعلقة بالحياة البشرية، وهو علم يتعلق بالملائمة الفيزيائية والنفسية بين الآلات والبشر، ويمكن أن يطلق عليه علم العمل الذى يهدف إلى تكييف عناصر وأنظمة العمل ليناسب العامل. ويهتم الإرجونوميكس بمعالجة المشكلات المتعلقة بالأعمال التى يصاحبها حركات متكررة لمدة طويلة والتى قد ينجم عنها إصابات مؤلمة لرسغ اليد أو فى الظهر من خلال التصميم السليم لمكان العمل ووضع الأدوات دون الاضطرار للإلتفاف بالجسم أو الإنحناء أو الامتداد بالجسم والذراع لتناول شىء أو تشغيل مفتاح بعيداً عن متناول اليد. وقد استخدم عام ١٩٤٠م مصطلح علم هندسة الموارد البشرية فى التطبيقات العسكرية، وقد ظهرت تطبيقاته أيضاً فى علم النفس والفسىولوجى والبيولوجى والإلكترونيات. وقد نجد فى مجال الضيافة الكثير من الضوضاء وبيئة العمل المزدحمة وكذلك الأحمال الثقيلة والأدوات الحادة وإمكانية التعرض للصعق الكهربى والأدوات الساخنة والحركات المتكررة والكثير من الضغط العصبى والجسمانى الذى قد يؤدى إلى الحوادث والإصابات العضلية الهيكلية للعاملين، هذا وعلى سبيل المثال فإن تعويضات حوادث الإنزلاق والسقوط فى المطابخ قدرت فى الولايات المتحدة بما يزيد عن ٦ بليون دولار عام ٢٠٠١م كذلك قدرت الدعاوى القضائية بما يقارب ٥٣% من دعاوى الإصابات المهنية. وقد أكدت النتائج أن أكثر أبعاد الإرجونوميكس ارتباطاً وتأثيراً على كفاءة العمل داخل المطبخ الفندقى هى (النشاط البدنى، تصميم مكان العمل، بيئة العمل)، على الترتيب. وبذلك فإن إشراك العامل فى إدارة وتخطيط العمل مع امتلاكه للمعرفة من أجل تحقيق الأهداف المرغوبة أصبح ضرورة ملحة فى مثل هذه الصناعة (صناعة الفنادق).

الكلمات الدالة: الإرجونوميكس، بيئة العمل، طاقم المطبخ، الفنادق.