Dependent seniors garment design

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Abstract. This paper is part of a PhD research in Textile Engineering at University of Minho and aims to establish an ergonomic pattern design methodology to be used in the construction of garments for elderly women, aged 65 and over, dependent of care. The research was developed with a close contact with four institutions involved in supporting this aged population, located in the cities of Guimarães (Portugal) and Teresina (Brazil). These clothes should be adequate to their anthropometrics and their special needs, in accordance with important functional factors for the dependency of their caregiver, such as: care for the caregiver and comfort for the user. Questions regarding the functional properties of the materials, the pattern design process, trimmings and the assembling process of the garments are specially considered in the desired comfort levels, in order to provide an adequate handling by facilitating the dressing and undressing tasks, but also to assure the user the needed comfort in all its variables.

1. Introduction

This paper describes five important phases of the ergonomic pattern design methodology to be used in the construction of garments for elderly women dependent of care. The first phase refers to the elaboration of the basic patterns for upper body, skirt and trousers, adapted to the anatomical complexion of two elderly groups from the cities of Teresina (Brazil) and Guimarães (Portugal). The second phase refers to the development of the prototypes, with the selected materials, aiming to offer greater comfort to the studied groups. The third phase refers to development of the basic pattern design blocks. The fourth phase refers to determination of ease table. The fifth phase refers to development of test prototypes.

For these five steps, we’ve quantified the measurements of the body to understand the most common shapes and postures, which have allowed us to drape the garment according to the body shape, compensation of asymmetries and changes in the somatic form. With this data, we intend to identify the comfort requirements (in all its variables) and factors associated with functionality and handling in the proposed clothing.

During the process, in two different moments, the measurements of the elderly women were collected in a seated position, and experimental methods of the measurements were constructed, developing size charts. The size charts correspond to an anthropometric dimension based on other existing ones, that did not contemplate the public in question, since they fit to an age group up to sixty years old. Therefore, the basic patterns design produced, emerging as a principle for the development of the prototypes for validation of the final product of this study.

Interest and importance of studying this specific public results from issues related to the demographic transition, which highlight an increase in life expectancy. This can become an economic and social problem when there are no public policies and programs aiming the growing ageing population. The demographic transition is a result of circumstantial changes from a young population to a position with low mortality and birth rates.
In this context, the reflection of the prolonged life expectation is also due to procedures related to health care, such as a healthier diet and the practice of more frequent physical exercises [1] [2]. Regarding these issues, the elderly public becomes relevant for research in different areas, as it presents specific needs, involving a physical structure directed to their age group.

This paper is part of a PhD research in Textile Engineering at University of Minho and aims to establish an ergonomic pattern design methodology to be used in the construction of garments for elderly women, aged 65 and over, dependent of care. Clothing should be adequate to the needs of the elderly in accordance with some functional factors for the dependency of their caregiver, such as: care for the caregiver and comfort for the user. Aspects related to the functional properties of the materials used, the pattern design process and the assembling of the garment, are fundamental in user’s comfort, as well as the handling by the caregiver, related to the easy of dressing and undressing.

2. State of the art

On the subject of aging discussed in debates at world conferences, the World Health Organization (WHO) has produced a policy report that helps people reach old age in the best possible state of health in order to achieve economic and social development [3]. The International Plan of Action on Aging, adopted at the First World Assembly in Spain in April 2002, has issued a policy statement with 19 articles, each stating that effective action is taken on the challenges that will be faced and promotion of well-being in old age [4]. In the process of aging, the loss of mental and physical functioning is perceived in the foreground, as the consequence of decay and deterioration [5] [6] [7]. It is the role of health policies to help more people reach advanced ages in the best possible health condition. Active and healthy aging is one of the objectives that seeks attention in the process of protection for the elderly.

Considering the conditions of aging and the existence of a part of the policies aiming to improve the life of the elderly, this research is about product design, considering the basic requirements of comfort. Noyes [8] argues that the only way of accurately assessing the issue of comfort is the user's own statement about the product. Jordan [9] states that products perceived to be comfortable are those that provide pleasurable sensations to their users. Van der Linden [10] suggested that comfort represents a well-being condition with absence of pain, discomfort and stress, defined from a feeling of discomfort. Every professional, at the time of the elaboration of a product, has the responsibility to guarantee the total interaction of the product with the user. It is important to use new assessments, still in the beginning of the process, to re-evaluate the design, with the intention of finding the correct answers to the human dimensions [11]. The responsibility becomes greater when the product produced provides more direct contact with the user, as is the case of clothing. Ergonomics plays an important role in the search for this state of comfort. Dul and Weerdmeester [12] point out that ergonomics comprises several aspects, such as posture and body movements (sitting, standing, pushing, pulling and lifting), environmental conditions (climate, lighting, noise and vibrations) and the relationship between jobs and tasks (appropriate and interesting). It is with the combinations of these requirements that is possible to develop safer, healthier, more comfortable and more efficient projects in the context of the daily life of the elderly.

In this study, anthropometry participates with the measurement of the body, in order to obtain the needed measurements, representative of the target population, to be used in the pattern design process. Melo and Santos [13] described the role and scope of anthropometry in biomechanics and commented on some applications and contributions, such as the importance of anthropometry on the measurement of the body in biomechanical studies of skeletal musculature. Amadio and Serrão [14] define biomechanics as the science that describes, analyzes and models biological systems. Therefore, we use this area to understand the clothing handling by the caregiver when dressing and undressing the user.

3. Methods and process

The direct contact with the research participants allowed us to define the shape of the body, building the basic patterns, representative of the elderly’s body. The most common shape found was the
rounded shape, an oval style with fat concentration in the abdomen and hips. Typical modifications of
the body are: a prevalence of fat mass, loss of height (deformations in the spine), alterations in skin
texture and muscle and bone loss [15] [16]. In addition, the advanced age of the research participants
further demonstrated the dependency condition, since the weakness of the age range from 65 years
onwards, with greater permanence of the elderly women in the sitting and lying positions.

Seventy-eight volunteers were measured in a sitting position, forty-six from two institutions in the
city of Guimarães, in Portugal and thirty-two from two institutions in the city of Teresina, in Brazil.
Measurements were obtained using a flexible measuring tape, in the position that the elderly women
were: casually dressed, sitting in any seat, wheelchair or other type of chair, in order to avoid causing
discomfort and stress, due to their sensible state.

3.1. First stage of the process: collection of the elderly body measurements
An optimized number of measurements were defined according to their importance in the pattern
design process. The eight selected measurements of the body were: Waist Girth (WG), Bust Girth
(BG), Hip Girth (HG), Front Bust Arc (FBH) - (armhole to armhole), Back Bust Arc (BBA) -
(armhole to armhole), Shoulder Length (SL), Arm Length - (AL), Crotch Depth (CD).

3.2. Second stage of the process: experimental method and selection criteria of the size charts
The proposed size charts for the elaboration of the basic patterns design, representative of the elderly’s
body, was developed from the average of all measurements. Some experiments were carried out,
starting from a possible size scale reference so that the samples would indicate acceptable results in
accordance with the pre-established criteria, presented in Table 1.

Table 1 presents the initial process of garment engineering. The execution of the basic patterns had
as principle the construction of rectangular geometric blocks, using the values of the obtained
measurements of the body of the elderly women. During the design of the basic patterns, divisions and
subdivisions (1/2 and 1/4 of the total contour) were made to the measurements of the developed table
with the means, found from an experimental method, considering 5 criteria: experimentation by HG;
reduced size table; larger sample representation of size M; smallest difference between averages from
one size to another (XS–XXS, S–XS, M–S, L–M and XL–L1) regarding HG; and larger unit of size
difference between contours (HG and WG).

The criteria were established based on a subjective evaluation that focused on selecting amounts
analyzed under field conditions, offering weight for each one that was more or less important. Thus,
each criteria was chosen on random occasions of analysis, as is the case of size M: usually prototypes
are made in this size because graduation is frequently started from this center size. Therefore, it
became the option that reached the highest weight, being defined as the most appropriate of the
average table found through five trials.

Table 1. Pre-established criteria and weight of selection of the adequate experimentation of the mean
of measurements.

| Options | Weight (%) | Criteria                                      |
|---------|------------|-----------------------------------------------|
| 1       | 20         | Experimentation by HG                          |
| 2       | 20         | Reduced size table                             |
| 3       | 40         | Larger sample representation of size M         |
| 4       | 10         | Smallest difference between averages from one size to another (XS–XXS, S–XS, |

1 Size letter according to the American and European standards. From the smallest to the largest size, the
following sequence is used: XXS, XS, S, M, L, XL, and XXL.
L–M and XL–L) regarding HG

3.3. Third stage of the process: Development of the basic pattern design blocks

The design process of the basic pattern blocks was done using Cavalheiro and Silva [17] methodology. The basic pattern blocks were composed by six basic patterns for the upper body, skirt and pants, using the standard measurements from the methodology and the proposed measurements from this study, necessary for a better adjustment to the new physique of the elderly in the sitting position.

When comparing both methodologies, in the skirt, the width was reduced at the front with the same widening at the back and, when considering the sitting position, height was added in the back center; in the body, most alterations occurred in the shoulder region (back) and an increase of the front and back armhole; and in the pants, was added value in the center height of the back and a greater depth of the front and back crotch line.

3.4. Fourth stage of the process: Determination of the ease table

In pattern design, the definition of the ease value to apply around the basic patterns is an important step as it will determine the space between clothing and skin. This value will be crucial not only for the aesthetics but also for the ergonomic comfort, according with the different static and dynamic positions of the body throughout the day.

To guarantee that the ease values of the developed table corresponded to the correct applicability in the pattern design of the final garments, a first prototype was produced and evaluated on the manikin. This allowed a three-dimensional view of height, width and depth, i.e. length, neckline dimensions, armholes, sleeve length and width, among other details of the garment in relation to the body. After these observations, the ease table, presented in Table 2, was defined by body regions (bust, waist, hip, and knee height) for each type garment (skirts, blouses, dresses, and pants).

Table 2. Ease values for the development of the final patterns for each style for the elderly women’s clothing.

| Body region (width) | Skirts (cm) | Blouses (cm) | Dresses (cm) | Pants (cm) |
|---------------------|-------------|--------------|--------------|------------|
| Bust                | 3-6         | 3-6          | 3-6          |            |
| Waist               | 3-6         | 6-8          | 4-8          | 3-6        |
| Hip                 | 4-8         | 8-10         | 7-10         | 6-8        |
| Knee height         | 12-16       |              |              | 14-20      |

Regarding this possible ease variation in garments Petrova [18] reinforces that it depends on the desired fit for the style, therefore clothes of the same size can have different dimensions. So, it is proposed a range of ease value for each body region, and during the pattern design process the right value must be defined and tested according to the expected final result, material used and anatomical shape of the user, in order to assure an adequate fit to the body.

3.5. Fifth stage of the process: Development of test prototypes

For the interpretation of the garments it was considered the initial phase of product design, the improvement of comfort and the pattern design relative to the modified body. As this study aims the development of an ergonomic garment, two ways of performing the experiments were used, as mentioned by Iida [19]: one in the laboratory, under artificially constructed and controlled conditions; and the other, from the observation of the phenomenon in the real conditions, in the field of research itself. Therefore, when analyzing the body and its movements, both from the user (elderly) and from
the caregiver, during their daily interaction it is possible to better understand and comment about the use of the products. This research involves vulnerable people, who present psychological manifestations that affect the body, focusing on the choice of basic requirements for the comfort condition of the product to be developed.

In a second moment of this ongoing validation process, the final garments will be produced in the industry, in the final selected materials, fabrics, trimmings and accessories, available in the market, but able to improve, the best way possible, the identified desired comfort variables.

4. Final Considerations
In addition to the phases presented in this paper, other stages of design will follow the process of clothing production. These can be defined in: (1) Creation of models and elaboration of technical and style drawings; (2) Analysis and interpretation of the models; (3) Marker planning and cut of patterns in similar fabrics for the first assembled experiments; (4) Assembly and analysis of the models to define the final assembly processes for each model (seams, trimmings, finishing processes); (5) Marker planning and cut of patterns in the final selected fabrics for validation in the users body; Assembly and analysis of the final models of clothing.

After validation of the products to be made, surveys will be applied both to users and their caregivers, with questions about the ease of handling, openings, closures, feeling of comfort to touch, microclimate management, aesthetics and their general experience of use. Each participant will use the garments for the period of one month and their experience will be monitored by the research team in both locations. The analysis of their feedback will be used to identify adjustments and corrections in order to improve the ergonomic quality of the products according to the objectives proposed in this research.

Based on the characterization made of the elderly women dependent of care, it was possible to understand the living situation of the institutionalized elderly person, their physical and psychological conditions, with the purpose of understanding and distinguishing the subject of this research. According to the outline of the research, we noticed that, because it is an elderly and debilitated population, the contact with them should be greater, in order to be able to identify means that could soften their condition of debilitation. These questions became relevant as they guide the wellbeing, comfort and quality of life of this people.

The proposed clothing should be appropriate to its target audience, as well as observe design attributes focused on ergonomic requirements, according to some aspects and characteristics of psychological and sensorial comfort. In the case of the elderly, necessarily, the attention must be greater, because besides the sensitivity of the skin, the body undergoes modifications, requiring conformity with the new physique.

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