ASSESSMENT OF ERGONOMIC PRACTICES IN GARMENT PRODUCTION WORKSHOPS IN MADINA, ACCRA AND THEIR IMPACT ON OUTPUT.

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DECLARATION

I, Efua Vandyck, hereby declare that, except for references made to other people's work which have been duly cited, this work is the result of my own original research and that this dissertation had neither in whole nor in part been presented for another degree elsewhere.

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ABSTRACT

The purpose of the study was to assess the ergonomic practices of garment producers in Madina, Accra. A simple random sampling technique was used to select 100 registered members of the Madina Branch of the Tailors and Dressmakers Association. The results were hand-coded and presented using frequency and percentage distributions, pie and bar charts. The chi-square statistic was used to test the hypothesis. The respondents were aged between 19 and 44 years. Eighty-one percent were females and 19% were males. Sixty-six percent had completed first cycle education, 32% second cycle and only one had had tertiary education. Seat heights (63%), seat width (49%) and seat depth (43%) did not meet recommended ergonomic standards of seat attributes for a sewing workshop. Eighty-three used seats with no backrest, 87% had unpadded seats while none had adjustable seat. Even though noise level, vision, lighting system and colour of walls were described as comfortable, the researcher observed the noise level to be more than the level reported. Those who described thermal comfort and ventilation as uncomfortable were 72% and 54% respectively. The respondents appeared to have limited knowledge of ergonomic features and practices, since the structural changes desired by 90% did not reflect ergonomic changes in their workshops. Hazards observed resulted from neck twisting and bending (92%), prolonged sitting without adequate back support (83%), bending of torso (62%), repeated motion (95%) and static motions (57%). The majority of the respondents (80%) never experienced pains in the hip, ankle/feet, thighs and wrist. However, 60-74% experienced pain in the lower back, neck, upper back and shoulders occasionally, frequently and daily while 15%-25% described their discomfort as slightly painful, and 37%-60% described it as severely painful. The chi-square statistic indicated

no relationship between the time spent seated at work and musculoskeletal disorders (MSDs) in neck, shoulder, lower back and upper back. Production rate of the respondents would increase by two and in some cases three times for different types of garments should ergonomic conditions improve in the workshops. It is suggested that the National Tailors and Dressmakers Association should organize seminars or workshops for its members to discuss the problem of ergonomics. As an organization, it should serve as a focal point for efforts to initiate ergonomic changes and training within the industry. If practitioners are to emphasize ergonomic principles, there will be the need to inject heavy capital into the industry in order to procure the machinery and other facilities of set standards. The government should set up a body that will enforce compliance with government regulations and international standards on the garment industry to make the President's initiative for garment production and export a reality.

CHAPTER ONE

INTRODUCTION

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1.0

The existence of an enabling environment for any type of work promotes efficiency of production. Webster (1981) defines ergonomics as the study of the relationship between people and their work environment. The U.S. Department of Labour Occupational Safety and Health Administration (1991) defines it as adapting jobs and work place to the worker by designing task, tools and equipment that are within the workers' physical capabilities and limitation. Ergonomics measures how a workplace has been designed to fit the worker so that a desirable product is created at low cost in terms of time, energy, safety, health and work satisfaction. It improves performance and well–being of the worker. For instance, an ergonomically designed sewing workplace enhances proper organization of work, reduces discomfort, fatigue, ill health and errors. It eliminates the drudgery of work and any undesirable condition that can cause danger, risk, distress or pain, improves well- being and productivity. The proper allocation of space, workflow, posture during work, ventilation, lighting, working surface height, seats and work space set up, to mention a few, are important ergonomic requirements that cannot be ignored (Kessler 1999). He pointed out that if several negative factors come together, productivity suffers. He further explained that under negative conditions there would be more frequent absenteeism from workers, lack of motivation for workers, reduction of work safety and decline in work satisfaction.

Ergonomics, also called human engineering, is not new. In the past, however, it was seen more as an office-related fad. Now, it is a major health and safety issue for business owners. Employee's health is key in terms of productivity (Department of Labour, 1990).

In many parts of the world such as North America and Europe, the garment manufacturing industry keeps pace with change and technological development and ergonomics has gained a sound foundation. In Ghana, though garment production is a popular small-scale occupation for both men and women, nobody has given due consideration to the set up of the working environment. The industry is mainly owned and operated by single persons as small enterprises in the informal sector. Many of these people operate in places where they may only be protected from the harsh elements of the environment like sunshine and rain, without considering important ergonomic factors that are useful for improved production. This implies that dressmakers and tailors particularly need to be adequately equipped in the light of modern global competition and technological advancement, with workable, pragmatic and useful knowledge and skills relevant to the industry. Thus, not only do seamstresses and tailors need sewing machines to do their work but all the necessary sewing aids require adequate space at the workshop. They must be placed in such a way that the worker can work with efficiency and comfortable movements. Noise, temperature, and lighting should be at levels that can enhance efficiency and production. The height at which workers perform their everyday tasks and the type of seats they use are also of great concern in the garment industry. For seated and standing work, the height of the workstation should allow workers to maintain a good working posture (Steidl and Bratton, 1968). Sewing machine operators suffer from musculoskeletal problems which are attributed to poor working posture (Li *et al*, 1995). In considering the requirements of the garment producer in his workplace, ventilation becomes important as polluted air can cause discomfort. For example, dizziness, headaches and nausea are some of the discomforts associated with poor ventilation.

Ignoring ergonomic requirements has a substantial cost for the garment industry. Not only does it improve employee well-being and morale but it can save business money by reducing cost related to issues like workers compensation, turnover and absenteeism. Ward (1970) argued that in less advanced or developing countries where technological advances are yet to come, there is an excellent opportunity to get the ergonomics right before the mass introduction of mechanical aids. It is believed that if the Ghanaian garment producer's work could be transformed in such a way that it combines optimal and work performance with minimum stress and wear, productivity will be enhanced. He/she can comfortably compete in the global village. It is, therefore, imperative that this important industry of garment production gets its ergonomics right in Ghana as it has been identified as an economic force in any country's economy.

1.1 Statement Of The Problem.

Ergonomically designed sewing workplace enhances proper organization of work, reduces discomfort, fatigue, ill health, errors and improves well-being and productivity. Poor working environment presents a serious threat to the livelihood and career of garment producers and other workers. Garment producers in Ghana are confronted with problems of inadequate space, poor lighting and ventilation in workshop as well as high levels of noise and improper working height and seats, to mention a few. It appears that they may not be aware of ergonomics and the application of its principles to save cost and reduce fatigue, among others, to improve productivity. Unfortunately, investigations on the influence of ergonomic practices on the garment industry have not received adequate attention in Ghana. The potential for an improvement in both the garment producer's tasks and working environment lies in the identification of the conditions and solution to the problems they face.

1.2 Main Objective

The main objective of this study, therefore, was to investigate the conditions under which garment producers in Madina work with regard to ergonomic principles in their task and work environment.

1.3 Specific Objectives

The specific objectives of the study were to:

- investigate the background characteristics of tailors/seamstresses
- examine tailor's/seamstress's knowledge on ergonomic features suitable for work.
- determine whether or not their work environment has stressors/hazards that affect productivity.
- find out if injuries attributed to the performance of tasks in their workshops occur, and at what frequency.

- compare productivity levels of respondents if ergonomic practices are not observed with expected productivity level under ideal ergonomic conditions, such as provision of good ventilation, proper lighting, good posture, suitable seats and appropriate working height.

1.4 Hypothesis

There will be no relationship between time spent seated at work and MSDs in neck, shoulder, lower back and upper back.

1.5 Significance Of Study

The results of this study may benefit:

- institutions and individuals who need to improve upon and maintain a healthy working environment in the sewing industry
- furniture manufacturers who produce worktables and seats for the sewing industries in Ghana to consider ergonomic principles for the design of their products.
- other researchers who would conduct parallel investigations
- The results may serve as literature for teaching and research.

CHAPTER TWO

LITERATURE REVIEW

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There is not much literature on ergonomics in Ghana. The relevant literature on the topic available to the researcher is focused on principles of ergonomics and their relevance to task performance and work environment of the sewing machinist worldwide. The literature will be review mainly on Hazards in the work Environmental and occupational MSDs.

2.1 Hazards In The Work Environment.

Different authors list various hazards or stressors or risk factors that contribute to musculoskeletal problems and stress resulting in low productivity in the workplace. For instance, Brutman (1996) writing about recognition and evaluation of risk factors, listed repetitive motions, awkward posture, forceful exertions, mechanical stress, vibration, extreme temperature and poorly fitting gloves as potential stress factors that affect production. He noted that the most common risk factors one could probably encounter on daily basis are repetitive motions, awkward posture, forceful exertion and mechanical stress. Kessler (1999), an ergonomic industrialist, also cited the most important stress factors as wrong posture, remaining in the same tense position for long periods, unbalanced strain, vibrations, monotony, inadequate lighting, extremes of temperature, inappropriate ventilation and ineffective work organization. Armstrong *et al* (1987) and Armstrong (1993) listed poor working posture, highly repetitive work, lasting static posture, lack of physical variation and high exertion of external force as risk factors common in work places.

Repetitive Motion

The Manitoba Ergonomic Guideline (1999) defined repetitive motions as task or series of motions that are performed over and over again by the same muscle groups with little variation. Brutman (1996) noted that there are numerous names for repetitive-related disorders and these included Repetitive Stress Injuries (RISs), Cumulative Trauma Disorders (CTDs) and overuse syndromes such as Carpal Tunnel Syndrome (CTS) or Writers Cramp which is a wrist related injury. Brutman (1996) argued that as a guideline, a motion is considered highly repetitive if the cycle time is less than 30 seconds, that is, more than one lift, step, exertion or motion occur in 30 seconds. The Occupational Safety and Health Administration of North America has been pushing for an ergonomics standard that would protect U.S. workers from the musculoskeletal or cumulative trauma disorders caused by repetitive motion. These injuries occur at jobs ranging from meat packing to word processing. A well-known cumulative trauma disorder or CTD is carpal tunnel syndrome.

Forceful Exertions And Contact Stresses

The Manitoba Ergonomic Guideline (1999) defined forceful exertions as forces that are generated by muscles of the hands and arms to cause movement. Some examples are turning a board or gripping an item. It referred to contact stresses as a risk factor. Here, parts of the body in contact with objects are considered risk factors as such contact can cause injuries. Brutman (1996) reported that while it is difficult to use an exact number to determine the severity of an exertion, simply holding a pen too hard or banging on keyboards can be considered forceful just as lifting 50 pounds weight or more also constitute a forceful exertion.

Awkward Posture

The Manitoba Ergonomic Guideline (1999) defined awkward posture as those postures outside the ''neutral'' range defined for each joint as optimal for applying force and minimizing injury. Writing about awkward positions, Brutman (1996) stated that for standing postures, neutral is with arm close at the side either straight or at a right angle (90 degrees) with the wrist in line with the forearm. For sitting postures, the upper body is the same as with standing, but feet should be flat on the floor with legs at approximately a 90°degree angle to the upper body. The neck for example should not be bent forward or backward or tilted to the side. He noted that the key to determining severity of an awkward posture is how far the joint is away from the neutral position.

''Extended Reaching'' is a special type of awkward work posture that means reaching to heights or distances outside of the range from knuckle to shoulder height and more than 46cm (18 inches) from the body. "Extended Reaching' can require bending, twisting, stretching, holding the arms up high or other awkward posture, thus, causing stress on muscles and tissues. According to Brutman (1996), static posture is a special type of awkward posture, which occurs when a body part is not moving but is still doing work. For example holding an object in the left hand while using the right hand to work on it is a body in a static posture. Grandjean and Hunting (1977), reviewing various problems of standing and sitting posture, reported that static work is characterized by slow contractions with heavy loads or by long-lasting holding postures where blood supply is impaired and waste products accumulate in the muscles causing acute pain in the statically loaded muscle.

Ergonomic Features And The Work Place Environment.

The object of considering the requirement of the worker in designing work places is to determine the conditions that result in a minimum of strain on the worker and require a minimum of effort to do the activity. Dees (1998) pointed out that a workspace is the area where daily-work operations are conducted and the space needs to be large enough to encompass any and all devices the workspace employee uses in the operation of this area. She stated that the production of efficiency depends upon the design and compatibility of the unit. The area size, the lighting, the surrounding area, the amount of noise, the floor type, the walls, the height of the walls in relation to the ceiling, among others, need to be considered when planning and designing a work area (Dees, 1998). Steidl and Bratton (1968) suggested the need to emphasize design criteria for work situations rather than standardized work methods and conditions since workshops differ widely. They explained that the words “strain” and “effort” must be broadly interpreted to include not only physical strain and effort but also the affective, cognitive and temporal cost of work.

Work Surface Area And Space Requirement

Peet *et al* (1970) noted that if a task permits the worker to remain seated for a considerable period of time, the worker, the chair and work surface should be in proportion to each other and right for the task. This means that the work surface should be clear of the thighs and must permit all parts of the body particularly the shoulder to remain in their natural alignment. Also adequate knee room should be provided. Similarly, Agan and Luchsinger (1965) reported that the surface for doing work while seated should be as low as clearance over the thighs will permit so that the worker will raise her arms as little as possible. Steidl and Bratton (1968) noted that proximity of sewing machine, ironing board, pressing equipment and storage of supplies and tools is of concern for the task of sewing. They suggested that an auxiliary surface be provided near the sewing area for temporary placement of supplies, tools and parts of the article being constructed and some storage space near the sewing machine for supplies and tools. Eberle *et al* (1995) wrote about "Ergonomic Sewing Work Station Design" and pointed out that the space required for comfortable working depends on the operation to be performed and the technology. Oborne (1982) cited Barnes (1963) to have proposed the normal and maximum areas based on the measurements of 30 men. The normal area is the area that can be conveniently reached with a sweep of the forearm with the upper arm hanging in a natural position at the side while the maximum area is the area that could be reached by extending the arm from the shoulder. Steidl and Bratton (1968) suggested an average horizontal distance of 32 inches (80cm) for the normal area and 39 inches (100cm) for the maximum area. Facilities and equipment which are unique to a particular activity, should be an integral part of the work center for that activity (Agan and

Luchsinger, 1965). They further stated that adequate space should be provided for all supplies and other articles to be used. This requires that equipment and material should be centered in front of the worker to prevent excessive stretching (Peet el, al 1970).

Seats And Seating Posture

Different seating positions have effects on the body's structure. A good seat is one that helps the individual to stabilize his body joints so that comfortable posture is maintained (Oborne, 1982). Grandjean (1973) pointed out that prolonged sitting itself causes health problems. For example, abdominal muscles slacken and curve the spine and also the function of some internal organs is impaired. Oborne (1982) cited Pottier, Dubreril and Mond (1969) to have reported that prolonged sitting (over 60 minutes) produces swelling in the lower leg of all sitters as a result of an increase in hydrostatic pressure in the veins and the compression of the thighs causing an obstruction in the return of blood flow. He further noted that, when seated, the primary support structures of the body are the spine, the pelvis and the legs and feet. Grandjean *et al* (1973) estimated that 50 percent of adults suffer backaches during, at least, one period of their lives. This is due to pathological degeneration of the discs, which lie between the bony vertebrae and act as an elastic cushion to give the spinal column its flexibility. Improper postures, they mentioned, wear out the disc. Yamaguchi and Umezawa (1970) were cited by Grandjean (1973) to have studied the effect on various seat inclinations of the spine and their main results showed that with a horizontal seat surface, a backrest angle of 125° is required to get a low tension in the spine. Oborne (1982) reported Kengan and Radke (1964) to have used X-ray to study the shape of the spine during different posture and suggested that the normal relaxed spinal shape is produced when a person is lying comfortably on his side with the thigh and legs moderately flexed. They pointed out that the sitting posture which produces the nearest approximation to the ‘normal’ lumber shape is the one in which the trunk-thigh angle is about 115 degrees and the lumber position of the spine is supported. A ‘‘sitting up straight’’, that is, 90 degree backrest angle position produces a great deal of spinal distortion. Oborne (1982) continued that a forward-seated posture causes the normally forwards-bent lumber area to straighten and eventually, bend backwards. This affects the angles of the thoracic and cervical areas causing a hunchback posture which when maintained for long periods increases the load on the musculature supporting the head and produces fatigue in the neck and back. Grandjean (1973) therefore suggested that seats should be designed so that in both forward and backward postures, they provide support to the upper edge of the pelvis.

Floyd and Ward (1969), in a study of muscular activity, reported that a sitting-up- straight without any backrest produced a fair degree of activity in the lumber region causing pain which, however, ceased as soon as a backrest was provided. A forward hunchback posture caused most activity to occur in the upper back and shoulder regions. Oborne (1982) mentioned that an upright and a forward leaning posture causes fatigue, while the provision of back rest reduces some of the lumber fatigue and an obtuse angle backrest helps to stabilize pelvis rotation. Branton (1969) suggested strongly that a seat might be ‘‘inefficient’’ to the degree to which it interferes with the primary activity for which the seat was required. The assessment of ‘‘comfort’’ therefore needs, sometimes, to give way to a consideration of operators ‘‘efficiency’’ since it is unlikely that one can exit without the other. The relative comfort and functional utility of chairs and seats are a consequence of the chair's physical design in relationship to the physical structure and biomechanics of the human body (McCormick and Sanders, 1982). McCormick and Sanders (1982) suggested that seats should have back support and should provide for correct curvature of the lumber or low back area in order to keep the spinal column in a state of balance. Oborne (1982) also reported that the type and dimensions of a seat must be related to the reason for sitting. For example, the dimension for a seat for work, pleasure, and relaxation, among others, should fit the appropriate anthropometric dimension of the sitter. The chair should be designed to provide support and stability for the sitter and vary his posture. Backrest should be prominent in the lumber region to reduce stress on the spinal column and the seat pan should be padded and be in a form to distribute the body weight pressure from the ischial tuberosities. Oborne (1982) argued that muscular fatigue and spinal deformation reduce comfort and increase the stress of the operators, which, in turn, will reduce performance. McCormick and Sanders (1982) indicated that a seat should be so designed that the weight of the body is distributed through out the buttock region by proper contouring of the seat pan in combination with other features of the seat such as seat height, seat angle and seat back. They further urged that whether at work, at home, at horse racing, on buses or elsewhere, people spend major part of their time sitting. They agreed that there are certain general guidelines that may aid in the selection of designs that are sufficiently optimum for the purpose in mind. Elese (1998) said that if the number of hours spent sitting in a chair add up to over 8hours, then the chairs adjustment, support and comfort are very important for good health and comfort. She said that it is, therefore, desirable to have a seat with an adjustable lumber support that can move up and down and in and out. Similarly, Ergonomic Report (1993) stressed the need to provide an ergonomically designed seat that is adjustable, has a backrest and has a large padded seat pan for machine operators. Agan and Luchsinger (1965) suggested an adjustable backrest not lower than 6inches (16cm) above the seat to support the lower spine. Elese (1998) pointed out that a lightly padded back and seat cushions and a chair on rollers to move easily from sewing machine, to the serger and cutting board without stressing the back were necessary. However, Dees (1998) warned that chair with rollers might be a health hazard as it may roll too freely on a highly waxed surface or threads from shag carpet could be caught in the wheel rollers. This could cause accidents making it necessary to re-consider chairs with rollers through research.

Seat Height

Oborne (1982), McCormick and Sanders (1982) and Bex (1971) stated that to avoid discomfort, the height of a seat should allow the placement of feet on the floor and should be such as to avoid excessive pressure on the thigh. This means that the front edge of the seat should be a bit lower than the distance from the floor to the thigh when seated. This is termed popliteal height. In this regard, McCormick and Sanders (1982) reported Tichaner (1978) to have recommended that the front edge should be at least 5cm (2 inches) below the popliteal crease (the crease at the back of the hollow of the knee). McCormick and Sanders (1982) suggested the provision of adjustable seat height of between 38 to 48cm to accommodate persons of various heights. Grandjean *et al* (1973) also suggested the provision of an adjustable seat and gave a work chair height of 43 to

50cm. McCormick and Sanders (1982) pointed out that the reason for the difference recommended seat height between easy and working or multipurpose chair is their usage. While easy chair should allow the legs to be stretched well forward for a relaxing posture, for a working chair, a more upright position is preferred with the feet flat on the floor for good posture.

Seat Depth And Width

With regard to seat depth and width, McCormick and Sander (1982) stressed that while the depth and width of seats depended on the purpose of the seat (whether multipurpose, typing or lounge chair, among others) the depth set should be suitable for small persons and the width suitable for large persons. Depth should be able to provide clearance for the calf of the leg and to minimize thigh pressure of the user. Oborne (1982) added that seat width needs to accommodate the largest person using the hip width dimension and the depth of the seat should ensure that the sitters find support in the lumber area from the backrest. He suggested a seat width of 43 to 45cm and a depth of 35 to 40cm for a work chair. While Agan and Luchsinger (1965) mentioned a width of 42 to 44cm and a depth of 33 to 37cm, Grandjean *et al* (1973) however, recommended that a multipurpose chair's depth should not exceed 43 cm and a width of not less than 40 cm. Oborne (1982) pointed out, that provided the seat height is adequate and the feet are able to be placed on the floor, compression fatigue in the thighs is unlikely to be induced. Oborne (1982) cautioned that for a working chair, it should be positioned for easy access to the worker's work area in front of him as backward tilting seat would cause a worker to bend forward and would curve his spine unnecessarily. Oborne (1982) reported Mandal (1976) to have taken this point further to argue that since most work is carried out in a forward bent posture, a forward- sloping seat is most appropriate.

Working Surface Height

Bex (1971) compared relevant static anthropometrics data with conventional desk heights and concluded that desks should be lower and adjustable. He noted that the most common heights have in fact been reduced from 76cm. in 1958 to about 72cm in 1970. He suggested a further reduction to a height of 71cm. Floyd and Roberts (1958) were reported by Bex (1971) that desk users must be able to sit comfortably with feet on the floor, and legs approximately at right angles to the thighs with forearms resting on the desktop and legs and arms unhampered. This is because freedom of movement and change of posture are comfort constituents. Bex (1971) further argued that the desktop must therefore be approximately at elbow height. McCormick and Sander (1982) noted that work–surface height is closely tied in with seat height, thickness of the work surface and thickness of the thigh. The combinations of variables involved make it about impossible to design a fixed work surface and seat arrangement that would be fully suitable for people of all sizes. Similarly, Agan and Luchsinger (1965) reported that the range of individual difference precludes the establishment of a single, universal height that will be appropriate for seated work surface. Steidl and Bratton (1968) noted that dinning or kitchen tables were too low for pattern laying and cutting out for sewing and could be backbreaking. Steidl and Bratton (1968) reported Bland, Mize and Simons (1959), Johnston, Smith and Wise (1957) to have suggested about 92 cm (36 inches) as a height comfortable for majority of people in two separate studies. McCormick and

Sanders (1982) reported Ellis (1951) that for standing, a work surface normally should be a bit below elbow height. Barnes (1963) proposed 5 to 10 cm below elbow as a suitable height for work surface. Steidl and Bratton (1968) suggested 8cm (3 inches) or slightly more depending on the activity and stressed that the height of elbow is an important landmark for determining the desirable height of work surface because of the need to maintain a posture and arm position that avoid static work and fatigue arising from it.

Agan and Luchsinger (1965) reported an average of 89cm (35 inches) height for ironing while standing and 67.5cm (26½ inches) while seated. Steidl and Bratton (1968) reported that ironing boards that can be adjusted are desirable since small differences in body proportion must be accommodated on individual bases. Whether the worker stands or sits, the level of the board must be sufficiently low to permit at least 90-degree angle between the forearm and the upper arm. Allowance must be made between elbow height and ironing board level for the height of the iron. They further stated that the level must permit an erect posture during work as well as the proper arm and shoulder positions.

Lighting And Vision

McCormick and Sander (1982) reported that in many aspects of life, people depend upon natural light, the sun, as a source of illumination. When human activities are carried out indoors as at night, it is usually necessary to provide some form of artificial illumination. A room must have a clean window of adequate size through which the sky can be seen (Gawthrope, 1972). Therefore, a room will be bright or dark in proportion to the amount of sky, which can be seen through the window. Peet *el al* (1970) agreed with this assertion and added that other conditions such as the use of shade and draperies also greatly influence the amount of daylight that is available in a room. Gawthorpe (1972) reported that badly lit room negatively affects the eye as well as having a depressing effect upon people. Agan and Luchsinger (1965) stated that both natural and artificial illumination should be adequate to facilitate work, reduce fatigue, prevent headaches from straining of eyes and eliminate some causes of accidents. They argued further that for general purpose, illumination level of 5 to 10 foot-candles might be all that is necessary. However, for a more acute vision, levels of 20 to 40 foot-candle may be required with 100 or more necessary for fine needlework on dark goods. They pointed out that the attributes of good lighting include adequate amount of light for the task, well distributed and properly positioned for visual comfort. Dees (1998) quoted Graham (1992) to have said that if a room is less than 2·8 x 3·05m, a ceiling fixture using 150 watts incandescent or 60 watts fluorescent light is needed. If the room is 3·05 x 3·6m or larger in size, two watts per square foot incandescent is needed. Peet *el al* (1970) mentioned that human seeing responses improve as lighting levels are increased and these bear directly on human performance and productivity. They reported Blackwell's (1969) research that stated that the need for illumination on a given viewing task increases as the age of the observer increases.

Ferguson *et al* (1974) reported that unsuitable lighting caused visual fatigue. They stated that lighting is unsuitable when it does not adequately brighten work objects or visible surroundings. Vision can only be improved by increasing the lighting level but only up to a point as the law of diminishing returns operates. Ferguson *et al* (1974), however, reported Ferguson (1971) to have stated that lighting would be more effective if ceilings were pointed white. Duke-Elder (1930) was also cited by Ferguson *et al* (1974), to have suggested that good seating posture is important for optimal visual performance and that often the need to see forced a short person to perch on a light weight stool with feet suspended with backrests unusable. Steidl and Bratton (1968) mentioned that to permit good vision, sewing machine operators should sit 18 to 20cm (7 or 8 inches) directly in front of the needle of the sewing machine. Oborne (1972) explained that glare is caused whenever one part of the visual field is brighter than the level to which the eye has become accustomed and can interfere with visual performance.

Surfaces – Wall And Ceiling

McCormick and Sander (1982) pointed out that the distribution of light within a room is not only a function of the amount of light and the location of luminaries, but it is also influenced by the reflectance of the walls, ceilings and other room surfaces. They stated that it is generally desirable to use lightly coloured walls, ceilings and other surfaces in order to contribute to the effective distribution and utilization of light in a room. Similarly, Grossmith and Chambers (1998) stated that walls painted in pastel colour have a high level of reflectivity and offers clear vision. Agan and Luchsinger (1965) and Gawthorpe (1982) both stated that light colours reflect light and add more light whilst dark colours absorb light making less light in a room.

Temperature

Oborne (1972) stated that there is a narrow range of temperature intensity under which a worker can and should operate. Departure from this optimum, either by increasing or by reducing the intensity, is likely to affect performance, comfort and in extreme cases, health. For example, man's ability to perform complex mental operations is affected in conditions of both extreme cold and extreme heat. Man's response to thermal environment depends primarily on a very complex balance between his level of heat production and heat loss (Oborne, 1972). The body temperature is maintained within its normal narrow range of between 36.1° and 37.2° C. An increase of 5° C or more can result in hypothermia when the environmental conditions are too hot and interfere with the ability of the sweet produced to cool the body.

Ventilation

Gawthorpe (1972) stated that ventilation might be described as the exchange of stale air for fresh air. The air in a room needs to be changed or the atmosphere becomes stuffy and causes discomfort. Stale air is warm, moist, very still and contains more carbon dioxide and impurities. McCormick and Sanders (1982) listed dizziness, headiness and nausea as some of the discomforts associated with poor ventilation. Brew and Ekuban (1991) mentioned that the different means to get fresh air from outside to replace moist hot air in a room include providing adequate windows or ventilation holes which help take out hot air from a room. They further stated that a good natural ventilation system could be provided if windows are placed a couple of feet from the ground and face each other. This constitutes cross ventilation when cool air enters from windows on one side of the room and warm air leaves through the windows opposite. Fan, air conditioners and air extractors were recommended by Brew and Ekuban (1991) as devices that can keep air moving in a room or take away moist air to create comfort. Dees (1998) similarly pointed out that proper ventilation is a must in a workspace. The airflow in a room needs to be circulated a various number of times a day to create a healthy environment. Polluted air can create many dangerous diseases such as tuberculosis and inhalation anthrax.

Noise

Oborne (1972) stated that noise is conveniently and frequently defined as unwanted noise. He explained that this definition is loose and enables a sound source to be considered as "noise" or "not noise" solely on the basis of the listener's reaction to it. Thus, a sound, which is labeled on one occasion as noise, may not be so on another occasion in a different environment. Both Dees (1998) and Oborne (1972) wrote that noise levels could hinder the efficiency of the worker. A comfortable noise level needs to be maintained. People speak between 45-75 decibels (dB) so any level much higher than this could become noise pollution (Barnhart, 1995). McCormick and Sanders (1982) stated that noise could lead to hearing loss. After exposure to continuous noise of sufficient intensity there is some temporary hearing loss, which usually is recovered a few hours or days after exposure. However, with additional exposure the amount of recovery gradually becomes less and less and the individual is left with some permanent loss. They quoted Jansen (1969) and Burn and Gullan (1974) who both explained that there is evidence that indicated that exposure to high noise levels (such as 95 dB or more) acts as a stressor and that over a period of years, it may produce pathological side effects and this may constitute a health hazard. McCormick and Sanders (1982) noted that irritability, headaches, tiredness, bad sleep and heart pains have been associated with''High level noise''. Poulton (1977) stated that excessive noise is a medical hazard and continuous noise at an intensity level of 100 decibels produces permanent deafness if people are exposed at work day after day. Noise, interferes with performance. Continuous noise needs to be distinguished from intermittent noise that is less deafening and more distracting. Noise should be reduced sufficiently to enable people to speak to each other (Poulton, 1977). Dees (1998) mentioned that wall covering could add or distract from the sound of a workspace. The type of wall covering can be a buffer for sound or the wall covering can create noise. A padded type of wall covering can absorb sounds. A glossy-wooden type can repel sound creating an echo or noise.

Bryan and Tolcher (1976) concluded from an experiment that there were large variations in noise levels in which people preferred to work. While some preferred to work in the quiet, others preferred "deafening noise levels (over 90 dB) and yet the latter suffered no deterioration in task performance compared with the former. Preferred listening levels are determined in part by the type of noise, task difficulty, personality traits, and possibly by noise sensitivity. Personal difference such as sex, age and status do not apparently affect preferred listening levels.

2.2 *Occupational Induced Musculoskeletal Disorders Or Injuries*

Closely related to risk factors are musculoskeletal disorders (MSDs). Poor ergonomics that result in both the working means (task) and the working place (environment) are considered to be at the soft heart of MSDs. The appearance of injuries and illness are often dependent on individual work factors including length of employment, workstation design and training received (Ergonomic Report 1993).

Musculoskeletal system refers to the soft tissues and bones in the body i.e. muscles, tendons, ligaments, nerves and blood vessels. Writing about ergonomic programme development and implementation, the Manitoba's Ergonomic Guideline (1999) defined MSDs as illnesses and injuries that affect one or more parts of the musculoskeletal system. It reported that a job may be considered to have ergonomic hazard if painful joints, pain in back, neck, wrists, shoulders, forearm, knees, pain tingling or numbness in hands or feet, shooting or stabbing pains in arms or legs, swelling or inflammation, stiffness, burning sensation and weakness or clumsiness in hands dropping things are experienced. Peet *et al (*1970) stated that fatigue might be described as an unpleasant feeling that lowers the individual's level of activity. This can become chronic and eventually cause illness. This is referred to as physiological fatigue and can be relieved by rest. The Manitoba's Ergonomic Guideline (1999) also gave a list of injuries that may be caused by exposure to ergonomic hazards and this included: Carpel tunnel Syndromes, Chronic low back pain, Cumulative trauma disorder (CTDs), Epicondylitis, Non- specific backache, Raynaud's Phenomenon, Cubital tunnel syndrome, Sprain and Strain. Cumulative trauma disorders (CTDs) are growing source of concern in occupational health (Department of Labour 1990). Vezina *et al* (1992) reported that epidemiologists have associated the job of sewing machine operators with high incidence of musculoskeletal and other health problems despite its classification as light work according to energy expenditure criteria. They further stated that the work posture during sewing was static and workers were seated with upper back curved and head bent over the sewing machine. Movement of the upper limbs involved abduction and adduction of the shoulder while exerting a force.

Grieco (1986), Punnett and Keyserling (1987), Vihma *et al* (1982), Chavalitsakulchai and Shahnavaz (1993) and Blader *et al* (1991) reported of MSDs in studies involving machine operators. According to Grieco (1986), 'backstitchers' remain in sitting and static posture for a long time creating a high risk of injury to the spinal segments and shoulder. Both Vihma *et al* (1982) and Blader *et al* (1991) noted in their studies that MSDs in the neck and shoulder region were frequent amongst workers performing monotonous, highly repetitive and high–speed precision tasks. Chavalitsakulchai and Shahnavaz (1993) mentioned MSDs symptoms in lower backs, neck and shoulder of garment and textile workers as a result of prolonged sitting, high repetitive and monotonous movements, poor posture, poor machine design and poor work organization. A survey of working posture by Vihma *et al* (1982) showed that sewing machine operators in garment industries were subjected to static posture which resulted in pain in the neck, shoulder and lower limbs but no back pain. According to Anderson and Gaardboe (1993) neck and shoulder complaint of sewing machine operators increased with the years of being sewing machine operators. In a garment factory, sewing machine operators and floor service employees experienced cumulative trauma disorders, back and other musculoskeletal injuries. An analysis of the work-site revealed that sewing machine operators had poor workstations with unadjustable, wooden chairs that caused them to use awkward postures when working. The sharp edges of the tables caused problems such as contact stress. Although there was a cost to changing this setup, the employer expected to make it up from increase in productivity and reduction in injuries (Center for Rehabilitation Technology, Helen Hayes Hospital (1999).

Punnett and Keyserling (1987) reported a study comparing sewing machinist to other workers and indicated a greater prevalence of pain and MSDs in the upper limbs of the sewing machine operators. Static work is characterized by slow contractions with heavy loads or by long-lasting holding posture. In a strong static concentration, the blood supply is impaired and waste products accumulate in the muscles. These causes the acute pain in the statically loaded muscle. Grandjean and Hunting (1977) and Li *et al* (1995) studied factors affecting posture for machine task and attributed MSDs to poor posture as well as to the repetitive hand and arm movement. They noted that the posture adapted was constrained by both the visual and manual aspect of the task, the design of the sewing machine and table. Trunk posture was found to be strongly related to the manual aspects of the task and head posture, by the view of the task/ needle. When the potential for improvement of industrial sewing was investigated, it was found that trunk posture and head/neck flexion could be improved significantly by altering table inclination and of the needle.

According to Grandjean and Hunting (1977), Yamaguchi and Umezawa (1970) reported that poor standing posture results in pain in the feet and legs, while sitting without back support creates pain in the extensor muscles of the back. Seats that are too high were likely to cause pain in the knee, lower legs and neck. Seats that are too low cause pain in the shoulders and neck. Extended arms during work give rise to pain in the shoulder and upper arms. For one to perform efficiently in a garment-producing workshop, therefore, the seat height, work surface, temperature, ventilation, the colour of the environment, among others must be right.

2.3 Definition Of Terms

For the purpose of this study

1. A garment producer refers to any tailor/seamstress who sews garment as his or her business.
2. Seamstress/Dressmaker – refers to female garment producers. In this study seamstress/dressmaker will be used interchangeably
3. Tailor – refers to male garment producer.
4. Hazard/Stressor/Risk – any undesirable condition that can cause danger, distress or pain in the garment producer's workshop. In this study hazard/stress/risk will be used interchangeably.
5. Injuries– pain caused by exposure to ergonomic hazard e.g. pain in back, neck, wrist etc
6. Workstation – is the work area, tables and sewing equipment where the service of constructing a garment is organized and provided.
7. Ergonomic features – conditions and circumstances in the sewing workshop that affect work, for example ventilation, lighting, posture and noise, among others.

8. Work environment – workplace of dressmakers/tailors where production of garment takes place.
9. Musculoskeletal Disorders (MSDs) - illnesses and injuries that affect one or more parts of the musculoskeletal system and include pain, aches, stiffness, numbness and burning sensation.
10. Posture - posture is the position of the body or way in which a body is held during standing or sitting.
11. Straight dress – a type of simple dress where the main seams are the two side seams
12. Political suit – a type of jacket and trousers of the same fabrics worn by men and popularized by politicians in Ghana.
13. Kaba and Slit- a traditional Ghanaian blouse and skirt

CHARTER THREE

METHODOLOGY

❖

3.1 Population And Sample Selection

All seamstresses/tailors registered with the Madina, (a suburb of Accra), Branch of the Tailors and Dressmakers Association constituted the study population. A list of registered members was obtained from the Association's secretariat at Madina. From the total list of 264 members, one hundred garment producers were selected by the simple random sampling technique to obtain the study sample. This sampling technique was used so that each member in the Association would have an equal chance of being chosen. Respondents in Madina were chosen because of their proximity to researchers residences and this helped cut down transportation cost.

3.2 Development Of Measuring Instruments

Two instruments were used to collect the data from respondents. They were:

(i) A structured questionnaire which included a symptom survey based on the Manitoba's Ergonomic Guideline (1999) on Programme Development and Implementation was developed. A structured questionnaire was used in order to solicit more detailed information. The questionnaire had both opened and close-ended questions and it was used to seek information by interviewing the respondents on:

- background characteristics e.g. age, education, among others.
- knowledge about of ergonomic factors.

- stressors present in work environment – both in the surrounding and in the task performance.
- injuries attributed to the job and possible causes.
- current production rates and if ergonomic practices were not observed, whether their rate of production might increase with improved ergonomic conditions. (See appendix A p. 101)

(ii) A structured unobtrusive observation guide. This was used so that information that the respondents did not give could be observed unobtrusively and added. An observational guide was prepared and was used to collect data on hazard/stressors present in the workshop. It comprised the following: ventilation, lighting, working height, seats, layout of equipment, floor and wall surface, temperature, noise, awkward posture, and repetitive motion. (See appendix B on p. 106)

3.3 Pretesting

The questionnaire was pretested in the first week of January 2001 with fifteen garment producers in the Madina area who were not part of the study sample. This was to determine whether the questions were clear and easy to understand. The necessary corrections made are indicted in 3.4 below.

3.4 Comments Made And The Changes Effected.

The dressmakers and tailors found questions on ways to reduce the potential for developing repetitive motion injuries irrelevant, thus those questions were deleted from the questionnaire. For example, what kind of repetitive motion do you encounter and how can this be prevented in opinion and deleted.

3.5 Administering The Questionnaire

The research was conducted from January to May 2001. The researcher visited the respondents to establish rapport and agree on convenient times for the data collection. It was agreed that the time for the structured interview and observation be scheduled for the mornings, from 10am to 12 noon, when there was much sewing activities at the workshops.

3.6 Data Analysis.

Responses on completed questionnaire were hand coded. Frequency and percentage distributions were used to describe the data obtained. The observations made by the researcher were laced with responses from respondents in the write up.

3.7 Testing Of Hypothesis

To determine whether a given discrepancy between theory and observation might be attributed to chance or whether it resulted from the inadequacy of the theory of observed facts, the chi-square statistic was used to test the hypothesis - there was no relationship between time spent seated at work and MSDs in neck, shoulder, lower back and upper back.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

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4.1 Background Information Of Seamstresses And Tailors

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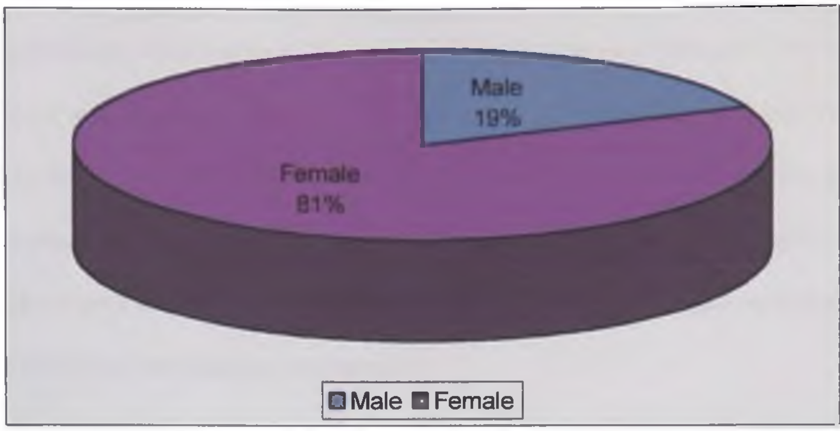
Gender Of Respondents

Figure 1 on page 34 shows the percentage distribution of the respondents' gender. Eighty-one percent of the respondents were females and 19%, males. Not until recently, in the Ghanaian culture, the 'tailor' traditionally referred solely to a male who made men's clothing whiles the female counter-part, "dressmaker/seamstress" referred to a female who made women's clothing. Unlike the dressmakers who make lots of clothes as a result of women's insatiable desire for clothes, tailors make suits for special occasions and are few in number. Again the sewing of apparel is viewed as a feminine vocation generally. Perhaps this is because sewing, like cooking, cleaning, washing and other jobs carried out originally in the confines of the home were culturally categorized as domestic and female roles. Traditionally, therefore, girls have fewer professional options, one of which is dressmaking. Boys on the other hand, have such options as carpentry, masonry, and mechanics, among others. It is, therefore, not surprising that less than 20% of respondents were males. Trends in professional options are changing gradually and girls are entering the once regarded male domains and vice versa.

FIG.1 GENDER OF THE RESPONDENTDS



Age Of Respondents

The age distribution of the respondents are shown in Table 1.

TABLE 1. AGE DISTRIBUTION OF DRESSMAKERS AND TAILORS

Age in years	%
< 20	1
20 – 24	9
25 – 29	31
30 – 34	25
35 – 39	23
40 – 44	9
45 – 48	2
Total	**100**

Total number of respondents =100

The respondents were between the ages of 19 and 48 years. The majority (79%) of respondents were between the ages of 25 and 39years and 9% each were aged between 20-24 and 40-44. Only 2% of them were over 44 years of age, and one was a teenager. The majority was therefore young in their prime and productive age. Perhaps the present emphasis laid on the study of practical subjects such as vocational skills by the Ghana Education Service in the Senior Secondary School has encouraged more youth to take up dressmaking and tailoring as a vocation.

Educational Backgrounds

When respondents were asked about their educational background, the following data were obtained as shown in Table 2.

TABLE 2. EDUCATIONAL LEVELS OF RESPONDENTS

Educational Level	%
No formal education	1
First cycle	66
Second cycle	32
Tertiary Education	1
Total	**100**

Total number of respondents =100

All the respondents were literate except one. While 66% had completed first cycle (Middle and Junior secondary schools) education, and 32% second cycle (secondary school) only one person had had tertiary education. It is worth noting that for both the first cycle and second cycle levels, a few female respondents (three in each case) were unable to complete school. They dropped out of school due to financial constraints and/or parenthood. In practice, an individual who sews has to use the tape measure to take body measurements of his/her clients and therefore the ability to read and write is very essential for success of the business. This might account for almost all the respondents (99%) having had primary education. To a large extent, however, sewing requires the use of ones' imagination and expression of creativity. It is up to students to build on the knowledge and skills they acquired in school and in apprenticeship training through interest and motivation. It is not surprising that about one-thirds of the respondents had had only second cycle education. This is because there are not enough vocational tertiary schools in existence in the country and the cost of tertiary education is very expensive. Many students go into vocations and later develop their abilities.

Apprentice Under The Respondents

Table 3 shows the apprentice population under the tutelage of respondents.

TABLE 3. PERCENTAGE DISTRIBUTION OF APPRENTICES UNDER RESPONDENTS' TUTELAGE

No of Apprentices	%
1-3	39
4-6	32
7-9	11
>10	1
None	17
Total	**100**

Total number of respondents =100

Thirty-nine percent of the respondents had between one to three apprentices. While 32% had between 4 and 6 apprentices, 11% of the respondents had between 7 and 9 apprentices. Only one person had more than ten apprentices and 17% had none. Professional training of a seamstress/tailor is acquired through apprenticeship and formal vocational school. Apprentices normally choose to train as dressmakers and tailors from some existing ones either through recommendation and/or observation of workmanship (Fianu and Acquaah-Harrison 1999). Respondents with 7-9 apprentices had bigger workshops. Perhaps the low number of apprentices per dressmaker can be attributed to lack space, equipment and facilities. It is common knowledge that the apprentices copy whatever skills, ideas about the workplace environment-set up, styles of furniture from their instructors. So they get sucked into the cyst of circular negativity or positivism.

Length Of Work Experience

Table 4 presents the number of years the respondents had been sewing as professionals.

TABLE 4. PERCENTAGE DISTRIBUTION OF LENGTH OF TIME RESPONDENTS HAD BEEN SEWING AS PROFESSIONALS

No of years as professionals	%
< 5	39
5 – 10	26
11 – 15	19
16 – 20	11
21 – 25	3
> 25	2
Total	**100**

Total number of respondents =100

While 39% had been sewing for less than 5 years, 26% had been sewing as professionals between 5 and 10 years, 19% between 11 and 15 years, 11% between 16 and 20 years, 3% between 21 and 25 years and 2% over 25 years. It appears from the data in Table 4 that few older garment producers register with the association of garment makers. This may be due to the fact that perhaps registration of garment producers with an association is a new concept, which has caught on with the younger generation. To deal with tax laws and other cooperate bodies in modern economies, registration with a related or relevant associations offers needed help to professionals. Ergonomic Report (1993) pointed out that, the appearance of injuries and illness are often dependent on individual work factors including length of employment. Perhaps dressmakers and tailors quit sewing as they grow older to the appearance of injuries and illness.

The Number Of Hours Spent At Work And Seated By Respondents

When respondents were asked the average time they spent working in a day and the average time they spent seated working in a day the data in Table 5 were obtained.

TABLE 5. PERCENTAGE DISTRIBUTION OF TOTAL NUMBER OF HOURS SPENT WORKING IN A DAY AND NUMBER OF HOURS SPENT SEATED WORKING IN A DAY AT THE WORKSHOP

Number of hours	Percentage of respondents at work per day	Percentage of respondents seated at work per day
<3	0	1
3 – 5	3	13
6 – 8	61	58
> 8	36	28
Total	**100**	**100**

Total number of respondents=100

Total Hours Spent At Work In A Day

Sixty-one percent of the respondents stated that they worked between six (6) and eight (8) hours while 36% and 3% worked for over eight (8) hours and between three (3) and five

(5) hours a day respectively. None of the respondents spent less than three (3) hours daily at work. The responses indicate that 36% of the respondents spent more than the International Labour Organizations' recommended eight (8) hours per day working time at work for formal setting. This in my view is a bit of an exaggeration, as respondents seemed to want to give the impression that they were serious workers. People who are self-employed in the informal sector, however, are not obliged to work the same number of hours as people in the formal sector. They therefore, can work longer or shorter hours in a day. However, spending less time at work means making less money. One indeed should have good reasons to spend only a few number of hours at work producing garments. It was not surprising that out of the 3% respondents who worked less than six (6) hours, one was recovering from a protracted illness and the other was a lactating mother of twins and therefore spent more time off work to be with the children. The more time a respondent spend at work engaged in awkward postures or exposed to hazards in the workplace, the more he is likely to encounter MSDs.

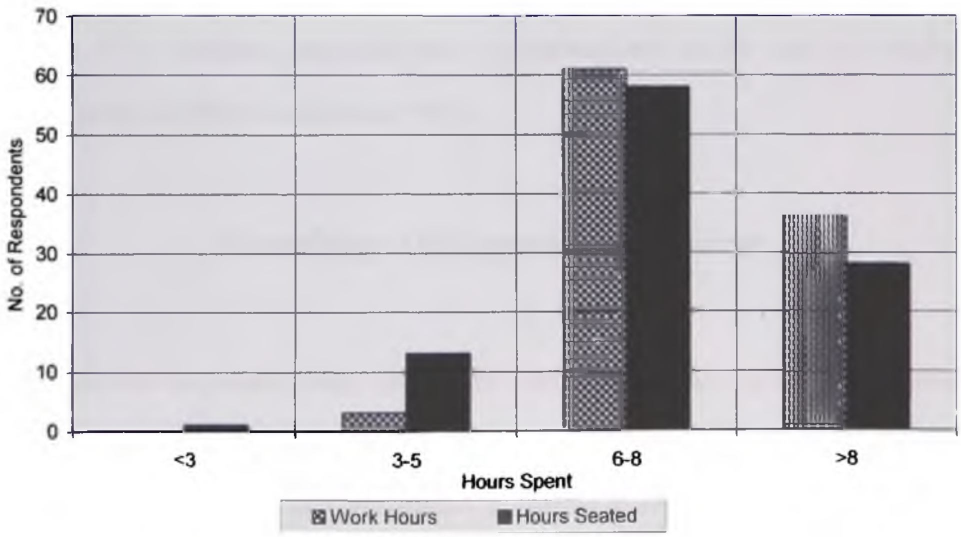
Working Hours Spent Seated At Work In The Workshop

While 58% of the respondents reported that they spent between six (6) and eight (8) hours seated during work time (Table 4), 28% stated they spent more than eight (8) hours seated at work. Thirteen percent reported that they spent between 3 and 5 hours, and only one stated less than 3 hours was spent at work seated. For dressmakers, a day's work may entail skills in sewing like tacking, hemming, sewing buttons–holes, fasteners and machine stitching. Other skills such as designing, cutting out and ironing also form part of a day's work. However, some of the respondents reported that the laying and cutting out of fabrics before sewing was done the night before the next day's work. Others did this weekly, usually on Mondays, that is, the beginning of each working week. Thus for most of them, a days work entailed mostly stitching of garments. They, therefore, sat for long periods in their workshops stitching except when on break, ironing, taking measurements of new clients, among others.

A Comparison Between The Number Of Hours Spent At Work And The Number Of Hour Spent Seated By Respondents In Their Workshop

Figure 2 is a bar graph based on the approximate number of hours respondents spent working in a day in their workshop and the corresponding hours seated.

FIGURE 2. THE NUMBER OF HOURS SPENT AT WORK AND THE CORRESPONDING HOURS SPENT SEATED BY RESPONDENTS



It is apparent that a lot of the respondents spent long periods seated while at work. More than three-quarters of the respondents' working time in each case was spent seated. The respondents (28%) spent more than 8 hours seated at work in a day. Prolonged sitting itself causes health problems by the creation of MSDs as pointed out by Chavalisaklchai and Shahnavaz (1993), Grieco (1986) and Gradjean 1973. This report suggests that respondents can be proned to MSDs as the majority of respondents (86%) spent more than 6 hours seated at work. Pottier, Dubreril and Mond (1969), cited by Oborne (1982) indicated that prolonged sitting (over 60 minutes) produces swelling in the lower leg of all sitters as a result of an increase in hydrostatic pressure in the veins and the compression of the thighs causing an obstruction in the return of blood flow. While Peet *el al* (1970) recommended that if a task permits the worker to remain seated for a considerable period of time, the worker, the chair, and work surface should be in proportion to each other and right for the task, Elese (1998) had noted that chair adjustment, support and comfort were very important for good health and comfort in such cases. It is, therefore, presumed that respondents, who do not meet the requirement suggested, are likely to experience MSDs.

4.2 Knowledge Of Ergonomic Features

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Factors such as posture, seats, table height, levels of ventilation, lighting, temperature and noise all combine in different ways to help the seamstress/tailor work with efficiency and in comfort. To find out the respondent's knowledge about ergonomic factors suitable for the workplace, a number of questions were asked. This was an attempt by the researcher to link certain responses to ergonomic knowledge since very often stressors/ hazards present in the task of sewing and environment account for non-optimal performance.

Respondents' Considerations Before Setting Up Workshops

Respondents were asked to indicate the factors they took into consideration before the setting up of their workshop. The respondents knew that seats, tables and lighting are very essential for the work. All the respondents said that they considered seats before setting up of their workshops. Table 6 shows the responses on ergonomic factors respondents took into consideration before setting up a workplace.

TABLE 6. PERCENTAGE DISTRIBUTION OF ERGONOMIC FEATURES CONSIDERED BEFORE SETTING UP WORKSHOPS

Features	%
Seats	100
Lighting	98
Table height	92
Temperature	64
Colour of wall surfaces	55
Noise	33
Ventilation	32
***Total**	**474**

**Number more than 100 due to multiple responses*

Lighting came second with 98% while table height was third with 92%. Temperature, colour of wall surfaces, noise and ventilation, were all given consideration by less than 70% of the respondents. However, they gave little thought to temperature, colour of wall surfaces, noise and ventilation before setting up their workshops. Temperature in the Tropics is fairly constant. Noise is all over and noise that is heard over and over again cannot even be "heard" over a period of time as one gets used to it. Probably these account for the little consideration given them.

Importance Placed On Ergonomic Factors By Respondents.

To find the knowledge level of respondents on ergonomics, respondents were asked the importance of ergonomic factors in relation to their work presently. Table 7 shows the number of respondents who placed importance on posture, seats, table height, ventilation, temperature, and noise in work performance.

TABLE 7. PERCENTAGE OF RESPONDENTS WHO PLACED IMPORTANCE ON ERGONOMIC FACTORS IN WORK PLACE

Factors	Importance (%)
Lighting	100
Type of seats	100
Temperature of the environment.	91
Table height	83
Color of wall surfaces	37
Noise	36
Ventilation	33
Posture	20
***Total**	**400**

**Number more than 100 due to multiple responses*

Lighting and seats were both considered by all of the respondents as important. Lighting in any form serves as a source of illumination for human activities. Poorly lit rooms do not enhance vision for task performance. Fashion designers need light for vision and that badly lit rooms could negatively affect the eye. Agan and Luchsinger (1965) recommended that to facilitate work, reduce fatigue, prevent eyestrain and eliminate some causes of accidents, both natural and artificial illumination should be adequate. Again, respondents might have realized that seats were necessary for their work because one cannot stand and sew for long periods as a professional.

Ninty-one percentage indicated that the temperature of the environment was important, 83% indicated the height of the table for work as important. Those who said the colour of wall surfaces, noise, ventilation and posture were important were 37%, 36%, 33% and 20% respectively. This is less than 40% in each case. Perhaps because the effects of inadequate and/or improper use of these features seem intangible they could not relate to them and therefore were not aware of their importance to garment production. However, temperature could easily be felt and the absence of light and seats in a workshop could be visualized and therefore were considered by over 90% of the respondents as important. One should, however, not discount the fact that even though they listed lighting, type of seats, table height and temperature as important, they did not relate them to ergonomics. This may be due to lack of knowledge about the concept, ergonomics.

Respondents' Satisfaction And Dissatisfaction With Their Work places

The respondents were asked to state their satisfaction and dissatisfaction with their workplaces. Fifty-six percent of the respondents stated that they were not satisfied with their workshop environment while 44% were satisfied with their workplaces. With the exception of space and noise, most of the reasons given for satisfaction did not reflect ergonomic features. Reasons for satisfaction included a peaceful and friendly neighborhood, access to basic amenities such as water supply and electricity, feeling of security, access to customers, workshop being at home and general contentment, among others. Similarly, reasons given for dissatisfaction did not reflect ergonomic issues in the work environment. Reasons given for dissatisfaction included poor location, poor drainage of locality, lack of basic amenities, stench from a nearby refuse dump and insecurity, among others. From these responses it can be assumed that ergonomic features for the workshops were not a priority for majority of the respondents - probably due to lack of knowledge.

Structural Changes Desired By The Respondents In Their Workshops

To further evaluate the respondents' level of knowledge about ergonomics, respondents were asked if they felt the need to make changes in their workplaces. While 93% affirmed they would love to make changes, 7% felt no need for changes. The respondents were therefore asked to state changes they would effect at their workplaces when given the opportunity. Table 8 shows the structural changes desired.

TABLE 8. PERCENTAGE DISTRIBUTION OF DESIRES IN STRUCTURAL CHANGES

Nature of change desired	%
Expand / enlarge facilities	72
Improve workshop environment	51
Purchase new equipment	34
Relocate/ build new shop	18
Improve ergonomic features	7
Need no change	7
***Total**	**189**

**Total more than 100 due to multiple responses.*

Seventy- two percent of the respondents wanted to expand the facilities in their workshop in various ways so that there would be increase in their income. While some wanted to enlarge the workshop to accommodate more apprentices, others wanted to build shelves and showcases for exhibition and sale of fabrics and haberdashery for added income. The more apprentices one has the more money one is likely to make from apprenticeship fee. Fifty-one percent of the respondents indicated that they would want to extend electricity and have pipe-borne water flowing in workshop, among a host of items such as repairing or replacing the wooden boards from which the floor of the kiosk is made of, changing curtains on windows, repairing leakage on ceiling of kiosk, fixing hinges on windows, re-painting interior and exterior of workshop, changing of mosquito nets, covering floor with linoleum, fixing new bulbs, fixing a sink, providing toilet facility and installing telephones in the workshops. Thirty-four percent of the respondents desired to purchase some new equipment which were electric, neatening and buttonhole machines for commercial production, ironing boards, pressing iron, among others. Those who wished to relocate their kiosks in a more conspicuous place for more customers, or move it from an unauthorized area, or build new shops were 18%. The nature of change desired by 7% of the respondents was however, related to ergonomic features in the work environment. These included the desire to enlarge windows for more air, raise the ceiling of kiosk to reduce the high temperature in the kiosk, provide padded seats, expand workshop to improve human traffic and improve the lighting system. When the respondents were asked why they had not yet made the changes, over 80% attributed their inability for making changes in workshop to financial constraints.

From the study, though over 90% of the respondents would like to make changes, the kind of changes the majority of the respondents had in mind, to a great extent, did not portray the desire to improve ergonomic features in the workshop. This is because very few mentioned changes in facilities for ergonomic benefits. It can be assumed that garment producers did not possess an appreciable sense of ergonomics.

4.3 Stressors/Hazards Present In The Work Environment That Affected Productivity

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Stressors or hazards present in a work environment result from poor ergonomic practices both during the motion of sewing (i.e. the working means or task) and the workplace environment (i.e. the physical surrounding). To determine the stressors present in the garment producers' working-environment, the stressors were divided into two groups- (a) stressors in the physical surrounding e.g. noise, lighting, color of interior walls and ceiling, temperature, ventilation, seats and table heights and (b) stressors in task performance e.g. awkward posture, repetitive motions, and forceful exertions.

Stressors Present In The Physical Surroundings

The result and discussions are based on responses from the respondents and those recorded through observation by researcher.

Noise As A Stressor

The respondents were asked if they experienced any unwanted noise. While 68% said they did not experience noise, 32% did. The sources of noise experienced were from welding machines, corn mill, sawn-mills, generators and steel-cutters. Also listed, as sources of unwanted noise were noises from musical shops, moving vehicles, hawking and general market noise and quarrels.

Noise Description

When respondents were asked to describe the noise level at their workplace, the data in Table 9 were obtained.

TABLE 9. PERCENTAGE DISTRIBUTION 0F THE RATINGS ON NOISE LEVEL

Description	%
No Noise	68
Barely audible	20
Annoying	8
Unbearable	4
Total	**100**

Total number of respondents =100

Of the 32% who did experience noise, 20% of them rated the noise in their workplace as barely audible. While 8% described it as annoying, 4% described it as unbearable. Dees (1998) and Oborne (1982) pointed out that a comfortable noise level is important as noise levels can hinder the efficiency of the worker. What one considers as noise may be different from another person's. It is therefore not surprising that as many as 68% of the respondents stated that they did not experience any noise. Madina has a big market so it is a busy place. The researcher observed that almost a half of the workshops (56%) were located within the market area. There was a lot of noise made by streams of moving cars and constant tooting of car horns. There were also blurring noises from many musical shops in addition to the noise from the market than was indicated by the respondents. Perhaps the respondents along the street discounted these as noise as they had grown accustomed to them. This difference between respondents' rating and researcher's observations confirms Oborne (1982) assertion that sound source is considered as being "noise" or not "noise" solely on the basis of the listener's reaction to it. Poulton (1977) cautioned that excessive noise is a medical hazard and may interfere with performance and should therefore be reduced sufficiently. It can be assumed that the respondents encountered undesirable and unpleasant noise in their workshops, which could have affected optimal performance.

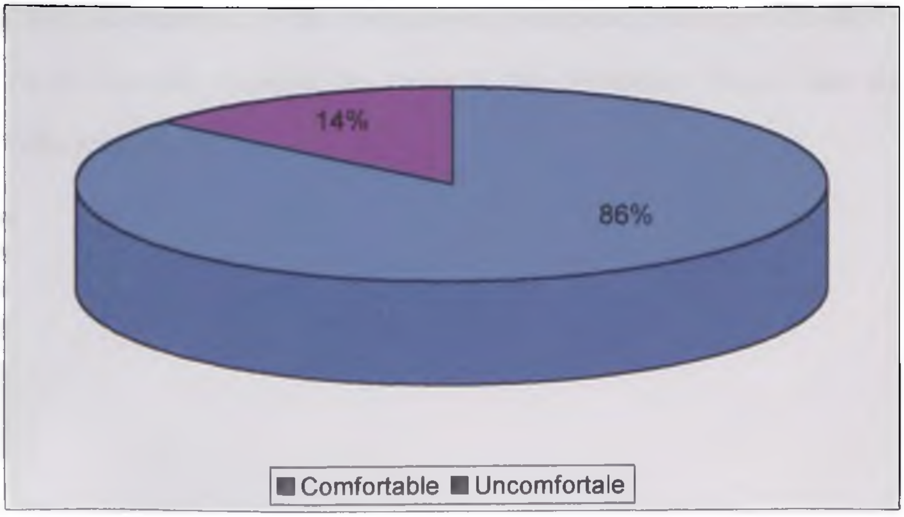
Lighting and Vision As A Source Of Hazard

The respondents were asked to state the source of light they frequently used. Seventy-eight percent of the respondents said that they used natural source of lighting (sunlight) throughout the period they worked (between the hours of 8am and 6pm). However, when the workshop was badly lit as a result of a bad weather then they used artificial light in addition. Those who reported using both natural and artificial source of light for the entire time because the amount of sunlight was not adequate for them were 22%. The situation where the majority used natural source of light is in consonance with McCormick and Sander (1982) who reported that people in many aspects of life depended upon natural light, the sun, as a source of illumination. The majority of the respondents use natural source of light because the climate lend itself to it and also because it is cheap for such kiosk dressmakers. The use of artificial light to provide adequate light becomes important, as there could be bad weathers that call for its use at daytime or where the workshops are in very enclosed area, for example, in complex buildings.

Description Of Visual Comfort

The respondents were asked to describe the visual comfort in their workplace. Figure 3 shows the description of the visual comfort by the respondents.

FIGURE 3 PERCENTAGE DISTRIBUTION OF VISUAL COMFORT

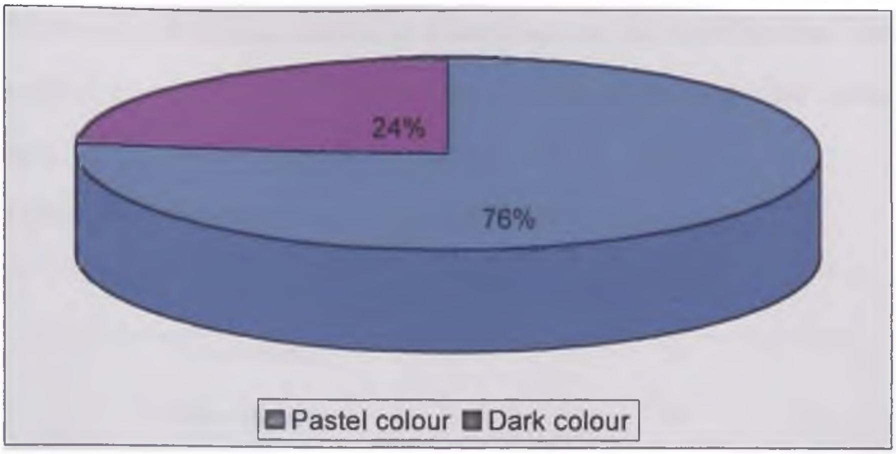


While 86% of respondent described the illumination in their workshop as comfortable, 14% found it uncomfortable. The majority of the respondents described attributes such as adequate amount and position of lighting in their workshops very high. Over 70% said the lighting system was properly positioned for the task, was adequate for the task and was well distributed. However, from the researcher's observation the visual comfort of the workshop was rated too high by the respondents. This is because windows to admit sunlight were small in proportion to the size of the room or were not existent and doors not wide to admit enough light from outside. Peet *el al* (1970) asserted that human seeing responses improved as lighting levels are increased and these have direct bearing on human performance and productivity. For good performance and high productivity, therefore, the respondents should improve the lighting system in their workshops.

Colour Of Wall Surface And Ceiling Of Workshop As A Hazard

Colour and texture add to the atmosphere of a workplace. The respondents were asked to describe how they perceived the colour in their workplace. The pie chart shows the results obtained.

FIGURE 4. PERCENTAGE DISTRIBUTION ON COLOUR DESCRIPTION OF WORKSHOP



Seventy-six percent of them described the interior colour of their workshop as light in shade while 24% described theirs as dark coloured. The researcher also observed 72% workshops as having walls in pastel colours and 28% walls had dark colours. It was also noted that the workshop of 67% of the respondents had white ceilings. Generally, therefore, the workshops were painted with light colours. Grossmith and Chambers (1998) reported that walls painted in pastel colours have a high level of reflectivity and offers clear vision. This ties in with Agan and Luchsinger (1965), Gawthorpe (1972) and McCormick and Sander (1982) assertion that the distribution of light within a room is not only a function of the amount of light and the location of luminaries, but it is also influenced by the reflectance of the walls, ceilings and other room surfaces by the use of pastel colours. This suggests that the pastel colours used to paint the walls in the workshop might have contributed to the "partial" visual comfort experienced in the workshop afore stated (Page 53).

Temperature As A Stressor

The intensity of thermal sensation in a workplace can affect performance, comfort and health of a worker. Table 10 presents how the thermal comfort in the workplace was rated.

TABLE 10. PERCENTAGE DISTRIBUTION OF RATING ON THERMAL COMFORT.

Description	%
Comfortable	28
Uncomfortable	24
Unbearable	48
Total	**100**

Total number of respondents =100

While 48% of the respondents rated the thermal comfort of their workplaces as unbearable, 28% and 24% rated it comfortable and uncomfortable respectively. Thus more than 70 % considered the workplace as not being comfortable. The respondents were therefore asked to rate the thermal intensity as indicated in Table 11 that follows.

Thermal Intensity

Table 11 shows how respondents rated the thermal intensity.

TABLE 11. PERCENTAGE DISTRIBUTION OF THE RATINGS ON THERMAL INTENSITY

Intensity	%
Very Hot	52
Moderately Hot	33
Cool	15
Total	**100**

Total number of respondents =100

Fifty-two percent of the respondents rated their workplaces as very hot, 33% rated theirs moderately hot and 15% felt theirs were cool. Thus, both the thermal description and thermal intensity showed that the majority of the respondents in each case felt that their workshops were rather hot and uncomfortable. The researcher also felt the heat during the observation. The period (January to May) when the study was conducted might have influenced the nature of the responses. It was the dry and hot season in the southern part of Ghana. Furthermore, the workshops that were roofed with aluminum sheets were also small, often over crowded and poorly ventilated. These were all good recipes for the tremendous heat experienced in them. Excessive heat in a workshop is likely to adversely affect performance, comfort and in extreme cases, one's health (Oborne 1972).

Ventilation As A Stressor

Stale air in a room needs to be exchanged for fresh air or the atmosphere becomes stuffy. Poor ventilation is associated with dizziness, headaches, nausea and discomfort. Good ventilation thus is essential for efficient production. Table 12 shows ratings of natural ventilation in the workplace by respondents.

Table 12. PERCENTAGE DISTRIBUTION OF RATINGS ON VENTILATION

Rating	%
Good	29
Moderate	54
Bad	17
Total	**100**

Total number of respondents = 100

Fifty-four percent rated ventilation in their workshop as moderate. Twenty-nine percent of the respondents stated that the ventilation was good while 17% said it was bad. However, from the observation by the researcher, 65% of workshops were poorly ventilated. Only two of respondents had well designed ventilation holes constructed in their workplace. The ventilation holes were achieved by the deliberate provision of adequate holes left in the walls and ceiling to help take out hot air from the room. However, in many of the workshops particularly the kiosks, there were defects, such as cracks in walls, gaps in roofs and in floorboards though dangerous let in some air and could serve as ventilation holes. Again the observation by the researcher revealed that 58% of the respondents did not have cross ventilation and in most cases windows were rather proportionately very small for the workshop. A few (13%) did not have any windows. Such situations were contrary to Brew and Ekuban (1991) and Dees' (1998) assertions that proper ventilation should be a must in a workspace. It follows that the majority of the workplace environment could be stuffy and unhealthy and could create discomfort for the respondents and expose them to contagious diseases such as tuberculosis. Forty-two of them, however, indicated that they often used artificial system in the form of ceiling and standing fans to increase air circulation. It is therefore not surprising that from observation a few number of workshops left their doors opened, during working hours, to aid ventilation.

Seat As A Stressor

A good seat is one that has the attribute to help the sitter stabilize the body joints so that comfortable posture is maintained. The respondents were asked to rate the attributes of seats in their workshop. Table 13 shows how respondents rated the attributes of their seats.

TABLE 13. PERCENTAGE DISTRIBUTION OF ATTRIBUTES OF SEAT RATED SUITABLE

Attribute of Seat Rated Suitable	%
Seat Height	92
Seat Depth	85
Seat Width	81
***Total**	**258**

**Number more than 100 due to multiple responses.*

Ninety- two percent of the respondents rated the height of their seats as suitable, 85% the depth while 81% mentioned the width. Thus less than 20% each of the respondents rated their seat height, width and depth unsuitable. Generally, carpenters were simply told to produce stools without being given any specifications. Stools were also bought from hawkers who often paraded them around – with no standard measurement since carpenters use their own discretions. A few stools were however, custom made. Seats were, therefore, of different heights, widths and depths. Those who worked from their homes on their verandas, in their halls and dinning rooms, mostly used ordinary dinning chairs or chairs meant for writing tables. It is therefore surprising that seats obtained from different sources were found to be suitable by the respondents.

Upon observation that was based on the literature, the researcher found that only 17% of the respondents had seats with backrest or support while 83% did not. Seats were mostly stools (Appendix C, p. 108). While three of backrests were positioned in the lower back, six of them were positioned in the upper back and eight from the nape to the seat pan. These were contrary to McCormick and Sanders (1982), Grandjean (1973), Floyd and Ward (1969) and Oborne (1982) assertion that seats should have back support and that the support should provide for correct curvature of the lumber, or lower back area in order to keep the spinal column in a state of balance to reduce stress and prevent fatigue and pain in the back, neck and shoulder. None of the respondents had a seat with a backrest that was adjustable as suggested by Agan and Luchsinger (1965) and Elese (1998). The few who had seat backs were seen to sit forward on the chairs away from the support of the backrest as if sitting on stool (Appendix D p. 109). Therefore, it will be better for respondents to have a seat with an adjustable lumber support that could move up and down, in and out to support the spine when desired, to prevent complications. Sitting on hard, unadjustable and no lumber support chairs cause the torso to be bent slightly and create pressure on the disk and muscles of the spine. The use of seats that do not have backrest could cause pain as observed by Grandjean *et al* (1973), Oborne (1982), Ergonomic Report (1993) and Elese (1998). It can be assumed that the respondents could suffer pain in the back region.

Only one of the respondents had a seat that had the front edge below popliteral height as suggested by McCormick and Sanders (1982). This seat measured 5cm below the popliteral crease as recommended by McCormick and Sanders (1982). The majority (99%) could therefore have excessive pressure on the thigh which could cause pain in the thigh region. Only 13% had padded seat. The padding was mostly found in the seat pan and not in the lumber area. It was mainly of foam, some of which had been roughly cut and simply placed on the seat. This was in sharp contrast to Elese's report (1998) which stated that a padded back and seat cushions were both desirable. Almost all the seat pans were not properly contoured to distribute the body weight through out the buttock region to avoid pressure from the ischial tuberosities (Oborne 1982).

The findings from both the interview and observation suggest that since the majority of respondents were using seats that did not have backrest, adjustable backrest, padded seat or seat with front edges that were 5cm below popliteral crease, or properly contoured seat pan, they respondents lacked comfortable and functional seat as prescribed by

McCormick and Sanders (1982) which could reduce performance (Oborne 1982). From these findings one could infer that respondents' level of awareness of ergonomic features of equipment was low.

Seat Height

Contrary to the high rating of respondents of the suitability of their seat height, seat width and seat depth in Table 13, a comparism between their seat measurements and those recommended in the literature were at variance. Table 14 shows the percentage distribution of the respondents and the seat heights they used.

TABLE 14. PERCENTAGE DISTRIBUTION OF RESPONDENTS AND THE TYPE OF SEAT HEIGHTS USED

Height (cm)	%
< 38	6
*38 – 50	37
> 50	57
Total	**100**

**Recommended seat height*

The study revealed that 37% of the respondents had seats that fell within the suggested 38–50cm range for heights suitable for work as suggested by Grandjean (1973) and McCormick and Sanders (1982). Fifty-seven percent of the respondents had seats higher than the recommended and 6% had seats that were less than the recommended height. Yamaguchi and Umezawa (1970) were cited by Granjean and Hunting (1977) that seats that are too high were likely to cause pain in the knee, lower legs and neck while seats that are too low cause pain in the shoulders and neck. This means that 63% of the respondents could develop lower leg, knee, shoulder and neck pains. Forty-eight percent of the study sample stated that the height of their seat did not allow them to place their feet on the floor. This suggests that their seats were rather too high and therefore respondents could encounter discomfort. Heights that do not allow the placement of feet on the floor exert excessive pressure on the thigh where it presses against the chair and also cause the swelling of the feet as it hangs in mid-air (Oborne (1982), Bex (1971), McCormick and Sanders (1982)). Yet, 92% rated their seats height as suitable (Table 13, p. 58). This might be due to the fact that some stools and tables used by respondents had a type of footrest at their base. This usually consisted of a strip of wood attached as part of the stool or table to secure and support the frame (Appendix C, p. 108). Though these were not designed originally as footrest, they do serve as footrest sometimes. Footrests are often used to compensate for a chair that is too high in order that the thigh does not rest on a sharp or a hard edge. Wide footrests give more choice of leg posture and therefore respondents were bound to experience some amount of discomfort by using the strips of wood.

None of the respondents had a seat that had an adjustable height as suggested by Grandjean *et al* (1973) and McCornick and Sanders (1982). When respondents were asked if the height of their seat allowed them adequate knee room, 68% said yes while 32% said it did not. This was contrary to Peet *et al's* (1970) statement that the work surface should be clear of the thighs and permit all parts of the body particularly the shoulder to remain in their natural alignment by the provision of adequate knee room. Thus, over 30% did not have knee space and were likely to feel crowded and unable to move legs into comfortable position (Bex 1971).

Seat Width

Table 15 shows the percentage distribution of respondents and the type of seat width used.

TABLE 15. PERCENTAGE DISTRIBUTION OF RESPONDENTS AND THE TYPE OF SEAT WIDTH USED

Seat width (cm)	%
< 42	13
*42 – 47	51
> 47	36
Total	**100**

**Recommended seat width*

The respondents (51%) had seats with widths that ranged between 42–47cm and therefore fell within the recommended range as suggested by Oborne (1982), Ergonomic Report (1993), Agan and Luchsinger (1965). Thirty-six percent of them had seats with widths larger than 47cm and 13% had seats of widths smaller than 42cm. The study therefore revealed that over 80% of respondents had seats broad enough for sitting comfortably to sew. This was consistent with Oborne's (1982) assertion that seat width should be broad to accommodate large persons with broad hips. Thirteen percent of the respondents had seats that were not broad and could cause discomfort in the thigh region.

Seat Depth

Table 16 shows the percentage distribution of respondents and the type of seat depth used

TABLE 16. PERCENTAGE OF RESPONDENTS AND THE TYPE OF SEAT DEPTH USED

Seat depth (cm)	%
< 33	52
*33 – 40	37
>40	11
Total	**100**

**Recommended seat depth*

Thirty-seven percent of the respondents had seat depths that ranged between 33-40cm and were within the suggested range of 30–40cm suitable for the workplace as suggested by Oborne (1982), Agan and Luchsinger (1965) and Grandjean (1973). Fifty-two percent of the respondents had seats with depths less than 33cm and therefore less than the recommended depth range and this could cause discomfort in the thigh region. Eleven percent had seats with higher depth. Depths that are not able to provide clearance for the calf of the leg do not minimize thigh pressure of the user (McCormick and Sanders 1982). This suggests that over 60% of the respondents had seats with depth that were unsuitable and respondents could therefore experience pressure and compression. Generally, therefore, seats used by the garment producers were poorly designed because the depth was not suitable for large persons as suggested by McCormick and Sanders (1982). Closely linked to seat are tables on which machines are placed for stitching. The respondents were asked if the height of their seats enabled them have their elbows at the top of their tables when seated. Eighty-five percent of the respondents indicated that the height of their seats allowed them to have their elbows well above table. This was contrary to Bex (1971) assertion that the desktop must be approximately at elbow height. Respondents had to raise their upper limb when stitching. This could lead to awkward arm posture, static work and fatigue (Steidl and Bratton, 1968).

Table Height

For cutting-out and pressing, the height of the elbow from the tabletop when standing is an important landmark for determining a desirable height. This can maintain a posture and arm position that avoids static work and fatigue. Table 17 shows the distance between respondents work surface and elbow height at a posture for standing work.

TABLE 17. PERCENTAGE DISTRIBUTION OF DISTANCE BETWEEN WORK SURFACE AND ELBOW HEIGHT AT STANDING POSITION

Elbow height in cm from work-surface	%
< 5	11
*5 – 10	38
>16	51
Total	**100**

**Recommended distance between standing work surface and elbow height.*

Thirty-eight percent of the respondents had their work surface between 5-10cm from the elbow, which was within the proposed 5–10cm below elbow by Barnes (1963). Fifty-one percent and 11% had distances over 16cm and under 5cm from elbow to their work surfaces respectively. The results implied that 51% of respondents had much lower tables that could make them bend forward over work surfaces and curve their spine unnecessarily at standing positions for work (Appendix E p. 110). The use of low tables makes users slouch over lower work surfaces and run the potential for neck and other body strains. On the other hand, tables that are too high can make respondents raise their elbows awkwardly high and bend their arms. Thus 11% of respondents could encounter pain in the arm.

Ironing And Cutting-Out Surface

Less than 17% of the respondents had special large tables on which both pressing and/or cutting out were done. Less than 30% had ironing boards that were used solely for ironing. The majority of the skirt boards were adjustable to vary the heights. This was in accordance with Steidl and Bratton's (1968) report that adjustable ironing boards are desirable since small differences in body proportion must be accommodated on individual basis whether the worker stands or sits and permits at least 90-degree angle between the forearm and the upper arm.

It was observed that the majority (over 70%) of the respondents usually used the same tables on which sewing was done, for their pattern laying and cutting-out. Seven percent of the respondents who had their workshops at home in their sitting or dinning rooms stated that they used their dinning or kitchen table for pattern laying and cutting-out. Steidl and Bratton (1968), however, warned that dinning or kitchen tables were too low for pattern laying and cutting-out for sewing and could be backbreaking. The respondents either asked carpenters to make them tables that would fit into their workshops without giving them any specifications or they bought tables already constructed for sale. Tables and work surfaces in the various workshops were of different heights and most of them undesirable as indicated in Table 17 page 65 (and Appendix E p.110). Working on an undesirable height of work surface results in poor body posture and arm position (Steidl and Bratton 1968). This has the potential for neck and body strain.

Perhaps some of the stressors encountered in the physical surrounding, for instance, high temperature, poor ventilation, inadequate lighting, improper seat and table heights could be attributed to the fact that, the Ghanaian worker is often faced with a chioce of efficiency against cost. The initial capital to establish a business may be a problem and therefore practitioners may resort to improvisation and adaptation. For example, every Ghanaian may appreciate a new car but may have to do with a second hand one, as they may not be able to raise the capital for a new car. Over 80% attributed their inability for making changes in their workshop to financial constraints and therefore stay with their mediocre working environment.

4.4 Stressors Observed by Researcher in the Garment Production.

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Production can be affected by hazards associated with the performance of the task of producing garments. Stressors to be discussed under this section include awkward postures, repetitive motion, contact stress, static motion and forceful exertions. The researcher observed the respondents as they went about their work of producing garments and recorded the stressors present in the task of sewing by using a structured observation format (appendix B Page 106).

Awkward Postures

Posture is the position of the body or way in which a body is held during standing or sitting. At work the human body assumes different postures. When a body is taken out of its normal alignment or a joint is moved towards the limits of its range of motion it creates unusual and uneven stress on the joints and surrounding soft tissues. Postures such as bending, twisting, prolonged sitting, stretching or holding the arms up high can cause pain on muscles and reduce efficiency. A checklist of awkward postures was drawn up to show the different risk factors under awkward postures outside the "neutral" range. Table 18 is the observation made by the researcher.

TABLE 18. PERCENTAGE DISTRIBUTION OF AWKWARD POSTURES

Awkward Postures	%
Neck Twisting or Bending	92
Prolonged sitting without adequate back support	83
Mild bending of Torso >15°	62
Severe bending of Torso more than 15° but less than 30°	29
Wrist bend or deviate	53
Twisting of Torso	49
Ankle flexion	19
Shoulder unsupported, elbow above torso	2
***Total**	**389**

**Number more than 100 due to multiple responses.*

Neck Twisting or Bending

Generally, postures for machining required frequent bending of the neck, shoulder, elbow, wrist, or finger joints. Almost all the respondents (92%) twisted or bent their neck while working. This is consistent with Grandjean and Hunting (1977), Ergonomic Report (1993) and Li *et al's* (1995) findings that trunk posture was strongly related to the manual aspects of the machining task and head posture by the viewing the fabric and the needle. The respondents sat with their heads bent forward to position the fabric for the sewing needle. Working with the head bent is considered a "hidden lifting task", since the muscle in the back of the neck must lift or hold up the weight of the head. The further down the head is bent the greater the strain. If the head is held in this position for a long period of time, the tensed, tightened neck and shoulder muscles can obstruct the flow of blood in the area. This can cause the muscle to fatigue rapidly, to work less efficiently, and to become strained and sore (Ergonomic Report, 1993). Production was bound to be affected.

Prolonged Sitting without adequate back support

Over 80% of the respondents were observed sitting without any back support while sewing continuously. An adjustable seat back was non-existent and respondents had reported that they sat as long as 5 to 8 hours at work (Fig.2 p. 41). This was similar to Gaardboe's (1993) analysis of a work-site which revealed that sewing machine operators had poor workstations with unadjustable, wooden chairs that caused them to use awkward postures when working. Grandjean (1973) pointed out that prolonged sitting in itself causes health problems. For example, abdominal muscles slacken and the functioning of some internal organs are impaired. Oborne (1982) quoted Pottier, Dubreil and Mond (1969) to have demonstrated that prolonged sitting (over 60 minutes) produces swelling in lower leg of all sitters. It is not surprising therefore that there were complaints of swollen legs by 17% of the respondents. In practice, prolonged sitting without back support while sewing creates stress and static loading on the musculoskeletal system of the shoulder, upper arm and upper back and makes the muscle, tendon, and ligament system more susceptible to injury. This suggests that respondents could encounter discomfort which would lead to injuries.

Torso Movement

While 62% of the respondents bent their torso mildly, that is less than 15° towards their sewing machine, 29% bent their torso severely between 15° and 30°. These postures were adopted both continuously and intermittently during sewing. These postures were caused by the type of seat used, the position adopted while stitching and the inclination of the sewing machine (see Appendix D p. 109). Thus the head, neck, and shoulders of respondents were not maintained in a neutral posture and they were likely to suffer backaches. Workers on the sewing machine were unable to change their position often. Nine percent of the respondents however, sat straight while sewing. This was the preferred posture by Grandjean (1973) as he believed a forward hunchback posture caused most activity to occur in the upper back and shoulder regions and might result in a musculoskeletal injury. Forty-nine percent were observed to be twisting their torso intermittently to pick fabrics or shears and other tools from other work surfaces, thus, causing stress on muscles and tissues.

Wrist bending and Ankle Flexing

It was observed that 53% of the respondents were engaged in both wrist bending and wrist deviation during their work. This was particularly so among the respondents who used the hand sewing machine. Hand wheels were used as a means of applying force to perform the function of stitching. This stress to the wrist can cause musculoskeletal disorder for the respondents. Nineteen percent of the respondents encountered ankle flexion. Flexing of the ankle continuously could lead to injury of the ankle because they used treadle machine. The use of foot controls on the sewing machine also restricted their posture because having to maintain the foot on a control made it more difficult to shift around in the seat or change position of the legs.

Special Awkward Postures

Special awkward postures such as repetitive motion, static motion, contact stress (parts of the body in contact with objects are considered risk factors as such contact can cause injuries), forceful exertions, extended reach and vibration might overload muscles and tendons causing stress, pain or injury. Table 19 shows special awkward postures as recorded by researcher in the performances of the respondents' work in their workshop.

TABLE 19. PERCENTAGE DISTRIBUTION ON SPECIAL AWKWARD POSTURES

Special Awkward Postures	%
Repetitive Motion	95
Static Motion	57
Contact Stress	33
Forceful Exertions	19
Extended reach	14
Vibration (leg & arms)	4
***Total**	**222**

**Number more than 100 due to multiple responses.*

Repetitive motion of the wrist, foot and lower and upper limbs were observed. Almost all the respondents (95%) were engaged in one kind of repetitive motion or the other. These were as a result of operating the sewing machine. The frequencies of the action or work cycle were repetitive. These awkward postures and motion are consistent with previous studies on people engaged in such jobs. Punett and Keyserling (1987), Grandjean and Hunting (1977) found that operating the sewing machine created a series of motions that were performed over and over again by the same muscle groups with little variation. This kind of repetitive and static motions (characterized by long-lasting holding postures where blood supply is impaired and waste products accumulate in the muscles causing acute pain in the statically loaded muscle) resulted in musculoskeletal disorders. Fifty-seven percent cases of static motion postures were recorded in this research (page 72). Similarly, both Vihma (1982) and Vezina *el al* (1992) noted that sewing machine operators in garment industries were subjected to static posture in the cause of their work.

Contact stress was observed intermittently amongst 33% of the respondents. This was caused by respondents coming into contact with sharp corners of tables as they moved round in the workshop in the performance of their work such as moving from the sewing table to the ironing table and during ironing. The edges of tables used by respondents were pointed. These often knocked into body parts to cause pain. The Center for Rehabilitation Technology, Helen Hayes Hospital publication (1999) stated that the sharp edges of the tables could cause pain and recommended that all edges of work surfaces should be rounded or padded where body contact takes place on continuous basis.

There were however, less than 20% extended reach and forceful exertions each, observed and recorded during the task of sewing by the respondents. For seated work, reaches for tools and materials did not exceed 25 inches (64cm) from most workers' position. Perhaps the recording of extended reach was less because tools and material used were centered in front of respondents during work or rather crowded in front and therefore prevented excessive stretching. Most horizontal distances were within reach this was in accordance with Steidl and Bratton's (1968) suggestion that an average horizontal distance of 32 inches (80cm) for normal and 39 inches (100cm) for maximum was ideal. Tools and equipment often in use should be positioned so that they are within easy reach at all times. This helps maintain proper-seated postures. Extended reach was minimal as equipment were very close the respondent when seated.

The forceful exertions recorded (19%) were as a result of the use of non-ergonomically designed pair of scissors that open with a lot of pressure from the respondents' hand. Ergonomically designed pair of scissors like the spring loaded scissors or electronic scissors do not open with a lot of pressure and can be utilized with the wrist maintained in a neutral position. In the use of covered button machines and in the operation of the sewing machine, forceful exertions were also occasionally observed.

Vibration of legs and arms were extremely few amongst respondents but for 4% male treadle machine users whose machines kept vibrating and shaking as they sewed. It appeared the machines were very old.

4.5 Injuries Attributed To Poor Ergonomic Design In The Workshops

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Respondents were asked whether they had any pain or discomfort believed to be related to their work. While 88% of the respondents experienced bodily pains and/or discomfort and related them to their work, 12% said they did not experience any bodily pains or discomfort. One respondent out of the 12 respondents, however, complained of an occasional pain in the lower back and attributed the pain to a much earlier motor accident she sustained. The 88% of the respondents attributed the pains they experienced to the sewing, as they had not had any previous injury involving the lower part of the body mentioned by one of the respondents.

Frequency Of Discomfort Or Pain Experienced

Musculoskeletal problems results in pain or discomfort and this in turn results in low productivity in the workplace. Respondents were asked how often discomfort or pain occurred in various parts of their bodies. Their ratings are tabulated in Table 20.

TABLE 20. FREQUENCY DISTRIBUTION OF RATINGS ON THE OCCURRENCE OF DISCOMFORT OR PAINS IN RESPONDENTS' VARIOUS BODY PARTS

Body Part	Never *f* (%)	Occasionally *f* (%)	Often *f* (%)	Always *f* (%)
Hips	85	2	0	1
Ankle/Feet	84	3	1	0
Thighs	81	4	3	0
Wrist	79	9	0	0
Lower Back	28	26	33	1
Neck	27	31	29	1
Upper Back	16	41	27	4
Shoulder	14	33	39	2
Total	**414***	**149***	**132***	**9***

**Number more than 100 due to multiple responses.*

The majority, over 80% of the respondents said that they never experienced pains in the hip, ankle/feet and thigh. Less than 10% of the respondents each complained of occasional pain or frequent pain in the hips, feet, thighs and wrists. However, occasional and frequent pains were more experienced in the lower back, neck, upper back and shoulders of the respondents. As regards pain in lower back, neck, upper back and shoulders, 26%, 31%, 41% and 33% of the respondents rated them as occasional respectively. Of those who described their pains as often, 33% suffered in the lower back, 29% in the back, 27% in the upper back, and 39% in the shoulder. Grandjean and Hunting (1977), Vihma *et al* (1982), Blader *et al* (1991) Chavalitsakulchai and

Shahnavaz (1993), Anderson and Gaardboe (1993), Li *et al* (1995), indicated in their reports and studies that MSDs in the neck, shoulder and back regions were frequent among sewing machine operators. They mentioned that these occasional and frequent pains were experienced because machine workers perform highly repetitive hand and arm movement, monotonous, high–speed precisions task and poor posture at work. It is therefore not surprising that respondents reported higher incidence of lower back, neck upper back and shoulder pains than pains in the hip, wrist, ankle/feet and thighs. The respondents were engaged in bad working postures like neck twisting or bending, prolonged sitting without adequate back support, mild bending and severe bending of torso, repetitive motion and static motion (see Table 18 p. 69 and Table 19 p. 72). Pains experienced in the upper limbs were however non-existent among the complaints of the respondents. This was contrary to the observation of Vihma *et al* (1982) and Punnett and Keyserling (1987) that indicated a prevalence of pain and MSDs in the upper limbs among sewing machine operators. Again unlike Vihma et al (1982) who showed that sewing machine operators in garment industries did not experience any back pain, this study has revealed that, the respondents experienced both lower and upper back pains (Table 20 p. 76). This could be due to the fact that since their chairs had hard seats, were unadjustable, and had no lumber support, the torsos were made to be bent slightly forward and therefore contributed to the back pains.

TESTING OF HYPOTHESIS

Table 21 indicates chi-square test between time spent seated and MSDs.

TABLE 21 CHI-SQUARE TEST BETWEEN TIME SPENT SEATED AND MSDs

Period of sitting (hrs).	Body parts affected by MSDs				
	Neck	Shoulder	Lower back	Upper back	Totals
3 – 5	4 (8.29)	9 (9.92)	12 (8.15)	11 (9.65)	**36**
6 – 8	36 (32.0)	41 (38.29)	25 (31.47)	37 (37.24)	**139**
>8	21 (20.72)	23 (24.79)	23 (20.38)	23 (24.11)	**90**
Totals	**61**	73	**60**	71	**265**

Expected, indicated in bracket. $\chi^2 = 6{\cdot}87$ df = 6 $p \leq 0{\cdot}05$ $p \leq 0{\cdot}01$

The null hypothesis that there was no relationship between time spent seated at work and MSDs in neck, shoulder, lower back and upper back was accepted since the calculated chi-square was less than the tabulated chi-square (see appendix F on pg. 111) at both 5% and 1% confidence levels. The alternative hypothesis was found to be untrue. Thus, even though Chavalitsakulchai and Shahnavaz (1993), Grandjean (1973), Oborne (1982) and Grieco (1986) reported that there was a relationship between the time spent seated at work and MSDs in neck, shoulder, lower back and upper back of garment and textiles workers the statistical test carried out in this current study revealed that there was no significant difference between the time spent seated at work and MSDs in neck, shoulder, lower back and upper back garment producers. This possibly may be due environmental or ethnic differences. It may be worthwhile to repeat to the study and test similar hypothesis to find out whether results will be the same or different. That may possibly give a true relationship between the time spent seated at work and MSDs in neck, shoulder, lower back and upper back of garment producers.

Rating On Severity Of Discomfort/Pain

When respondents were asked to rate the severity of the discomfort/pain in various body parts, the data in Table 22 were obtained.

TABLE 22. PERCENTAGE DISTRIBUTION OF RATINGS ON SEVERITY OF DISCOMFORT/PAIN

Body Part	No Discomfort *f* (%)	Severe pain *f* (%)	Slight Pain *f* (%)
Hips	85	2	1
Ankle/Feet	84	3	1
Thighs	81	6	1
Wrist	79	9	0
Lower Back	28	17	43
Neck	27	24	37
Upper Back	16	9	60
Shoulder	14	15	59
***Total**	**414**	**85**	**202**

**Number more than 100 due to multiple responses.*

Less than 10% of the respondents each described their discomfort in the hips, feet, thighs and wrists as slightly painful or severely painful. As regards the lower back, neck, upper back and shoulders, 43%, 37%, 60% and 59% of the respondents rated the pain as slight respectively. Of those who described their pains as severe, 17% had complaint in the lower back, 24% in the neck, 9% in the upper back and 15% in the shoulder. These were consistent with the reports of Grieco (1986) and Li *et al* (1995) who noted high risk of injury to the spinal segments, shoulder and back regions as being frequent among sewing machine operators.

4.6 Productivity Levels Under Improved Ergonomic Features

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A comparison of the present and expected daily averages of garments that could be produced under improved ergonomic features was used to assess the production levels. The respondents were asked how many garments (of different types) they could produce in a day as against how many of the same type of garments they could produce if ergonomic features and conditions were improved. Kaba and Silt, Straight Dress, Shirt, Men's trousers and Political Suit were used for the evaluation.

Current Average Daily Production Rate Of Selected Garment.

The respondents were asked to indicate the average number of garments that they could produce in a day alone under their current ergonomic features and conditions. Table 23 shows the frequency of current average daily production rate of garment.

TABLE 23. FREQUENCY OF CURRENT AVERAGE DAILY PRODUCTION RATE OF DIFFERENT GARMENT PRODUCED

Daily Production rate	Slit & Kaba (*f*)	Straight Dress (*f*)	Shirt (*f*)	Men's Trousers (*f*)	Political Suit (*f*)
1	35	7	0	8	7
2	31	20	16	28	6
3	17	41	43	20	5
4	4	23	25	6	0
5	2	7	9	0	0
6	0	2	2	0	0
Total	**89**	**100**	**95**	**62**	**18**

The average production rate per day for the different garments were varied. For example the respondents could produce more Straight Dresses and Shirt per day on the average than Men's Trousers or Political Suit. This was because the different garments listed for evaluation required different processes and skill and therefore different length of time for their completion. Not all the respondents made all the different types of garments listed for evaluation. For example none of the female respondents made Political suit.

A Comparison Of The Current And Expected Daily Average Production Rate Of Garments

Respondents were asked how many garments (of different types) they could produce in a day as against how many of the same type of garment they could produce if ideal ergonomic features and conditions were improved - for example good ventilation, proper lighting, good posture and suitable seats and working height, were provided. It is worth pointing out here that it took a bit of explanation and education on what constituted good ergonomic practices and how simple ergonomic interventions can have a significant impact resulting in fewer errors, lessen time spent and improve the well-being and productivity before the question could be answered by some of the respondents.

Productivity Levels Of Kaba And Slit

Table 24 shows the average number of Kaba and slit respondents made in a day as against their anticipated production rates when given the right ergonomic conditions.

TABLE 24. CURRENT AND EXPECTED DAILY AVERAGE PRODUCTION RATE OF KABA AND SLIT

Current Average Daily Production Rates		Anticipated Daily Average Production Rates Under Right Ergonomic Conditions		
No. of Kaba and Silt	Percentage of Respondent	No Change in Production Rate (%)	Two Times Current Rate (%)	Three Times Current Rate (%)
1	35	7	23	5
2	31	11	18	2
3	17	11	6	0
4	4	2	2	0
No response	13		-	

Total number of respondents=89

Thirty-five percent, 31%, 17% and 4% of the respondents said, in a day, they could on the average produce 1,2,3 and 4 kaba and silt respectively. All the female respondents did produce kaba and silt but only 6 males were engaged in that production. Probably this was because kaba and silt is purely a feminine garment and females tend to specialize in making female clothing rather than male garments and vise versa. Some female styles could be intricate and demand special skill and interest in the production of such complex designs. Forty-nine out of the 89 respondents who produced that type of traditional clothing interviewed, indicated that their daily average could, at least, be doubled if ergonomic conditions in their workshops improve in future. For example 23 out 35 respondents who produced one kaba and slit per day on the average said they could double their production while18 out of the 31 respondents who produced 2 kabas and slits per day said they could produced 4 kabas and slits per day each with improved ergonomics. Such improvements to mention a few could include the proper chair for the worker, the use of correct and efficient work-methods to avoid unnecessary repetitive motions, maintenance of good posture by keeping the spine and head upright, if people are comfortable, they will work better.

Productivity Levels Of Straight Dress

A Straight dress is a type of simple dress where the main seams are the two side seams. Table 25 shows the current and expected daily average production rate of straight dress by respondents.

TABLE 25. CURRENT AND EXPECTED DAILY AVERAGE PRODUCTION RATE OF STRAIGHT DRESS

Current Average Daily Production Rates		Anticipated Production Rates With The Right Ergonomic Conditions		
No. of Straight Dress	Percentage of Respondent	No Change in Production Rate (%)	Two Times Current Rate (%)	Three Times Current Rate (%)
1	7	0	4	3
2	20	3	10	7
3	41	8	27	6
4	23	5	12	6
5	7	1	6	0
6	2	0	2	0

Total number of respondents=100

While 41%, 23% and 20% of the respondents said they could produce 3, 4 and 2 simple straight dresses respectively per day, less than 10% each said they could produce 1, 5 and 6 simple straight dresses on the average in a day. However, more than half of the respondents in each case said they could increase the daily average by 50% or more if ergonomic conditions in their workshop improve. For example, 10 out of 20 respondents who produced two straight dresses per day on the average said they could double production with improved ergonomics, while 27 out of 41 respondents who produced three straight dresses per day said they could produce six dresses each with improved ergonomics. The influence of poor ergonomic features therefore has, to a large extent, a negative impact on the production of garments as the respondents could more than double their output if the ideal situation prevails.

Productivity Levels Of Shirt

Shirt often required the sewing skills of a collar, sleeves opening and fastenings. Table 26 shows the current and expected daily average production rate of shirts by respondents.

TABLE 26. CURRENT AND EXPECTED DAILY AVERAGE PRODUCTION RATE OF SHIRT

Current Average Daily Production Rates		Expected Production Rates With The Right Ergonomic Conditions		
No. of Shirts	Percentage of Respondent	No Change in Production Rate (%)	Two Times Current Rate (%)	Three Times Current Rate (%)
1	0	0	0	0
2	16	1	15	0
3	43	13	25	5
4	25	6	18	1
5	9	2	7	0
No response	7	-	-	-

Total number of respondents = 93

While 43 of the respondents said they could presently make 3 shirts on the average in a day, 25%, 16% and 12% said they could make 4, 2 and 5 shirts respectively. More than half of the respondents in each case said they could produce twice or more times the number of shirts they were producing currently if ergonomic conditions improve in their workshops. For example 15 out of the 16 respondents who produced 1 shirt per day on the average said they could double production while 25 out 43 respondents who produce 2 shirts per day, and 18 out of 25 who produce 3 shirts per day on the average said they could each double their daily production with improve ergonomics. The need to practice good workplace ergonomics cannot be emphasized, as an increase in output will mean more income for the garment producers and a corresponding improvement in their quality of life.

Productivity Levels Of Men's Trousers

The sewing of men's trousers usually include the processes of fixing a waistband, a fly and fastening to close the fly. When respondents were asked how many pairs of trousers they could make on the average per day, both presently and also anticipated when given the right ergonomic conditions, the data in Table 27 was obtained.

TABLE 27. CURRENT AND EXPECTED DAILY AVERAGE PRODUCTION RATE OF MEN'S TROUSERS

Current Average Daily Production Rates		Expected Production Rates of Respondents With The Right Ergonomic Conditions		
No. of Men's Trousers	Percentage of Respondent	No Change in Production Rate (%)	Two Times Current Rate (%)	Three Times Current Rate (%)
1	8	0	5	3
2	28	2	6	10
3	20	5	11	4
4	6	3	2	1
No response	38	-	-	

Total number of respondents = 62

While 28% of the respondents said they could presently sew 2 pairs of trousers, on the average, in a day, 20%, 8% and 6% of them said they could make 3, 1 and 4 pairs of trousers per day respectively. More than half of the respondents each said they could double or in some cases, produce three times the number they were producing currently if ergonomic conditions in their workshops changed for the better. For example 5 out 8 respondents who produced one men's p[air of trousers per day on the average and 11 out of 20 respondents who produced 3 men's trouser a per day, on the average, said they could each double their daily production with improved ergonomics.

Table 28 shows present and expected daily average production of political suit by the respondents.

TABLE 28. CURRENT AND EXPECTED DAILY AVERAGE PRODUCTION RATE OF POLITICAL SUIT

Current Production Rate/Day		**Expected Production Rates With The Right Ergonomic Conditions**		
No. of Political Suit	Percentage of Respondent	No Change in Present Rate (%)	Two Times Current Rate (%)	Three Times Current Rate (%)
1	7	1	5	1
2	6	1	3	2
3	5	2	3	0
No response	82			

Total number of respondents = 18

Surprisingly only 18% of the respondents said they did engage in the production of political suits in their workshops and none was a female. Like the kaba and slit, which is purely a feminine garment, political suit is seen as masculine and only males were engaged in the production of political suits. While 7% of the respondents said they could make one political suit in a day, 6% said they could make two political suits in a day and

5% said they could make three political suits daily on the average. However, the respondents indicated that if ergonomic conditions improve in their workshop they could increase output. Eleven of the respondents in this group said they could double their current output.

Obviously, a work environment that is ergonomically sound will be more enjoyable and will encourage productivity. However, the production rates reported by the respondents generally seemed to have been exaggerated as from the researchers observation of the speed of daily production the number of garments they claimed they could make were on the high side. For example producing six shirts single-handedly in a day, or six or more pairs of trousers in a day, or producing six political suits single-handedly in a day would be grossly beyond them even in first class ergonomical situation.

CHARPER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

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Summary

The purpose of this study was to investigate the ergonomic situation at the workshop of dressmakers and tailors, knowledge about ergonomic factors suitable for their work, the hazards present in their work environment and in the performance of their vocations, injuries attributed to the performance of their task, and to determine productivity levels. A simple random sampling technique was used to select 100 seamstresses and tailors from the Madina Dressmakers and Tailors' Association. The instruments used for the collection of data were a structured interview questionnaire and an observational guide. Frequency and percentage distribution were used to present and describe the data. Chi-square statistic was used to test the hypothesis that there was no relationship between time spent seated at work and MSDs in neck, shoulder, lower back and upper back.

The respondents were 81 females and 19, males. They were aged between 19 and 50 years. Thirty-three percent had completed secondary and tertiary education. Seventy-one percent of the respondents had between one and six apprentices under their tutelage. Eighty-four percent had been sewing as professionals between one and fifteen years. Eighty-six percent spend 6hours or more seated at work daily. From observation, noise levels were rather high, ventilation was poor, temperature in the workshops was high, lighting inadequate, and with improper seat and table heights. Though over 90% of the respondents would want to make structural changes in their workshops, the kind of changes expressed did not portray improvement in ergonomic features in the workshop. Sixty-eight percent said they did not experience any unwanted noise in their workplaces though the researcher thought otherwise. Seventy-eight percent of the respondents used natural source of lighting throughout the period they were at work and 86% rated vision as comfortable. Seventy-six percent described the colour of their workshop as lightly coloured. Only 28% described the thermal comfort of the workshop as comfortable. Fifty-four percent rated ventilation in their workshop as moderate. Over 80% rated seat height, seat width and seat depth as suitable. The study however, revealed that 63% of the seat heights did not fall within the recommended seat standards in the literature. Similarly, 49% and 63% did not fall within the recommended seat width and seat depth respectively. Eighty-three percent of the respondents used seats that did not have any backrest. Only 13% had padded seats. None of the respondents had an adjustable seat. Eighty-five percent of them indicated that they had seats that allowed them have their elbow above their work tables when working at a standing posture. This is contrary to recommendation from literature.

From observation a large number of the respondent were engaged in awkward postures. These included neck twisting or bending (92%) prolonged sitting without adequate back support (83%), mild bending of torso (62%), wrist bending and deviation (53%), repetitive motion (95%) and static motion (57%). The majority of the respondents (80%) never experienced pains in the hip, ankle/feet, thighs and wrist. Between 60%-74% of the respondents experienced pain in the lower back, neck, upper back and shoulders occasionally, frequently and daily. Between 15% 25% of the respondents described their discomfort as slightly painful, while between 37% 60% described it as severely painful. The study revealed that, 60% and 69% of the respondents experienced both lower and upper back pains respectively. This could be due to the fact that since their chairs had hard seats, were unadjustable, and had no lumber support, the torsos were caused to be bent slightly forward and therefore contributed to the back pains. About 50% or more of the respondents who reported that they produced a certain average number of items in a day indicated that they could double their production if Ergonomic conditions improved. A few could increase theirs 3 times with improved ergonomic condition.

Conclusion

The respondents had limited knowledge about ergonomics as related to garment production. They sat for long hours on the unsuitable seats, used in appropriate tables for laying, cutting-out and sewing and worked in an unfriendly environment. Pains were experienced in their lower and upper backs, neck and shoulders due to awkward posture such as neck twisting and bending, repetitive and static motion and bending of the torso. There was a relationship between the time spent seated at work and MSDs in neck, shoulder, lower back and upper back. With improved ergonomic conditions in the workshop the respondents could perceive an increase of 2 and sometimes 3 times production rate in the garments they produced.

Recommendations

From the foregoing summary and conclusions, the following are recommended

1. A meeting between the Home science Department and the executive members of the National Tailors and Dressmakers' Association be arranged and the results of this study made known to them. This initiative may start an ergonomic awareness programme for the National Tailors and Dressmakers Association members. This awareness, it is hoped, will improve their well-being by improving their knowledge of ergonomics for maximum garment production.

2. A survey needs to be undertaken to determine desirable and satisfactory characteristics required by garment producers in terms of equipment and layout.

3. The Ghana Government should set up a body that will enforce compliance with government regulations and standards on the garment industry.

4. If practitioners are to emphasize ergonomic principles, there will be the need for heavy capitalization of the industry in order to procure the machinery or other facilities that follow these sets of principles.

5. The National Tailors and Dressmakers' Association should organize refresher courses for its members to discuss problems of ergonomics. As an organization, it should serve as a focal point for initiating ergonomic changes and training within the industry. For example, garment producers should be given sufficient education

and information regarding the musculoskeletal problems caused by their jobs and how to prevent the disorders in addition to redesigning undesirable furniture.

6. The National Dressmakers and Tailors Association in consultation with the National Vocational Training Institute (Apprentice Training Board) should develop a common curriculum and textbook and also design courses for its members and apprentices, that may institute ergonomic improvements in the workplace to:
    a. reduce job injuries and health care cost.
    b. improve productivity and worker moral
    c. comply with government regulation

7. A properly trained ergonomist must be employed to make a full ergonomic evaluation of dressmakers and tailors since ergonomics covers a wide range of study and proper intervention requires a variety of approaches implemented over a period of time.

8. There is the need to create the awareness of occupational safety and health problems associated with garment producers at the national level. The Ministry of Health should place emphasis on the dissemination of occupational safety and health information.

9. Further studies be carried out to gather relevant data which will help improve the quality of life of dressmakers/tailors by reducing stressors in the work environment and musculoskeletal disorders bearing in mind personal characteristics of workers since physical structure, physical condition or medical history may be needed for a meaningful study of the type of injury present.

10. Studies with samples from selected the Textile Manufacturing Industry in Ghana should be carried out since that is closely related to garment production to investigate ergonomic conditions under which employees work.

REFERENCES

1. **Agan, J. and Luchsinger, E.,** 1965. The House. J.B.Lippincott Company United States America pp. 82-168, 301-317.

2. **Anderson, J. H. and Gaardboe, O.,** 1993. Prevalence of persistent neck and upper limb pain in a historical cohort of sewing machine operator. *Am J Ind Med* 1993 Dec. 24 (6) pp. 677-87

3. **Armstrong,T.J.,** 1993. A conceptual model for work related neck and upper limb musculoskeletal disorder, *Scandinavian Journal of Work Environment Health,* Vol. 19 pp.73- 84.

4. **Armstrong, T.J., Radwin, R.G. and Silverstein, B.S.,** 1987. Ergonomics and the effects of vibration in hand intensive work, *Scandinavian Journal of Work Environment Health* Vol. 13 pp. 286 –289.

5. **Barnes, R. M.,** 1963. Motion And Time Study 5th Edition, John Wiley and Son Inc. New York.

6. **Barnhart, Robert K.,** 1995. The World Book Encyclopedia. World Book, Inc.: Chicago. U.S.A. Vol. A-K, p. 537.

7. **Bex, F. H. A.,** 1971. Desk Height *Applied Ergonomic,* 1971 Vol. 2, N° 3 pp. 138-140.

8. **Blader, S., Barch-Holst, U., Daielsson, S., Ferhn E., Kalpammaa, M., Leijon, M., and Mardkhede, G.,** 1991. Neck and Shoulder complaints among sewing machine operators *Applied Ergonomics,* 1991. Vol. 22 pp. 251-257

9. **Branton, P.,** 1969. Behaviour, body mechanics and discomfort, *Ergonomics* Vol. 12 pp. 316-327.

10. **Brew, C.A., and Ekuban, G.E.,** 1991. Management In Living for Senior Secondary Schools. Ministry of Education, Accra. pp. 154 –155

11. **Brutman, M.**, 1996. "Recognition and Evaluation of Risk Factors and Potential Stressors" Part1 Ehlers Danlos National Foundation Articles, *Loose Connection*, Vol xi, N° 3. 1996. WEB version http://www.ednf.org/articles/ergo-1.htm

12. **Bryan, M.E., and Tolcher, D.,** 1976. Preferred noise level whilst carrying out mental task. *Journal of Sound and Vibration*, 1976 45.1, pp.139-156.

13. **Chavalitatsakulchai, P., and Shahnavaz, H.,** 1993. Musculoskeletal Disorders of Female Workers and ergonomics problems in five different industries of Thailand, 1993, *Journal of Human Ergology,* Vol. 22, No 1, pp. 29-43.

14. **Center for Rehabilitation Technology, Helen Hayes Hospital.** Work Bench: Sewing Solutions. *Assistive Technology in Action.* Volume 1, April 1999. mailto:tamanoy@helenhayesshop.org http://www.helenhayeshospital.org/crtnews799.htm#workbench

15. **Dees, A.,** 1998, WorkspaceResources www.workspaceresources.com

16. **Department of Labour**, 1990. Bureau of Labour Statistics Report on Survey of Occupational Injuries and Illnesses in 1977–1989. Washington D.C. U.S. Department of Labour, 1990.

17. **Eberle, H. Hermeling, H. Hornberger, M. Menzer, D. and Ring, W**. 1995. Clothing Technology- From fiber to fashion Verlog Europa- Lehrimittel, Norway, Vollmer Gmbtt and Co 42781 Haan-Gruit imo-Grossdrukerei, 42275 Wuppertal pp. 186-187.

18. **Elese**, "Elese's Advice: ergonomics - chairs, chairs, chairs!" *Sewing and Quilting Newsletter* Vol.1, no.3, Nov./December, 1998 http://www.thimlenet.com

19. **Ergonomic Report**, 1993 – SIC. CODE 2328 Sept. 14, United States Department of labour (Bureau Of Labour Statistics) http://www.iacindustries.com/ergo/1998injuryreport.htm.

20. **Ferguson, D.A., Major, G., and Keldoulis, T.,** 1974 Vision at Work- Visual defect and the visual demand of tasks, *Applied Ergonomics* 1974, Vol. 5.No 2, pp.84 –93.

21. **Fianu D., and Acquaah-Harrison P.,** 1999. Apprentiiceship system of "Wayside' seamstress from selected neighbourhood in Accra, *Journal of Asian Regional Association of Home Economics,* vol. 6, 1999 pp. 245

22. **Floyd, W.F., and Ward J.S.,** 1969 Anthropometic and physiological considerations in school, office and factory seating. *Ergonomics* Vol. 12, 1969 pp 132-139.

23. **Gawthorpe, L**, 1972. The Home, Hulton Education Publication Ltd U.K pp. 66.

24. **Grandjean, E.,** 1973. Ergonomics in the Home, Taylor and Francis, London.

25. **Grandjean, E., and Hunting, W.,** 1977. Ergonomics of posture- Review of various problems of standing and sitting posture. *Applied Ergonomics* Vol. 8 No.3 Sept. 1977. Pg 135-140.

26. **Grandjean, E., Hunting W., Wotzka G. and Shärer, R.,** 1973. An ergonomic investigation of multipurpose chairs. *Human Factors* 1973 Vol.15 No.3 pp. 247-255

27. **Grieco, A.,** 1986. Sitting posture: an old problem and new one, *Ergonomics,* 29, pp. 345-362

28. **Grossmith E. and Chambers G.,** 1998.The Role of Ergonomics in Process Design, Product Design and Design for the Environment. CTD Resource Network Inc. webmaster@tifag.org

29. **Kessler GmbH.,** 1999 CD ROM: Title-Ergonomics KESSLER AMERICA, LLC 4220 Steve Reynolds Blvd Suite 15 Norcross, Georgia 30093 U.S.A. www.kessler-ergo.com.

30. **Li, G., Haslegrave, C. M. and Corlett, N., E.,** 1995. Factors affecting posture for machine sewing tasks. *Applied Ergonomics* 1995, Vol. 26, N° 1 pp. 35-46.

31. **Manitoba Ergonomic Guideline** 1999. A Guide to Programme Development and Implementation. Manitoba Labour–Workplace Safety and Health, *Manitoba's Ergonomic Guideline* Fall 1999 WEB Version.
http://www.gov.mb.ca/labour/safety/publicat/guidelin/ergonomic/errgoguid.html

32. **McCormick, E. J. and Sanders, M.** 1982. Human Factors in Engineering and Design 5th edition. Mc Graw – Hill Book Company, New York pp. 7, 313-453

33. **Oborne, D. J.,** 1982. Ergonomics at Work, Wiley and Sons Ltd. New York pp.1-3, 150-155, 129-246.

34. **Peet, L., Pickett, M., Arnold, M. and Wolf, I.,** 1970. Household Equipment. Published by John Wiley and Sons Inc. U.S.A pp. 424 – 45

35. **Poulton, E C.,** 1977. The environment at Work, *Applied Ergonomics* 1972 Vol.1 pp 24-29.

36. **Punnett, L., and Keyserling, W.M.,** 1987. Exposure to ergonomic stressors in the garment industry: application and critique of job-site work analysis methods. *Ergonomics,* 30 pp 1099-1116.

37. **Steidl, R., and Bratton,E.,** 1968. Work in the Home, John Wiley and sons Inc. U.S.A pp. 119- 137, 265-292, 335-339

38. **United States Department of Labor, Occupational Safety and Health Administration,** 1991 Ergonomics: The Study of Work, pp. 1-19

39. **Vezina, N., Tierney D. and Messing, K.,** 1992. When is light work heavy? Components of physical workload of sewing machine operators working at piecework rates. *Applied Ergonomic,* 1992 Vol. 23 N°·4 pp. 268-276.

40. **Vihma, T., Murmien, M. and Mutanen,P.,** 1982. Sewing Machine operators' work and musculoskelatal complaints, *Ergonomics,* 25 pp 295-298.

41. **Ward, J.,** 1970. Ergonomic in the Home. *Applied Ergonomics* Sept. 1970 Vol. 1, N° 4 pp. 223-227.

42. **Webster's New Dictionary,** 1981. G and C Merrian Co. U.S.A.

43. **Yamaguchi Y., and Unezawa,** F. 1970. Development of a chair to minimize distortion in sitting posture. Papers at the 4th Int. Congress on Ergonomics, Strasbourg, July 1970 unpublished (cited in: E Grandjean ("Wohnphysiologie" Verlag for Architeketur – Artmis, Zurich, 1973)

APPENDIX A

ASSESSING ERGONOMIC SITUATIONS IN THE GARMENT PRODUCTION WORKSHOPS AND THEIR IMPACT ON OUTPUT

Questionnaire for Garment Producers
This questionnaire has been designed purposely to solicit information on the above topic. The researcher would be grateful if you could answer the questions truth fully and to the best of your ability. Any information given will be treated confidential

1. Age at last birthday?
1. ☐ >20
2. ☐ 20-24
3. ☐ 25-29
4. ☐ 30-34
5. ☐ 35-39
6. ☐ 40-44
7. ☐ 45 years and above

2. Sex
1.☐ Male
2.☐ Female

3. What is your educational background?

1. ☐ No Formal education
2. ☐ First cycle
3. ☐ Secondary
4. ☐ Tertiary education
5 ☐ Any other (specify...

4. How long have you been sewing as a professional? ....

5. How many apprentices do you have under your tutelage? ....

6. Approximately how many hours do you spend working in a day?....................

7. How many hours do you remain seated? ....

8. Would you want to make any structural changes in your workshop Yes/No

9. What changes would like to make? ....

10. Why have you not done it yet?...

11a. How would you rate the importance of the following on your work?

Factors	Not much	Very much
1. Temperature		
2. Lighting		
3. Ventilation		
4. Table height		
5. Type of seat		
6. Surfaces		
7. Noise		

b) In what ways do they help your work?...
....

NOISE

12. Do you experience any unwanted sound?

1. ☐ Yes   2. ☐ No

13. What is the source of the noise? ....

14. How do you rate the level of noise in your workplace?

1. ☐ Barely Noticeable
2. ☐ Annoying
3 ☐ Unbearable
4 ☐ No Noise
☐ Annoying

15. How do you rate noise intensity?

1 ☐ Very Loud

2 ☐ Moderately loud

3 ☐ No Noise

LIGHTING/ VISION

16. What source of lighting do you use and for how long?

Source	Type	Duration
Natural		
Artificial		

17. How would you rate visual comfort in your workshop?

1.☐ Comfortable

☐ 2. Uncomfortable

18. How do you rate the intensity of colour of your workplace?

1. ☐ Light/Pastel

2. ☐ Dark

TEMPERATURE

19. How would you describe the thermal comfort in your workplace?

1 ☐ Comfortable

2. ☐ Uncomfortable

20. How do you rate the intensity of thermal sensational?

1.☐ Very hot   2. ☐ Moderate   3. ☐ Cold

VENTILATION

21. How do you rate the natural ventilation in your work place?

1.☐ Good   2. ☐ Moderate   3. ☐ Bad

22. Do you use any artificial system of ventilation? ? Specify e.g. fan air conditioner

……………………………………………………………………..

SEATS

23. How would you rate the following attributes of your workshop seat?

Attribute	Suitable	Unsuitable	Measurement
Seat height			
Seat width			
Seat depth			

24. By how much centimetres in your work surface for standing work is below elbow height.? ....

25. Does the height of your seat allow you?

1. To place your feet on the floor Yes ☐ No ☐
2. Provide adequate knee room Yes ☐ No ☐
3. To have your tabletop at elbow height Yes ☐ No ☐

26. On the average how many of he following garments can you make in a day currently, and how many garments do you think you can make if conditions such as lighting, temperature, ventilation, noise, seats, working height etc are improved to your taste/specifications?

Type of clothing	Current production No.	Expected production No.
1. Slit and Kaba 2. Straight Dress 3. Shirt 4. Men's Trousers 5. Political suit		

INJURIES ATTRIBUTED TO POOR ERGONOMIC DESIGN IN THE WORKSHOP

27. Have you ever had any pain or discomfort during the last year that you believe is related to your work?

a. Yes
b. No

28. If yes, for each body part described in the boxes on next sheet, please indicate:

How often you have discomfort in each body part
The severity of discomfort.

PHYSICAL DISCOMFORT SURVEY

Please note 'pain' may include aches, stiffness, numbness, tingling or burning sensations

NECK

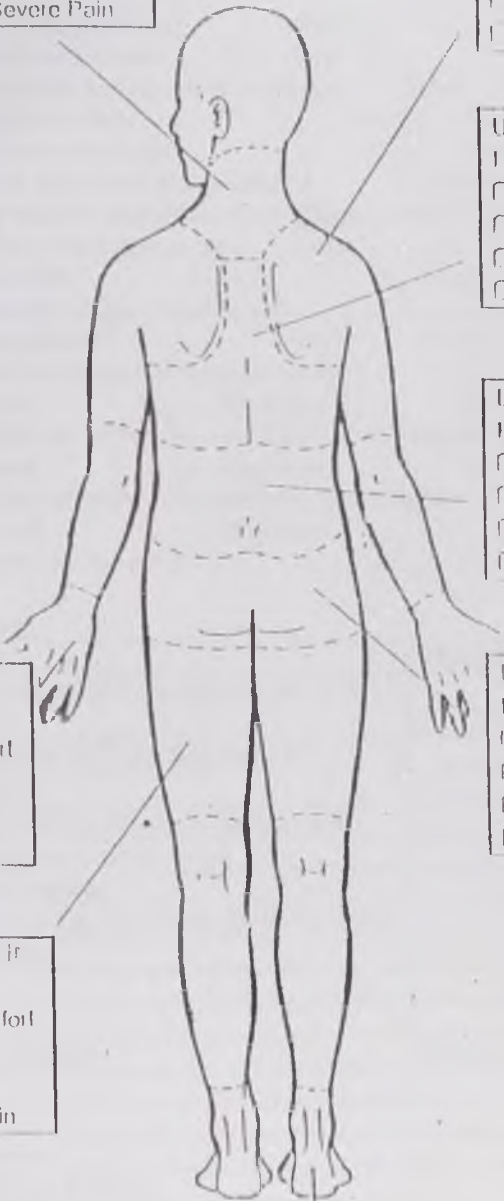
How often?	How Much?
[ ] Never	[ ] No Discomfort
[ ] Occasionally	[ ] Discomfort
[ ] Often	[ ] Pain
[ ] Always	[ ] Severe Pain

SHOULDERS [ ] right [ ] left

How often?	How Much?
[ ] Never	[ ] No Discomfort
[ ] Occasionally	[ ] Discomfort
[ ] Often	[ ] Pain
[ ] Always	[ ] Severe Pain

UPPER BACK

How often?	How Much?
[ ] Never	[ ] No Discomfort
[ ] Occasionally	[ ] Discomfort
[ ] Often	[ ] Pain
[ ] Always	[ ] Severe Pain



LOWER BACK [ ] right [ ] left

How often?	How Much?
[ ] Never	[ ] No Discomfort
[ ] Occasionally	[ ] Discomfort
[ ] Often	[ ] Pain
[ ] Always	[ ] Severe Pain

WRISTS/ HANDS [ ] right [ ] left

How often?	How Much?
[ ] Never	[ ] No Discomfort
[ ] Occasionally	[ ] Discomfort
[ ] Often	[ ] Pain
[ ] Always	[ ] Severe Pain

HIPS [ ] right [ ] left

How often?	How Much?
[ ] Never	[ ] No Discomfort
[ ] Occasionally	[ ] Discomfort
[ ] Often	[ ] Pain
[ ] Always	[ ] Severe Pain

THIGHS [ ] right [ ] left

How often?	How Much?
[ ] Never	[ ] No Discomfort
[ ] Occasionally	[ ] Discomfort
[ ] Often	[ ] Pain
[ ] Always	[ ] Severe Pain

ANKLES / FEET [ ] right [ ] left

How often?	How Much?
[ ] Never	[ ] No Discomfort
[ ] Occasionally	[ ] Discomfort
[ ] Often	[ ] Pain
[ ] Always	[ ] Severe Pain

APPENDIX B

CHECK LIST FOR UNOBTRUSIVE OBSERVATION ON STRESSORS PRESENT IN THE PERFORMANCE OF THEIR TASK AND SEWING ENVIRONMENT

1. Are there ventilation holes? Yes ☐ No ☐
2. Is there cross ventilation? Yes ☐ No ☐
3. Are walls painted in light (pastel) colours? ☐Yes No ☐
4. Is ceiling painted white? Yes ☐ No ☐
5. Does seat have a backrest? Yes ☐ No ☐
6. If yes, where is the backrest positioned ☐ Low back ☐Upper back
7. Is the front edge of seat below the popliteral crease? Yes ☐ No ☐
8. If yes, by how many centimeters...
9. Is seat adjustable? Yes ☐ No☐
10. If yes, what are ranges of seat height..
11. Is your seat padded? Yes☐ No ☐
12. Rating layout of equipment when working?
    1. ☐ Good 2. ☐ Moderate 3. ☐ Bad
13. Rating of the size of the room in relation to the number of occupants.
    1. ☐ Good 2. ☐ Moderate 3. ☐ Bad
14. Rating of size of table in relation to no. of occupants
    1. ☐ Good 2. ☐ Moderate ☐ 3. Bad
15. What type of structure is it?..

Risk factors in task

A Awkward Posture	Intermittent	Continuous
1. Severe forward bending of Torso more than 15° but less than 30°		
2. Mild forward Bending of Torso less than 15°		
3. Twisting of Torso		
4. Prolonged sitting without adequate Back support		
5. Inadequate Foot support while seated		
6. Neck Twisting or bending		
7. Shoulder unsupported arm or elbow above mid torso		
8. Wrist bend or deviate		
9. Ankle flexion		

10	Repetitive Motion	Intermittent	Continuous
11	Wrist		
12	Ankle		
13	Contact stress		
14	Vibration (Leg & arms)		
15	Static Motion		
16	Forceful exertions		

G. Ratings of environmental condition using the ff. scale

Phrase	Noise	Thermal sensation	Lighting	Ventilation
Very comfortable				
Comfortable				
Uncomfortable				
Comments				

APPENDIX C

Appendix C illustrates typical seats used by practitioners

Strips of wood which served as foot rest (as stated on page 62)

Most seats that did not have any backrest or support. Seat were unadjustable. Seat were not padded or properly contoured and were often narrow. Such poor ergonomically designed seats render workstations less comfortable and functional, resulting in awkward postures and stressful motions of various body parts.

APPENDIX D

Pictures indicates posture at work

The position adopted during sewing results from the type of seat used and the inclination of the sewing machine. Respondents were seen to sit forward on the chair away from the support of the backrest as if sitting on a stool. Thus the head, neck, and shoulders were not maintained in a neutral posture. This exposed respondents to risk factors leading the body injuries.

APPENDIX E

Picture illustrates a typical table and a worker bending over

The use of low tables makes users slouch over lower work surfaces and run the potential for neck, back and other body strain.

APPENDIX F

Testing of Hypothesis

Hypothesis: *There is no relationship between time spent seated at work and MSDs in neck, shoulder, lower back and upper back.*

Contingency Chi-square statistics was used to test the hypothesis.

Time spent seated at work and frequency of occurrence of discomfort/ pain in various body parts.

No. of hrs seated at work	Frequency of occurrence of discomfort/ pain in various body parts.							
	Neck		Shoulder		Lower back		Upper back.	
	Occ.	Always	Occ.	Always	Occ.	Always	Occ.	Always
3 5	3	1	8	1	7	5	7	4
6 - 8	19	17	17	24	13	12	17	20
> 8	9	12	7	16	6	17	17	6

For statistical analysis date on occasional and always have been added together to indicate the occurrence of some discomfort or pain to various parts of the body. The aggregate date therefore is as follows.

No. of hrs seated at work	Body parts affected by MSDs.				
	Neck	Shoulder	Lower back	Upper back	Totals
3 – 5	4	9	12	11	36
6 – 8	36	41	25	37	139
>8	21	23	23	23	90
Totals	61	73	60	71	265

No. of hrs seated at work	Body parts affected by MSDs.				
	Neck	Shoulder	Lower back	Upper back	Totals
3 – 5	4 (8.29)	9 (9.92)	12 (8.15)	11 (9.65)	36
6 – 8	36 (32.0)	41 (38.29)	25 (31.47)	37 (37.24)	139
>8	21 (20.72)	23 (24.79)	23 (20.38)	23 (24.11)	90
Totals	61	73	60	71	265

Expected, indicated in bracket

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

O -- E	$(O - E)^2$	$(O - E)^2 / E$
4 – 8.29	18.40	2.22
9 – 9.92	0.85	0.09
12 – 8.15	14.82	1.82
11 – 9.65	1.82	0.19
36 – 32	16.00	0.50
41 – 38.29	7.34	0.19
25 – 31.47	41.86	1.33
37 – 37.24	0.06	0.002
21 – 20.72	0.08	0.004
23 – 24.79	3.20	0.13
23 – 20.38	6.86	0.34
23 – 24.11	1.23	0.05

$\sum = 6{\cdot}866$

χ^2 cal = 6·866

χ^2 table df of 6 =12·592 at $p \geq 0{\cdot}05$

χ^2 table with 6df =16·812 at $p \geq 0{\cdot}01$

The null hypothesis that there is no relationship between time spent seated at work and MSDs in neck, shoulder, lower back and upper back was accepted since the calculated chi-square was greater than the tabulated chi-square at both 5% and 1% confidence levels. The alternative hypothesis was found to be untrue. Thus, there was no relationship between the time spent seated at work and MSDs in neck, shoulder, lower back and upper back.