ACTIVEWEAR FOR OLDER WOMEN

WHO EXERCISE REGULARLY:

A PRODUCT DEVELOPMENT APPROACH

by

Haiyan Zhang

A Thesis Submitted to
The Faculty of Graduate Studies
in Partial Fulfillment of the Requirements
for the Degree of

MASTER OF SCIENCE

Department of Clothing and Textiles
University of Manitoba
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Of

MASTER OF SCIENCE

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ABSTRACT

Active sportswear for older women is expected to represent a substantial and durable market because of the increasing number of older women engaging in regular physical activity. It is important to recognize and respond to the latent demand of active mature women on sportswear. This research applied a theory of user-oriented product development by Rosenblad-Wallin (1985) to develop a prototype of an exercise top for 20 older women aged 55 or over. Individual face-to-face interviews were conducted to identify participants' demands for active sportswear. Content analysis yielded 23 functional and symbolic values. They were subsequently reduced to 10 essential values, from which design features and textile properties were derived. The final design was selected by the participants. The prototype went through a two-week wear test followed by individual interviews. The results showed that a majority of the participants were satisfied with the prototype in general and the fulfillment of essential values. The prototype provided a fairly comfortable thermal state during exercise. Participants valued functional values much more than symbolic values. They were also slightly more satisfied with the fulfillment of essential functional values than that of the essential symbolic values. Participants' body measurement data also confirmed that ASTM D5586 captured the anatomical characteristics of older women.

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CHAPTER ONE

INTRODUCTION

The world's population, especially in industrialized countries, will grow markedly older in the next 50 years. Adults aged 65 or older are projected to account for 23% of the Canadian population by 2041, up from 12% in 1995, and 5% in 1921 (Statistics Canada, 1999). Due to higher life expectancy, women make up a relatively large share of the senior population.

The aging baby boomers seem to be willing to spend on clothing. Canadian retail statistics from 1994 to 1996 showed that the largest increase in sales of women's clothing occurred in either the 55 to 64 or the 65 or older age groups (Horne, Campbell & Scholz, 1999). Similarly, after comparing the data of American Bureau of Labor Statistics Consumer Expenditure, Charbonneau (1999) found that from 1989 to 1995, while sales of women's apparel dropped $11 billion, apparel purchases by women aged 55 to 64 or 65 and older were increasing (Kirkel, 1997).

Evidence from repeated Canadian surveys suggested that physical activity among older adults has increased over time (Canadian Fitness Survey, 1992). In 1996 and 1997, 50% of all seniors exercised regularly versus 56% of the 25-to-64 age group (Health Canada, 1999a). A physically active lifestyle can prevent typical age-related declines and the onset of some disabilities (Carlson et al., 1999).

The increasing awareness of the benefits of physical fitness and social interaction

has motivated older women to join exercise classes, which may create a demand for particular modes of dress. Literature review also provides convincing evidence that the recreation-related lifestyle affects clothing expenditure of older adults. For older Canadian households among the 55-to-64 age group, those who spent money on recreational pursuits outside the home environment spent 190% more on clothing than those who did not (Duncan & Horne, 1999). Although such a potential market for active sportswear exists among older female consumers, the researcher is not able to find evidence that major sportswear companies have responded to the needs of this market segment.

In fact, older women's demand for active sportswear is yet to be studied by researchers in clothing and textiles. The existing knowledge provides only insights into older women's general body characteristics, clothing behavior and demands. For example, older women remain active in the apparel acquisition process (Chowdhary, 1998; Pankratz, 1995), and use apparel to ameliorate the effects of aging (Jackson & O'Neal, 1994). As women age, some notable changes in body shape and configuration occur, which include loss of height, thickened waist, largened hips, rounded shoulders, prominent abdomen, and sagging bust. An intensive review of these body changes has been conducted by Horne et al. (1999) and Charbonneau (1999). In addition, it has been well documented that the aging process contributes to the inability to adapt to the heat and cold as a result of decreased metabolism and heightened sensitivity to changes in temperature (Khan, Roper & Rogers, 1993; Rosenblad-Wallin & Karlsson, 1986).

It has been widely recognized that older women are dissatisfied with the fit of ready-to-wear in the marketplace, of which Horne et al. (1999) gave a thorough literature review. This can be attributed to the outdated sizing system that the clothing industry has been using. The research is timely because there now exists a new database of body measurements that are representative of older women's physical characteristics -- the American Society for Testing and Materials (ASTM) D5586 Body Measurements for Women Aged 55 and Older (all figure types). Researchers have suggested that it is an invaluable database for developing well-fitting clothing for older women (Campbell, 1998; Charbonneau, 1999; Kallal, Keiser, MacDonald & Mullet, 1999).

This research applies the user-oriented product development for functional clothing by Rosenblad-Wallin (1985) (see Figure 1) to develop active sportswear for older women systematically. This theory advocates developing clothing from the perspective of users in the use-situation. The major processes in this theory include: 1) an analysis of a problem or a deficiency experienced by users in the use situation; 2) a formulation of user and use requirements in terms of functional and symbolic values of clothing; 3) a transformation of these values into measurable engineering requirements; and 4) an iterative design process where prototypes are tested by users and modified by the designer.

This exploratory research has practical contributions to the existing body of knowledge. It recognizes a segment of older women who are physically active and identifies some attributes of this segment. It sheds light on the subjective demands of

older women for activewear. By developing a prototype of activewear based on a product development model, it examines older female exercisers' overall comfort and satisfaction with the specially designed prototype. Moreover, it helps to know the applicability of ASTM D5586 to develop well-fitting clothing for older women. Furthermore, an understanding of older women's demand for active sportswear and ASTM D5586 body measurement database may help manufacturers realize the potential of this market segment, and the feasibility of catering to it.

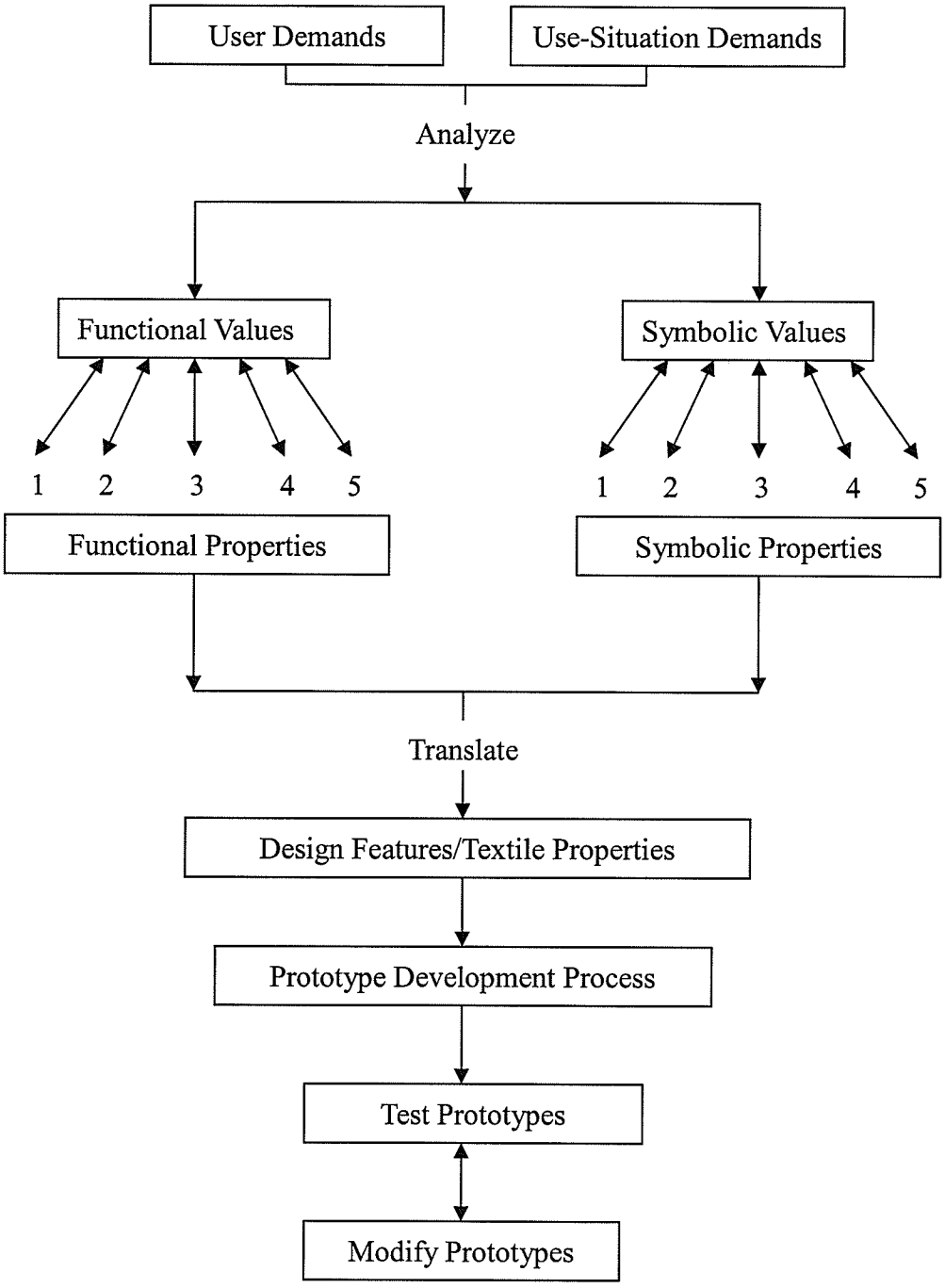


Figure 1. The process of user-oriented product development (Rosenblad-Wallin, 1985).

Justification

The group of older adults is the fastest growing population segment in Canada. The majority of them are women (Statistics Canada, 2000). They are expected to represent a substantial and durable market for apparel products (Horne et al., 1999). In particular, active sportswear seems to be a potential market opportunity because of the increasing number of older women engaging in regular physical activity. However, scant attention has been given by major sportswear companies and apparel researchers. In-depth research is necessary to investigate the activewear demands of older women who exercise regularly and how to satisfy their demands from a product development viewpoint.

Research Objectives

This study targeted women aged 55 or older who regularly participated in exercise classes. It was initiated to investigate their demands and to develop a prototype of active sportswear that responded to the demands. Four objectives were formulated:

1. To apply the theory of user-oriented product development by Rosenblad-Wallin (1985) to develop active sportswear for older women who exercise regularly, with emphasis on:

    a. Identifying the symbolic and functional values that older women associated with active sportswear.

    b. Translating selected essential symbolic and functional values into design

features and textile properties for active sportswear.

c. Incorporating those design features and textile properties into prototype development.

2. To use relevant ASTM D5586 body measurements in the prototype development process.

3. To test the prototype.

4. To measure the extent to which the prototype corresponded to the essential symbolic and functional values as well as participants' satisfaction with the prototype.

Research Questions

This study was designed to answer the following research questions:

1. What are the symbolic and functional values that older women demand for active sportswear?

2. What are the essential symbolic and functional values?

3. What are the major design features and textile properties that are translated from the essential values?

4. How do the participants respond to the prototype?

5. How well does the prototype satisfy each essential value?

6. How well can ASTM D5586 body measurements be used in the prototype development?

Definitions

The following definitions include both conceptual and operational definitions of terms used in this research.

1. Product development: refers to the process of carrying a product concept through stages from initial conceptualization to actual appearance in the market (Wolfe, 1998). It consists of: idea generation, screening, prototype pattern, sewing/fitting, adaptation, testing, sample garment, and evaluation.

2. Aerobics: refers to classes at health clubs and gyms that combine endurance and toning exercises.

3. Active sportswear: refers to apparel worn for playing active sports (Tate, 1999). In this research, it specifically means fitness wear worn for aerobics.

4. Older women: refer to healthy and active women who are 55 years or older.

5. Seniors: refer to older adults who are 65 years or older.

6. Symbolic values: refer to properties of clothing that arise on a relation between the wearer, the product and the socio-cultural environment (Rosenblad-Wallin, 1985).

7. Functional values: refer to properties of clothing that are formed in a relation between the wearer, the product and the actual environment (Rosenblad-Wallin, 1985).

8. Essential values: refer to the functional or symbolic values that participants rank as the most important. Points are assigned to each essential value according to its

ranking. For example, the first ranking is 10 points; the second ranking is 9 points, and so on.

9. Comfort: means "freedom from pain, freedom from discomfort" (Hatch, 1993, p. 27).

10. Thermal comfort: refers to "any condition of the mind that expresses satisfaction with the thermal environment" (Fanger, 1970, p.13). This definition has been widely accepted by researchers in many disciplines (Li, 2001; Maher & Sontag, 1986; Powitz & Balsamo, 1999). In this study, it is operationally defined by McGinnis' thermal scale (Hollies, 1970).

11. Exercise purpose: is operationally defined as agreement with the statements "go to exercise primarily to make friends" and "go to exercise primarily to stay healthy", based on a five-point Likert scale: 1 = strongly disagree, 2 = disagree, 3 = no opinion, 4 = agree, 5 = strongly agree.

12. Exercise intensity: is operationally defined as participants' response to the 6-20 Borg's ratings of perceived exertion (RPE) which ranges from "very, very light" to "very, very hard" (Howley, 2000).

CHAPTER TWO

LITERATURE REVIEW

This chapter contains an overview of relevant literature regarding the aging population, popularity and benefits of exercise participation, active sportswear and older consumers' demands, challenges of developing active sportswear for older women, theoretical framework, and summary.

The Aging Population

According to a recent prediction by the Population Division of the United Nations, the world's population, especially in industrialized countries such as some European countries, the United States, Canada, and Japan, will grow markedly older in the next 50 years. This rapid aging will see the number of people aged 60 years or older triple to nearly 2 billion worldwide by 2050 (Dillin, 2001).

Although the Canadian senior population was small (12%) in 1995 compared with that in other major industrialized countries, e.g. 16% in United Kingdom, and 17% in Sweden and Italy (Health Canada, 2000), seniors are projected to make up 23% of the Canadian population by 2041, up from 10% in 1981 and 5% in 1921 (Statistics Canada, 1999). In 2001, 22.5% of Canadians were 55 years or older while it was 20.9% in 1996 (Statistics Canada, 2002).

Due to a greater life expectancy, older women tend to outlive their spouses

remaining widowed and living alone in old age (Mercer & Garner, 1989). Therefore, women make up a relatively large share of the older population, especially in the very oldest age ranges. In 2001, 57.2% of all Canadians aged 65 or over, and 69.8% of those aged 85 or over, were women (Statistics Canada, 2002).

Today's older consumers are not aging like their predecessors who were portrayed as sedentary and frail. They are leading varied healthy lifestyles, including exercise participation.

Popularity and Benefits of Exercise Participation

It is reported that more than one-quarter of American women aged 65 or over claimed to exercise regularly (Vierck, 1990). Evidence from repeated Canadian surveys further suggests that participation in exercise among older Canadians has increased over time (Canadian Fitness Survey, 1992). According to the 1996 to 1997 National Population Health Survey (Health Canada, 1999a), 50% of all seniors exercised regularly versus 56% of the 25-to-64 age group. It is also revealed that 41.1% of the 55-64 age group were active or moderately active, versus 42.7% of the 25-34 age group, 38.7% of the 35-44 age group, and 37.5% of the 45-54 age group (Health Canada, 1999b). Older adults usually take low or moderate-intensity exercises, as only 29% of women 55 years or older were classified as physically active in the survey.

Although factors such as improved health and economic conditions, and plenty of leisure time, may have contributed to the popularity of exercise participation among older

adults, a major motivation seems to be awareness of the benefits of a physically active lifestyle. Nearly 24% of the 55-64 age group in the Health Canada survey thought that increasing physical activity was the most important action they should take to improve health while 27% actually took the action (Health Canada, 1999b).

The benefits of physical activity to older adults have been well documented. A physically active lifestyle can improve the quality of life by preventing typical age-related declines and the onset of some disabilities (Carlson et al., 1999). Active older adults show overall motor performance which is similar to that of younger adults, and better than that of their inactive peers (Clarkson & Kroll, 1978; Rikli & Busch, 1986). Physical activity has been reported to improve muscle strength (Bravo et al., 1996; Lord, Ward, Williams & Strudwick, 1995; Pyka, Lindenberger, Charette & Marcus, 1994), endurance, flexibility, agility (Bravo et al.), balance (Lord et al.; Shaw & Snow, 1998), and reduce the rate of falling in older adults (Lord et al.). Furthermore, physical activity has a positive effect on balance problems, obesity, muscle weakness, high blood pressure and osteoporosis, thereby delaying or limiting the severity of cardiovascular diseases, hip fracture, and osteoarthritis in the aging population (Carlson et al.).

Besides the physical benefits, physical activity also confers psychological and social benefits. Exercise can significantly increase well-being and self-perceived health (Blumenthal et al., 1989; Bravo et al., 1996; Moore & Bracegirdle, 1994), improve mood, lower anxiety, increase self-esteem (Carlson et al., 1999; King, Taylor & Haskell, 1993), reduce the chance of cognitive impairment (Clark, Long & Schiffman, 1999; Molloy,

Beerschoten, Borrie, Crilly & Cape, 1988; Paillard & Nowak, 1985;), and improve life satisfaction (Clark et al.).

Active Sportswear and Older Consumers' Demands

There exists a direct equivalence between sportswear and the North American style because it is an American invention, an American tradition, and the foundation of the American ready-to-wear industry (Martin, 1985). The concept of sportswear has changed over time. It is originally a term applied only to clothing designed for athletic purposes; later, to apparel worn by spectators at sports events; and then broadened to include simple, tailored costumes retaining the informality of athletic attire (Picken, 1957). The term 'active sportswear' or 'activewear' is used to designate apparel worn for playing active sports (Picken; Tate, 1999), of which function and easy care are the main concern (Tate). Frings (1999) subcategorized active sportswear as fitness apparel worn for exercise, and sports apparel worn to play sports. In this research, activewear specifically refers to fitness apparel.

Although it is known that some older women are committed to exercise, little is known about them as consumers of exercise-related goods, including activewear. A literature search on clothing and older exercisers yielded very few research papers relevant to this topic. The publications can be loosely classified into three clusters – advice on how to dress appropriately for exercise, older consumers' general preference

for sportswear and improvement of fit, or responses to various types of clothing or textile materials.

Ting (1991) dispensed advice on clothing for older exercisers. He indicated that clothing was vital to older runners because of their bodies' heightened sensitivity to extreme thermal changes. He further recommended: 1) layered clothing for maximum insulation; 2) specialized thermal clothing, e.g., polypropylene to prevent hypothermia and skin irritation; 3) gloves and thermal socks to combat the decrease in peripheral vascular capacity.

Berman (1995) and Kallal et al. (1999) examined the clothing preference of older consumers and suggested improvements. In her Master's thesis research, Berman used questionnaire survey to investigate the preferences and fitting problems of elderly women regarding activewear. The recommended improvements include easy-to-read fiber content/fabric care labels and laundering instructions; use of pre-shrunk fabrics with stain-free finishes; wider availability in lengths of pants and sleeves, especially shorter lengths; 3/4-length sleeve styles; pants that did not exaggerate or call attention to heavy hips and thighs, special features such as extra pockets to accommodate eye glasses, tissues, etc.; wider, lower cut necklines (i.e. V-shaped necklines); zipper with large pull; and pants that are easier to draw the feet through (i.e., pants with wider openings at the ankles and Velcro® tab closings). Kallal et al. suggested that for active older adults: 1) fit should imperceptibly accommodate changes in the figure and promote comfort without looking age-specific; 2) construction details should incorporate adjustable fit; 3) standing,

seated, and active positions are all necessary in fit testing.

With respect to older women's social-psychological response to exercise clothing, Sinden, Martin Ginis, and Angove (2003) found that older women who were more physically active responded more positively to stimuli which depict revealingly exercise attire than those who were less active. They further reported that active sportswear could affect the wearer's physical activity involvement and mood. Specifically, exposure to revealingly attired older exercisers might actually cause a decrease in older women's self efficacy about exercise. Therefore, they advocated a non-revealing dress code to help attract and retain older women in exercise groups because feelings about the self and the exercise group could influence exercise adherence. Consequently, well-designed activewear is expected to boost the motivation of healthy older adults to engage in physical activity and may help them adhere to it.

In addition to treating older adults' preference as an element of demand, their spending pattern is another variable in gauging demand. Although there is not much direct information about older women's demand for exercise clothing, research on the clothing expenditure of older consumers is relatively abundant.

Clothing Expenditure of Older Consumers

Secondary analyses of family expenditures have consistently shown that while clothing expenditure and income are positively related (Abdel-Ghany & Schwenk, 1993; Yang, 1996), clothing expenditure tends to decline with age (Cook & Settersten, 1995;

Harrison, 1986; Neal, Schwenk & Courtless, 1990). However, when the clothing expenditure of older consumers is brought under sharp focus, a number of behaviors begin to emerge. Their spending pattern tends to be linked to a number of sociodemographic characteristics such as education, age, gender, and income. Better educated elderly consumers have higher clothing expenditures than less educated consumers do (Lee & Hanna, 1997; Rubin & Nieswiadomy, 1994). Older females spend more on clothing than older males (Duncan & Horne, 1999; Lee & Hanna). Jackson (1992) found that older consumers with a reported annual income of $30,000 or higher showed a high mean apparel expenditure. Duncan and Horne (1999) reported that clothing was a necessity for the 55-to-64 age group and a luxury for the 65-to-74 age group. This is consistent with the findings of Horne et al. (1999) that older females at the 'young' end of the age continuum spent more on clothing than those at the 'old' end.

Retail sales data also provide valuable insights into older consumers' clothing expenditure. From 1989 to 1995, total sales of women's apparel in the United States dropped US$11 billion (Kirkel, 1997). Despite the overall decrease, from 1994 to 1996, the largest increases in purchase of women's clothing for all age groups occurred in either the 55 to 64 or the 65 or older age groups in both Canada (Horne et al., 1999) and the United States (Charbonneau, 1999).

Some empirical research findings distinguish the spending preference of older adults and its correlation with their clothing expenditure. Zimmer and Chappell (1996) reported that 50% of interested consumers would choose to purchase recreational items if

they had additional incomes. Duncan and Horne (1999) further indicated that for Canadian households headed by persons 55 years or older, those who spent money on outside-of-home recreational pursuits spent more on clothing than those who did not. Remarkably, among the 55-to-64 age group, clothing expenditures were 190% greater if the household also spent on outside recreation.

From the literature review on benefits of exercise and clothing expenditure, it appears that the increasing popularity of exercise among older women seems to formulate a consumer group for activewear products. Empirical studies reveal that such recreational pursuits may stimulate a greater clothing expenditure. Clothing retail data and the positive relationship between income and clothing expenditure reflect the command of some older consumer segments on their disposal or discretionary income (Holland & Conaway, 1991). Therefore, activewear for older adults seem to be a tenable market segment. However, no research attention has been devoted to older adults' demands for exercise clothing, not to mention activewear developed specifically for older women. To the researcher's knowledge, major sportswear manufacturers have not targeted older exercisers as a segment. The practical contributions of this exploratory research are to give insights into the subjective demands of older women for exercise clothing and the feasibility of catering to them, and hence, to help apparel manufacturers realize the potential of this market segment.

Challenges of Developing Activewear for Older Women

Although activewear for older women is a potential market, it is complex to serve. In addition to scant knowledge of their clothing demands, some practical challenges deserve in-depth investigation to develop well-fitting clothing for older women. These challenges include typical physical changes during the aging process, and clothing sizing standards specifically for older women.

Physical Changes and Aging

Aging is a normal biological process that affects every system within the body. The variety of age-related physiological changes contributes to the complexity of targeting older women. In a survey of Swedish older adults' clothing problems, Rosenblad-Wallin and Karlsson (1986) classified the changes into three categories: anatomical, physiological and pathological. Anatomical changes in the body size and configuration are particularly relevant to the fit of clothing. In general, older females tend to decrease by one to two centimeters in height and increase in the girth of bust, abdomen, waist, and hip (Goldsberry & Reich, 1989; Rosenblad-Wallin & Karlsson). The loss of height is more pronounced in women than in men (Borkan, Hults & Mayer, 1982). A thorough review of anatomical changes with aging has been reported by Horne et al. Examples of physiological and pathological changes include decline of muscular strength, stiff tendons and connective tissues, reduced grip strength and dexterity, and disorders of the musculoskeletal system and the nervous system (Rosenblad-Wallin & Karlsson).

To develop active sportswear which is functional and flattering, those changes must be taken into consideration. For instance, due to the general stiffness and decline of grip strength and coordination in the upper extremities, designs requiring great mobility of the upper body or grip coordination, such as pulled over styles, closures on the shoulders/back, and small buttons should be avoided (Rosenblad-Wallin & Karlsson, 1986). The decrease in metabolism and the sensitivity to temperature changes determine that older adults need light and isolating garments to attain a thermally comfortable environment (Khan et al., 1993; Rosenblad-Wallin & Karlsson; Ting, 1991). Moreover, as hair and skin pigments fade with age, the intensity of colors most attractive to women generally shifts toward softer or lighter shades (Designs on 'Older' Women, n.d.; Weiland, 1990). Charbonneau (1999) thoroughly summarized the physiological changes associated with age and fit problems of females over the age of 55; and design strategies in terms of fit, style, fabric and color to maximize some physical features while minimizing others.

Anthropometric Data and Sizing Standards

One of the key product development tools in ready-to-wear industry is a pool of body measurements which is representative of the users' physical characteristics. Currently, the Voluntary Product Standard PS42-70: Body Measurements for the Sizing of Women's Patterns and Apparel has shaped the way manufacturers developed standard sizes. PS42-70 is a database of 58 body measurements taken from about 15,000 women across the U.S. in the 1940s, in which only 2% of women aged 65 or over were included

(Goldsberry; 1995; Woodson & Horridge, 1990). The body conformation of older women has changed greatly since then. After comparing body measurements of 104 women aged 65 to 95 with those of PS42-70, Woodson and Horridge found significant difference in body dimensions and posture.

Until 1994, when the American Society for Testing and Materials (ASTM) published the ASTM D5586, no accurate anthropometric data on older women existed. The ASTM D5586 is the result of an extensive anthropometric survey of 6,786 U.S. women who were 55 years or older at the time. The data were clustered into realistic measurement charts that added the ease necessary for a comfortable fit. Up to 75% of body measurements in ASTM D5586 were significantly different from those in PS42-70, and thus confirmed changes in body dimensions affecting the fit of apparel (Institute for Standards Research, 1993).

The only known case of using the ASTM D5586 data base to develop consumer goods is Vogue Patterns. According to an article in Vogue Patterns (1999), Sandra Betzina, Design Director of Vogue Patterns, incorporated ASTM D5586 measurements into ten alphabetical sizes (designated by letters A to J) in six patterns. Patterns developed from Betzina's sizing fit well. The article also indicated that measurement increments among these sizes were greatly different from those of Vogue Patterns for young women. Campbell (1998) is the only research that has empirically tested the efficacy of the ASTM D5586 for garment fit. Campbell examined the relationship between satisfaction and performance outcomes with trousers produced from body measurements in the ASTM

D5586 and Canada Standard Sizing (CSS) for Women's Apparel – Trade Sizes. She found that higher levels of satisfaction were associated with the ASTM trouser than the CSS trouser although the difference was not statistically significant.

Although ASTM D5586 seems to provide an important resource for developing well-fitting apparel for older female consumers (Campbell, 1998; Charbonneau, 1999; Kallal et al., 1999), much work remains to be done to improve fit of ready-to-wear. For example, a systematic set of sizing specifications for apparel manufacture needs to be established because ASTM D5586 only provides body measurements.

Realizing the challenges in age-related body changes and sizing standards is important for the prototype development in this study. The research will contribute to the ongoing effort to apply the ASTM D5586 body measurement data to clothing for older women in specific end use.

Theoretical Framework and Product Development Models

The definition of product development bears certain characteristics of the particular industry or scientific discipline. In marketing, product development is defined as creating new products or improving the existing products of the firm for current or new customers (Bates & Parkinson, 1969; Griffin, Ebert & Starke, 1996; Hill & Jones, 1995). In the clothing area, Wolfe (1998) defines product development as the process of carrying a product idea through stages from initial conceptualization to actual appearance in the

market. The sequential process is divided into: market and trend research, merchandising, market screening, design, and development of the final product which may include sample pattern, sewing/fitting, adaptation, testing, sample garment, line selection, production pattern, and specification (Frings, 1999). This research adopts Wolfe's definition, but omits the commercialization stage.

Due to the customer-driven nature of apparel market, the choice of theoretical framework is limited to product development models that involve customers in the process. Kaulio (1998) pointed out that different methods supported the involvement of customers: 1) at different phases of the design process, particularly in three phases: specification, concept development and prototyping; and 2) in different ways, of which three types are identified: design for customers, design with customers and design by customers. Eight product development methods are compared, which include quality function deployment, user-oriented product development (UPD), concept testing, beta testing, consumer idealized design, lead user method, participatory ergonomics, and ergonomic design. UPD is the only one that has been applied to clothing (Karlsson & Rosenbald-Wallin, 1998; Rosenbald-Wallin, 1985). It involves users in all the three stages: specification, concept development and prototyping, and the end products are designed both for users and with users. This model is also suggested to be applied to products whose functional properties are of great importance (Rosenblad-Wallin). Therefore, UPD seems to be the most proper theoretical product development tool for this study.

The User-Oriented Product Development Model

The user-orientated product development model (UPD) is based on the human being as the user of products or services and stresses the properties required of the products in use (Rosenblad-Wallin, 1985; 1988). User demands are collected through user analysis, while demands of the use-situations are deduced from measurements, descriptions and evaluations of relevant factors in the use environment. General requirements, such as expert and third party requirements, cost price and production techniques etc. are added into the demand list later. UPD is characterized by: 1) a problem or a deficiency analysis of the final users with a starting point in the use situation, leading to the formulation of functional and symbolic values of the user/use requirements; 2) a transformation of these requirements into measurable technical terms or standardized estimations with given limits or desirable values; 3) an iterative design process under the guidance of those specified contributing requirements, where prototypes are tested by users and modified by the designer (Kaulio, 1998; Rosenblad-Wallin, 1985; 1988).

UPD has been applied to different technical research and development areas including aids for handicapped people, equipment for dwellings, personal hygiene equipment and medical care (Dahlman, 1983; Kärrholm, Dahlman & Rosenblad-Wallin, 1977; Rosenblad-Wallin, 1985), packaging and surface coatings, functional clothing (Rosenblad-Wallin; Rosenblad-Wallin & Kärrholm, 1987), footwear (Rosenblad-Wallin, 1988), and fasteners (Sperling & Karlsson, 1989). It has also been used to investigate

clothing problems of disabled users (Thoren, 1996), and clothing demands of older people at home and in nursing homes (Rosenblad-Wallin & Karlsson, 1986). For example, Sperling and Karlsson applied UPD to the development of new fasteners for long-term-care patients. By evaluating the practical use of different standard clothing fasteners and their positions, user demands were specified and an adapted oval button and a 'finger strap' alternative to hook-and-eye were designed. Another example of the application of UPD is the military footwear developed as a part of the new Swedish battle dress system (Rosenblad-Wallin, 1988). The requirements of healthy feet were the starting point in contrast to an established last in previous work. The assessed footwear requirements were based on literature and studies of the biomechanical and physiological functions of feet, and interviews with the soldiers.

The efficacy of UPD in the clothing area has been confirmed by empirical trials including working clothes for mechanical engineering and professional fishermen, military clothing, clothing for the elderly and the disabled. For example, the design of the overall for mechanical engineering using UPD was so unique that it could be protected by three patents (Rosenblad-Wallin & Kärrholm, 1987). The finger strap designed by Sperling and Karlsson (1989) in accordance with UPD was a technical innovation because of its advantage to patients with hemiplegia and joint complaints; and the combination of oval buttons and vertical buttonholes improved the function for most patients. The new boots resulting from UPD were lighter, softer, better fit, more mobile and comfortable than traditional ones; the new methods of production resulted in lower

costs of production than before (Rosenblad-Wallin, 1988).

In short, UPD has been applied to a variety of areas including functional clothing, and been shown to be generally effective. Since little is known about its effectiveness in developing active sportswear for older women, this research may give insights into it.

Functional Values of Clothing

According to the UPD theory, functional values of a product are formed in a relation between man, the product and the actual environment (Rosenblad-Wallin, 1985). The most important functional properties of clothing are to offer protection and comfort (Khan et al., 1993; Li, Keighly & Hampton, 1988; Rosenblad-Wallin; Watkins, 1995). The manipulation of clothing and textiles can assist in maintaining a comfortable and healthy environment.

Protection

Although most people do not consider clothing as an intimate environment, many clothing items function as a portable environment by providing protection for the human body (Watkins, 1995). Watkins thoroughly described the development of functional clothing for protection against hazards in terms of radioactivity, electricity, solid particles, flame and molten metal, weightlessness, buoyancy, and chemical/biological hazards, as well as the design of impact-protective clothing for intensive sports such as hockey and football. In a normal environment, clothing should protect wearers from pollutants such as dirt, and mechanical impacts such as wear, tear and abrasion (Rosenblad-Wallin,

1985).

Comfort

Compared to protective values, comfort is a nebulous and complex subject that has attracted great attention from researchers. Comfort refers to "a pleasant state of physiological, psychological, and physical harmony between a human being and the environment" (Slater, 1985, p. 4). From another viewpoint, comfort means "freedom from pain and discomfort" (Hatch, 1993), a neutral state where people are unaware of their garments both psychologically and physiologically.

Rosenblad-Wallin (1985) stated that comfort was related to thermal climate, ease of movement, weight/load, fit, pressure on the body, friction against the body, tactility, and static electricity. Hatch (1993) condensed the comfort state into a number of performance properties: 1) thermophysiological comfort, "the attainment of a comfortable thermal and wetness state; involves transport of heat and moisture through a fabric" (p.26); 2) sensorial comfort, "the elicitation of various neural sensations when a textile comes into contact with the skin" (p.26); 3) body-movement comfort, "the ability of a textile to allow freedom of movement, reduced burden, and body shaping, as required" (p.26). Similarly, Li (2001) used thermal-wet comfort, tactile comfort, and pressure (body-fit) comfort as independent sensory factors of clothing comfort. The classification of comfort by Hatch and Li are basically identical.

According to Li (2001), the relative importance of the three performance properties

in sensory experience varies with different combinations of physical activities and environmental conditions. For sportswear, thermal-wet comfort is perceived to be extremely important, accounting for 43% of the total variances, followed by tactile comfort and pressure comfort. In developing active sportswear for older women, thermal-wet comfort is worth particular consideration because the ageing process reduces the adaptability to heat and cold (Khan et al., 1993; Rosenblad-Wallin & Karlsson, 1986) while exercise generates heat.

The acceptability of functional properties of clothing also depends upon permitting a satisfactory "feel" in the fabric-skin contact (Li et al., 1988). When examining physiological responses and psychological sensations in wearer trials with knitted sportswear, Li et al. found that the overall preferences for sportswear worn next to the skin, in both cold and hot conditions, were mainly determined by the tactile and tactile-fit sensations and not by the thermal-wet sensations.

Moreover, since poor fit of clothing is a frequent complaint of mature women, adaptation to anatomical changes is required for proper body-fit comfort. Rosenblad-Wallin and Karlsson (1986) suggested that for active, but arthritic older adults, it might be beneficial to design clothing with extra pockets that were conveniently placed, larger armholes, lightweight, stretchy materials, and manageable closures such as zippers with larger pull-tabs for easy dressing/undressing. In addition, body movement needs to be studied, and clothing design should accommodate body changes in movement (Watkins, 1995). For example, when the knee is bent, at least two changes can be

observed: 1) length of the leg increases over the kneecap and decreases along the back of the knee, 2) the circumference of the leg in the bent area may also increase as muscle tissues and fat move into different positions. Consequently, tight and nonstretchy pants styled for the body in the anatomical position may be difficult for kneebend.

Symbolic Values of Clothing

Consumers' requirements for apparel products are much more than comfort and protection. Symbolic properties represented by aesthetic appeal seem to be more fascinating to consumers. Symbolic values or nonmaterial values arise on a relation between man, the product and the socio-cultural environment, which may include self-esteem, fashion, decoration, group-membership, and respectability (Rosenblad-Wallin, 1985). In other words, symbolic value originates in man's emotional judgment of a product.

Clothing has been widely recognized by society as a powerful communicator of information during social interaction and as an aid in the establishment of self-identity (Chowdhary, 1988, 1991; Daters, 1990). It may assist women to fit in to society or a group so that they feel accepted and interact easily (Kirkel, 1997). Some kinds of clothing can signify the wearer's identity or membership in a special organization, i.e., a monogrammed bowling shirt shows that the person belongs to a team while a flight attendant's uniform tells the identity of the wearer.

Clothing has been shown to be closely related to the wearer's self-perception

(Frederick & Shaw, 1995; Maguire & Mansfield, 1998; Tatarka, 1996) and others' perception of the wearer's ability (Behling, 1994; Morganosky & Creekmore, 1981). For example, Tatarka found that the symbolic image of a garment was congruent with an individual's self-concept because the participants' body-self relations played an important role in their clothing attitude. Behling reported that students' perceptions of the ability of their peers could be influenced by physical appearance produced by their clothing. Accordingly, dressing well can raise morale and self-esteem (Markee, Carey & Pedersen, 1990). Research confirmed that a professional image through apparel such as pants/blouse and pants/jacket could reinforce an individual's self-confidence and feelings of competence in his or her jobs (Belleau, Miller & Church, 1988; Solomon & Douglas, 1985). Kratz et al. (1997) confirmed that adapted sportswear enabled the wheelchair users to concentrate better on exercise and live up to the expectations of others, and it also positively changed their mood.

Fashion, as a symbolic value of clothing, is extremely important to an elderly population in social situations outside the home. Older women have high interest in fashion (Charbonneau, 1999; Chowdhary, 1988, 1989; Kaiser & Chandler, 1984; Khan et al., 1993; Richards, 1981; Robins, 1999). Chowdhary (1988) noted that 80% of the elderly in her research expressed interest in stylish clothing. Khan et al. (1993) found that when moderately active and highly active older adults planned to "go out" for social gatherings, fashionable clothing and concern for proper appearance was ranked only next to comfort. The study also noted that older persons who were more socially involved

tended to be more interested in fashion. A possible explanation is that older women use appearance management activities such as selecting apparel styles that are more flattering to their image to ameliorate the effects of growing old (Jackson & O'Neal, 1994). Since social interaction is an important motivation that many active mature women partake in exercise (Poole, 2001; Traphagan, 1998), older female exercisers are expected to have great demands on fashion and proper appearance.

On the other hand, appropriate clothing can promote older adults' social-interaction by boosting their self-esteem (Calhoun & Morse, 1977; Chowdhary, 1988, 1991; Fritz-Cook, 1990), whereas the lack of appropriate clothing may deter it (Fritz-Cook). In such a way, clothing may help older adults cope with changes in life that require building new relationships and identities. Moreover, research has shown that exercise clothing can influence older adults' willingness to participate in exercise programs (Martin, Leary & Rejeski, 2000; Sinden et al., 2003).

Summary

The world is facing an aging population. Adults aged 65 or older are projected to account for 23% of the Canadian population by 2041 (Statistics Canada, 1999). Older females make up the majority of older adults, and have a longer life expectancy than older males. The vitality and prosperity of many seniors have conjured a very different image of seniors as wealthy and capable (NACA, 1999).

Awareness of the health benefits of a physically active lifestyle results in the

increasing popularity of physical activities among older adults. In 1996 and 1997, one-half of all seniors exercised regularly versus 56% of the 25-to-64 age group (Health Canada, 1999a). As older women continue to recognize the benefits of exercise, active sportswear for this segment is expected to represent a substantial and durable market. Empirical research has suggested that recreation-related goods or services are likely to be objects of discretionary spending by older consumers (Duncan & Horne, 1999; Zimmer & Chappell, 1996). Hence, it is very important to recognize and respond to the latent demand of active mature women on sportswear.

Knowledge of older women's demands for activewear is very limited and indirect, but older consumers' spending pattern indicates that activewear for older adults is a potential market segment. To develop well-fitting clothing for older women, two major challenges must be confronted, which are body changes with aging and a proper sizing standard.

It is well documented that some of the most notable age-related body changes include the loss of height, the thickened waist and larger hip, rounded shoulders, prominent abdomen, and sagging bust. Ample evidence also suggests that special clothing adaptation is necessary to accommodate the anatomical and physical changes (Charbonneau, 1999; Goldsberry, 1995; Horne et al., 1999; Rosenblad-Wallin & Karlsson, 1986). In addition, older consumers' inability to adapt to the heat and cold as a result of decreased metabolism and heightened sensitivity to changes in temperature (Khan et al., 1993; Rosenblad-Wallin & Karlsson) must also be considered, especially in an exercise

condition.

Fit is the most salient source of dissatisfaction with clothing among older women. It mainly results from the outdated sizing systems that the clothing industry is using. As ASTM D5586, a body measurement database for women aged 55 or older, is now readily available, it can be a good resource to develop well-fitting ready-to-wear clothing for older women.

The model of user-oriented product development by Rosenblad-Wallin (1985) is the theoretical framework for this study. In this model, the design features of clothing are outcomes of systematic analyses of the demands of the users and the use situation. The user/use demands are first interpreted as the symbolic and functional values of clothing associated with its specific end use. Once the values are derived, they would be translated into design details and measurable technical terms. An iterative design process would be the subsequent stage where prototypes are tested by users and modified by the designer.

This research can give insights into the subjective demands of older women on sportswear, and objective demands from the exercises and the surrounding environment. The study may also help apparel manufacturers realize the challenges and opportunities of this potential market segment, and hence, develop activewear products to satisfy older women's demands.

CHAPTER THREE

METHOD

This chapter describes the procedure used to achieve the objectives stated in Chapter One. The entire process is explained in five sections: sample recruitment, user and use demand collection and analyses, prototype development, wear test, and responses to the prototype.

Sample Recruitment

The research participants were recruited by placing notices (see Appendix A) and directly talking to exercisers in three fitness centers that had programs for older adults. Individuals who thought they had the following characteristics were encouraged to contact the researcher: (1) being women aged 55 or older; (2) regularly attending exercise classes in the fitness centers; (3) being in good health and living independently; (4) enrolling in the same class until March 2003; (5) being residents of the city of Winnipeg; (6) height is between 61 and 66 inches, bust girth is between 35 and 40 inches, waist girth is between 31 and 35 inches, and hip girth is between 37 and 42 inches.

The exercise was mainly limited to aerobics. Because different types of exercise had different requirement on clothing, it was necessary to focus on a particular type. Due to the intensity of aerobics and the shortage of aerobic wear expressly designed for older women, the researcher decided to develop a prototype of exercise clothing for aerobics.

The reason for choosing a specific range of body measurements was to conform to the most common sizes in ASTM D5586. According to the ASTM D5586 survey, the total 6,786 subjects were categorized into 55 sizes. There were 6 sizes that accounted for 22.6% of the subjects, which were sizes 14, 16, and 18 of the Misses and Misses Petite figure types. In other words, 22.6% of the subjects were classified into 11% of the sizes. It means that they were the most common sizes in older women. Therefore, the anthropometric range in this research was chosen to correspond to these 6 sizes.

Interested persons were invited to contact the researcher. During the first contact, the purpose and procedure of the research were briefly explained and the sample selection criteria were orally verified. If the volunteer was willing to participate, the researcher would meet her at her home. At the beginning of the meeting, the researcher took height, bust, waist and hip measurements of the volunteer. Theoretically, meeting all the criteria was necessary to be a participant. However, the researcher felt justified to relax the original anthropometric criteria because finding a sample of older women whose body measurements were exactly matched with the anthropometric criteria would take a long time or yield a very small sample. Therefore, to ensure an adequate sample size, the researcher decided that if a volunteer fit criteria 1 to 5 and at least one of the body measurement ranges in criterion 6, she would be eligible to participate in the research. She was then asked to sign a consent form to be a research participant (see Appendix B). Finally, a sample consisting of 20 older women was recruited. Each participant was assigned an alphanumeric code for identification purposes.

User and Use Demand Collection and Analyses

This section describes the procedures to collect data with respect to demand for active sportswear from users and the use situation. It is covered under the following subtitles: use-situation demand, individual interview for user demand, identification of functional and symbolic values, and data reduction for essential values.

Use-Situation Demand

According to the model by Rosenblad-Wallin, the process of product development starts with the user or use demand. To examine use demands or problems arising from the use situation, the researcher went to the three fitness centers to experience the environmental temperature and humidity. In addition, the following aspects were carefully observed, 1) environmental space setting: whether it was an open space where all the exercisers could see each other, or a close aerobic studio; 2) class setting: whether it was a co-ed class; 3) the different modes of exercise in which participants engaged; 4) exercise clothing that people were wearing; and 5) how well the exercise clothing fit on the body when different movements were performed.

Those observations were carried out for three purposes. The first purpose was to help the researcher better understand the responses of participants during the interview. The second was to identify what properties or design features were necessary to accommodate the exercise or the environment. The third was to find out whether and how the use-situation affected participants' demands on attributes of active sportswear.

Individual Interview for User Demand

To collect qualitative data in terms of participants' demands for active sportswear, an individual interview was conducted (see Appendix C). This method of data collection could provide more flexibility in obtaining information, and might yield more accurate information and a greater depth of response than could be obtained through a questionnaire.

The structured interview contained questions to elicit responses relevant to five categories: (a) purposes of fitness enrollment, (b) subjective assessment of exercise exertion, (c) exercise garments currently worn by participants, (d) the degree of satisfaction with the current exercise clothing, (e) desired active sportswear attributes. A force-choice questionnaire was also included to collect demographic information including age, marital status, education, employment, occupation, income, and self-perceived health status. Regarding the question of subjective rating of exercise intensity, the researcher used the 6-20 Borg's perceived exertion and pain scale (Howley, 2000). This scale has been used to examine the physiological response to walking in simulated tropical conditions while wearing two designs of wet weather jackets (Malcolm, Armstrong, Michaliades & Green, 2000).

The interview questions were tested in two stages as suggested by Dillman (1978). In the first stage, the instrument was reviewed for face validity by the researcher and the researcher's advisor. In the second stage, after receiving approval from the Ethics Review

Board, the researcher conducted the interviews with the first two volunteers. Minor editorial changes and adjustment to the order of the questions were made to the demographic questionnaire.

The interview was conducted at the home of each participant. With permission of participants, the entire interview process was recorded on audio tapes. Instructions and questions in the interview schedule were exactly followed. The researcher also obtained permission to take pictures of clothing that the participants most often wore to aerobic classes. This would help the researcher to visualize participants' response to open-ended questions when analyzing data.

Identification of Functional and Symbolic Values

Responses to the open-ended interview question regarding demands on active sportswear were first transcribed verbatim from the tapes. The qualitative data were then subjected to content analysis where it was coded and categorized either into functional properties or symbolic ones based on the definitions by Rosenblad-Wallin (1985).

Data coding was conducted independently by the researcher and the researcher's advisor. Subsequent to the completion of the initial coding, the two coders met to compare their coding and to discuss the conflicting decisions so as to reach a final consensus. Due to intercoder reliability, no second coding was thought to be necessary.

In the coding process, the two coders picked out participants' expressions that had either symbolic or functional implications. No rewording was made in order to avoid

coders' subjective interpretation. This process yielded a list of 66 symbolic attributes and 84 functional attributes. Since those attributes were in the participants' original expressions, some of them represented very similar concepts, hence, were grouped into one value. For example, the three functional attributes, "moving with the body", "not cutting into the body" and "not tickling the body", were considered to be all relevant to the tactile property of a garment. Therefore, a category labeled "friction against the body" was created to represent the underlying meaning of these attributes. Similarly, "decent-looking", "being more covered up", and "not being seen through" were all covered under the symbolic value "modesty". This process resulted in 23 values, of which 12 were functional and 11 were symbolic.

Responses to dissatisfaction with current exercise wear revealed that the participants encountered more problems and had greater dissatisfaction with garments for the bottom than for the top. However, considering the variety of preferences to the bottom in terms of length and style, it would be impossible to design one prototype to cater to all the participants. Additionally, in response to the symbolic and functional values, more design features and textile properties could be incorporated to a top than to a bottom. Therefore, it was decided that for the purpose of this research the prototype would be an item for the upper body.

Data Reduction for Essential Values

From the previous stage, the researcher identified 23 functional and symbolic

values. Since the theory was a user-oriented product development method, it was necessary to listen to the users regarding the relative importance of those values for a top which they would wear to exercise classes. However, after consulting with the committee, it seemed impractical to ask the research participants to rank 23 items. Moreover, it was also impossible to incorporate all the values when designing a prototype. Hence, the researcher decided to reduce the information to a manageable level by asking the participants to identify 10 values that were essential to them and later rank them.

For this purpose, group meetings with the participants were carried out. In each meeting, participants were provided with a questionnaire that consisted of the 23 symbolic and functional values, along with examples of the corresponding product attributes that yielded the values (see Appendix D). To avoid order effect, the researcher randomized the order in which the 23 values were listed. After reviewing the questionnaire, participants were asked to select 10 values that they considered essential for an exercise top. Then, they were asked to rank the 10 values according to the relative importance. A ranking of 1 would mean the most important and 10 would mean the least important.

To determine the group's ranking of the 10 essential functional or symbolic values, weights were assigned to the individual ranking of each of the 10 essential values. The individual rankings from 1 to 10 were allocated points 10 to 1 respectively. In other words, a ranking of 1 was allocated 10 points; a rank of 2 was allocated 9 points and so on. The weighted scores of each value were then summed up. The functional and

symbolic values that had the top 10 highest scores represented the sample's ranking of 10 essential values.

Prototype Development

With the 10 essential values in hand, the prototype development began. This part is described in terms of transformation of essential values into engineering requirements, design sketches, pattern development, fabric testing, and prototype production.

Transformation of Essential Values into Engineering Requirements

According to Rosenblad-Wallin (1985), after the formulation of the user and use demands in terms of functional and symbolic values, the next step was to transform these demands into measurable engineering requirements. Therefore, the researcher set out to translate the essential values into either design features or textile properties. The design features would guide style design while the textile properties would direct fabric selection.

Some design features or textile properties were actually brought up by the participants when they elaborated upon their demands during the first interview. Others were elicited by the researcher based on apparel design principles. For example, "fit" was translated into the design feature "a little form-fitting, but not tight". This was because most of the participants expressed their preference of fit as "form-fitting", "not big baggy", or "not tight". "Appearance and body image" was translated to "v-neck", "dark

color", and "vertical decorative or functional lines". According to design principles, a person looks slimmer in dark colors than in light colors because dark colors make an object recede. Vertical lines have a similar visual effect as they draw people's attention in the vertical direction. A garment with vertical stripes can make the wearer look more slender than the one with horizontal stripes. In addition, most women in this research thought a v-neck design would flatter them. On the other hand, a few functional or symbolic values might point to one design feature or textile property. As mentioned above, the design feature "a little form-fitting, but not tight" was also related to "ease of movement", "ease of dressing" and "covers imperfections", which means the garment should not fit so snugly as to restrict movement, cause difficulty to take off, or reveal the body parts that they want to cover.

Design Sketches

Based on the derived design features, the researcher developed design sketches of upper body activewear. Ten designs were created and screened by the researcher and a local activewear manufacturer. The criteria for screening the sketches included technical aspects of production, attractiveness of the design on older women, and the extent to which the design corresponded to the essential symbolic and functional values. Subsequently, two sketches were chosen to be presented to the participants (see Appendix E).

In the panel meeting which was held at the university, the researcher explained to the participants the ranking results from the previous meeting, how design features and textile properties were generated, as well as how the two designs reflected those design features and textile properties. The panel was asked to evaluate the sketches. To eliminate any color influence to their choice of the style, both sketches were in black and white. Fifteen of the 20 participants voted for sketch "1", which became the design for the prototype.

The chosen design was a cross v-neck pullover (see Appendix E-1). Two vertical style lines (piping) run from the shoulder to the hem on both the front and the back. The garment was in black while the neckband and piping were in a light color. It was form-fitting with some shape in the waist. The torso length was about a couple of inches above the hip line. The short sleeves were of middle upper arm length. There was no zipper or label attached to the garment.

Pattern Development

The pattern for the chosen design was not customized for each participant. Instead, the participants were divided into a few size groups based on the comparison of their body measurements and those of ASTM D5586.

Body Measurements and Sizing

Participant's body measurements at bust, waist, hip and height were compared with the measurement charts in ASTM D5586. Then, each participant was categorized into a

figure type and size that had measurements closest to her actual ones. When it was hard to match all of the four measurements, bust and hip were the most accountable. Those specific figure types and sizes were further combined into 6 size groups according to the similarity of those key body measurements. Since most size groups included more than one size, the average measurements were calculated within each group. The size that was closest to the average was chosen to be the representative of that group.

Patternmaking

Based on the six representative sizes, the researcher engineered the patterns for the chosen design using Aldrich's patternmaking method for easy fitting jersey wear (Aldrich, 1994). The reason for choosing the Aldrich method was that it had been proven to create well-fitting garments. Moreover, all the specific body measurements that it required to develop patterns could be found in ASTM D5586 tables.

All the patterns were manually drafted on brown paper. The patterns for each size group were developed separately because the irregularity of increments among different sizes made it extremely difficult to grade from a base pattern. The patterns were then digitized into an industrial apparel computer-aided-design system. The seam and hem allowances, 3/8" and 1" respectively, were added. Finally, patterns were plotted and sent to the owner of a local activewear company who suggested two modifications to the patterns from the production viewpoint. One was to make the sleeve cap smaller because knit fabrics generally required the armhole circumference to be equal to or slightly bigger than the sleeve cap in order to be assembled nicely. The other was to straighten the neck

curve because it could ease construction without interfering with the appearance and comfort. Patterns were changed accordingly.

Fabric Selection and Testing

While the design features were incorporated into sketches and patterns were developed for the particular design, the textile properties guided the fabric selection. Because dark colors could create a slim-looking image and make perspiration less conspicuous on the garment, the top was decided to be in the color black. Moreover, due to limited retail supply channels of fabrics in Winnipeg and the research budget, it was impractical to find a fabric that would capture all the desired properties. Therefore, the researcher decided to look for a fabric that would satisfy most of the desired textile properties.

A variety of fabrics for exercise purpose were obtained and inspected. After considering minimum purchase quantity, color choices, weight, price, and suppliers, six fabrics were selected (see Appendix F). All of them were machine washable and dryable, soft and smooth, medium weight, wrinkle resistant, and nontransparent. To determine their exact performance in terms of other textile properties, several textile tests were conducted in the laboratory.

Air Permeability Test

This test was conducted to correspond to the textile property of breathability which was translated from the value "thermal comfort". The testing process followed the

CAN/CGSB -4.2 No.36-M89 method. With the differential pressure air permeability tester, air permeability was tested in terms of the number of cubic centimetres of air passing through one square centimetre of fabric per second when the differential between the air pressure on opposite sides of the fabric was equal to 0.5 inches of water. The results showed that fabric A had the highest air permeability among the six fabrics while fabrics B, C, D, and E were similar in this property (see Appendix G-1).

Colorfastness to Washing Test

This was to test the textile property of colorfastness to washing translated from the value "fabric performance". Since the design involved two different colors, good colorfastness was necessary to ensure that the black would not stain the light-color neckband and piping during washing. The testing process followed CAN/CGSB-4.2 No.19.1 Test No.1-M90, Colorfastness to Washing – Accelerated Test – Launder-ometer at 40 °C temperature, 200ml water, 0.5% detergent, with 10 steel balls and run for 45 minutes. Colorfastness was assessed in terms of shade changes (color fading) and staining (color bleeding). The measuring scale was AATCC Grey Scales for Evaluating Staining and Change in Color, in which number 5 represented no colour fading or no staining and 1 represented severe color fading or staining. The test results showed that fabric B and C had the best colorfastness to washing, followed by fabrics F and A (see Appendix G-1).

Vertical Wicking Test I

The test was conducted to evaluate the moisture management property that was

generally related to thermal comfort. The testing process followed the vertical wicking test method by Canadian Government's Department of National Defence. Three specimens (1.2×5.9 inches long) in both the lengthwise and crosswise directions were tested. Each specimen was marked with 1 cm intervals. The end of the specimen was lowered into a beaker of water and the time it took for the water to reach each marked intervals was recorded. The distance that the water travelled on the specimen in 15 minutes was also recorded. Results showed that fabrics B and C had the best performance (see Appendix G-1). There was no result for fabric A because it was extremely difficult to detect where the water traveled in this particular fabric. This could be considered an advantage of fabric A because perspiration would be inconspicuous as well.

Stretch Recovery Test

The test was conducted to examine the stretch property of the fabrics which contributed to a garment's ease of movement. The testing process followed ASTM D6614-00 Stretch Properties of Textile Fabrics – CRE method. In this test, specimens were cut along the stretch direction. One end of the specimen was secured. A weight of 4 lb was applied to the other end and held for 5 minutes. The growth in length was recorded. Specimens were left to relax for 5 minutes before another measurement of length was taken. Then fabric growth and stretch were calculated. The results showed that fabric F performed much better than all the other fabrics in terms of stretch (see Appendix G-1), which implied that a garment made of fabric F could provide more ease of movement.

After these four screening tests, fabric E was eliminated because its colorfastness

was the worst and its performance in the other three tests was not outstanding. Fabric B was also excluded from further testing because the researcher could not get small testing samples from the mills. Therefore, only fabrics A, C, D and F went through the next round of screening, which included vertical wicking test II, and pilling resistance test.

Vertical Wicking II

As mentioned above, the first vertical wicking test did not successfully apply to fabric A. Therefore, the researcher decided to adopt another wicking test to compare fabric A with the two superior fabrics from the first wicking test, namely, fabrics C and D. The second test followed the vertical wicking test by Textile Protection and Comfort Center (T-PACC) at the North Carolina State University. In this test, instead of recording the time that the water reached each marking line, the researcher measured the water transport rate in centimetres at 1, 5 and 10 minute intervals. The results showed that fabric A had the best wicking property comparatively (see Appendix G-2).

Pilling Resistance Test

This test was conducted to examine the pilling resistance aspect of durability. As directed in ASTM D3512-96 for Pilling Resistance and Other Related Surface Changes of Textile Fabrics: Random Tumble Pilling Tester, specimens were tested for both 10 and 30 minutes. Fabric F performed the best (see Appendix G-2). There was almost no pilling although the surface became a little fuzzy after 30 minutes. Fabric A and D pilled seriously and their surface became very fuzzy after the 30-minute test. For fabric C, after 30 minutes, the surface change was quite noticeable: the fuzziness increased and fibres

were matting although not forming pills.

After the second set of screening, fabrics A and F stood out for wickability and pilling resistance respectively. In conclusion, fabric A had good wickability, air permeability and satisfactory colorfastness to washing. Fabric F had excellent performance in stretch, pilling resistance, and colorfastness to washing. In general, fabric A seemed to be superior to fabric F in properties such as quick dry, wicking, and breathability, while fabric F was easier to care for and more durable. After comparing the ranking of the functional and symbolic values that corresponded to those properties, the researcher was inclined to choose fabric F. Meanwhile, the researcher learned from the mills that actually fabric A and C were not in stock and would no longer be produced. This left fabric F as the remaining best choice. It was a jersey knit made of 90% cotton and 10% Lycra®. Afterwards, the trim fabric was selected, which had the same fiber content but was in a light green color.

Pilot Tests of the Prototype

The main purpose of pilot tests was to find out if the general appearance of the sample garments truly reflected the design sketch, and if the fit was satisfactory to the participants. It was also aimed to test how well the appearance and fit were maintained after laundering. For those purposes, the pilot tests entailed two stages, sample fitting and alterations, and sample laundry testing.

Sample Fitting and Necessary Alterations

As the patterns were developed and the fabrics were chosen, one sample was made for the MP18 group and the M14 group respectively because these two groups together accounted for over one-half of the participants. The samples were made by the local activewear manufacturer. Upon receiving the samples, 11 participants in the MP18 and M14 groups tried on the corresponding sample at one of the fitness centers. The participants' response showed that they had different subjective preference for fit, which made it difficult to foresee the fit simply based on body measurements. Therefore, the researcher decided to make one test sample for each remaining size categories.

Once the researcher received all the samples, measurements of the torso (high point shoulder to hem), bust (1" below armpit), chest, back, and shoulder were taken. Then, they were compared with the measurements of the original patterns and the differences were recorded. Consistently, the sample bust measurements in all the six sizes were about 1 to 1.2 inches bigger than what they were supposed to be. The shoulder length was 0.6 inch longer. The chest and back widths were about 0.8 inch bigger while the torso length was about 1 inch shorter. These differences could be attributed to imprecise intake of seam and hem allowance during construction. However, due to time constraints, the researcher decided to take into consideration the imprecision during the following fit testing, rather than modify the sample garments at this moment.

The second fitting test was conducted at the University of Manitoba in September 2003. Seventeen participants attended the fitting session. Two participants dropped out

because they had severe health problems and could not continue to exercise while the third one lost interest in the study. During the fit testing, each participant first put on the sample in her proposed size. The fit of the torso length, neck, sleeve, shoulder, chest, back, bust, waist, and location of the piping were examined and necessary amount of alterations was recorded (see Appendix H). The researcher might ask the participant to try on other sizes to ascertain the best fit. If the fit size was different from the proposed size, the fitting situation was also recorded. This better-fit size would become the basis for alteration. The assessment of fit primarily depended on the participants' personal preferences and partially on the opinion of the researcher. Some participants responded favorably to the cotton/Lycra® knit fabric.

In the fitting process, the concerns most frequently expressed by the participants were that: 1) the shoulder was too long, 2) the chest and the back were too wide, 3) the piping was about 1.6 to 1.8 inches away from the bust point on each side, 4) the sleeve hem was too wide, and 5) the torso length seemed to be a little short. However, in light of the imprecision in sample making, there was almost no need to modify the torso length, shoulder length, back width and chest width.

The 17 participants were regrouped according to their fit size and the actual measurements of the fitting samples. This resulted in four size groups. Since the alteration amount was quite consistent in each size group, same changes were applied to these four size groups. Those changes included: 1) shortening the shoulder length by 0.2 inch, 2) reducing the chest width and the back width by 0.4 inch, 3) reducing the width of

the sleeve hem by 1 inch, 4) reshaping the piping line so that it was 1.6 inches closer to the torso center from the bust point down to the hem, 5) reducing the seam allowance to 0.3 inch and increasing the hem allowance to 1 inch. In addition, there were two participants who could not find a satisfactory fit size. Separate patterns were altered for these two participants from M16 and MT10 respectively, which was called M16B and MT10B.

Sample Laundry Testing

To ascertain the performance of the sample garments in a home laundering environment, three samples were tested according to CAN/CGSB-4.2 No.58-M90 for Colorfastness and Dimensional Change in Domestic Laundering of Textiles. Each of them was washed five times at low speed/delicate setting, timing for 8 minutes, medium load (4.4 lb loaded with dummy), one rinse, and 60 g detergent. However, each sample was assigned a different wash temperature, 30 ± 2 °C, 40 ± 2 °C, and 50 ± 2 °C, representing cool, lukewarm and warm water, respectively. The drying process was the same all samples, that is, tumble dried in the ultra delicate setting for 45 minutes.

The results showed that at 30 °C wash temperature, the lengthwise shrinkage was 3.75% while no shrinkage occurred in the crosswise direction. At 40 °C wash temperature, shrinkage was 5.75% in the lengthwise direction and 2% in the crosswise direction. At 50 °C wash temperature, shrinkage was 6.125% in the lengthwise direction and 2% in the crosswise direction. Moreover, no color transferred from the black fabric to the light color piping and neckband of the sample garments. These results meant the appearance of

the dark and light colored garment would not change after laundry, but its fit would be affected by shrinkage.

Two decisions were made based on those testing results. The first was to determine the prototype care instruction to be given to the participants. Since washing at 30 °C water temperature yielded the least amount of shrinkage, the researcher decided that the prototype should be washed in cool water and delicate setting, and tumble dried at low temperature. The second decision was to preshrink the fabric before cutting it to minimize fit problems caused by fabric shrinkage. The researcher intended to preshrink the fabrics in a water temperature higher than 30 °C to cover the possible scenario that the participants might subject the prototype to a wash temperature of 30 °C or higher. A fourth sample garment was laundered once at 50 °C without detergent and dried in delicate cycle to simulate the preshrink process. Its lengthwise shrinkage was 5.5% and the crosswise shrinkage was 1.5%. Since the result was close to that of washing in 50 °C water for five times, it seemed logical to preshrink the fabrics at this temperature.

Prototype Production

The cotton/Lycra® knit fabric was ordered from a local mill while the trim fabric was purchased from the local activewear manufacturer. All the fabrics and trims were first prewashed at 50 °C for 8 minutes without detergent and tumble dried at the delicate setting. They were left to relax on a flat surface for at least 24 hours before cutting to allow for recovery. Cut pieces were examined for fabric defects before sewing. The

researcher produced all the prototypes using a home sewing machine, a 4-thread serging machine and a steam iron. All the prototypes were assembled in the same sequence so that mistakes or confounding variables in the production process might be minimized. To eliminate unwanted effects of brand perception, size, or fabric content, etc., no label was attached to the prototypes. The researcher inspected each finished prototype to ensure the accuracy of construction and measurements.

Wear Test

Of the 17 participants who remained in the study after the prototype fitting tests, three withdrew before the wear test. One of them dropped out because of health problems. The second one was on a long overseas vacation, and the third one lost interested in the study. Therefore, fourteen participants attended the wear test. The two-week wear test was intended to give participants a sufficient period of time to wear and maintain the prototype.

The researcher personally delivered the wear test prototypes to each participant. At the same time, the participant received a booklet which included wear test instructions, laundry and care instructions, and a diary (see Appendix I). The participant was asked to put on the prototype. Photographs of her from the front, side, and back were taken. Then, the instructions for wear test and laundry were explained to her. Each participant was asked to wear the prototype at least three times over a two-week period, and to wash it after every wearing. She was also asked to record in the diary the duration of each

wearing, her wear experience, laundry and care experience, as well as any other comment about the prototype. The diary could help the participant recall her experience in the subsequent interview. At the end of the two weeks, the researcher called every participant to confirm the completion of the wear test, and to schedule a post wear test interview.

Responses to the Prototype

Each post wear test interview lasted about one-half hour. Interviews were conducted at the participants' home, and were audio taped with their permission. At the beginning of each interview, the researcher asked to see the diary and the prototype. The interview questions pertained to: (1) the degree to which the prototype satisfied each essential symbolic or functional value, (2) participants' thermal state when wearing the prototype in fitness classes, (3) participants' overall comfort sensations about the prototype, and (4) participants' general satisfaction with the prototype (see Appendix J). A few open-ended questions were also included to collect participants' responses to laundry and care, comments about this research as well as suggestions for further research. In the end, the participant had a chance to raise any specific questions about the research.

Satisfaction Scale

To ascertain how well the prototype satisfied the essential functional and symbolic values, a satisfaction scale was devised (see Appendix K). Since each value was a concept, great care had to be taken to ensure that the wording of the question truly

reflected the elements of that concept. The researcher used the exact attributes that the participants expressed at the first interview to construct the concept statements. For example, "fabric performance" was worded as "the color does not run when I wash it" and "it does not shrink". Satisfaction with the essential values was examined by the participants' agreement with each concept statement based on a 4-point scale, "strongly agree", "agree", "disagree", and "strongly disagree". As to the general satisfaction with the prototype, a 4-point scale ranging from "very dissatisfied", "dissatisfied", "satisfied" to "very satisfied" was used.

Thermal Comfort Scale

The McGinnis' 13-point intensity scale for thermal comfort (see Appendix L) was used to measure the thermal state of participants when they wore the prototype. The scale ranged from 'so cold I am helpless' to 'so hot I am sick and nauseated' (Hollies, 1970, 1975; Hollies, Custer, Morin & Howard, 1979). Minor wording changes were made to reflect the situation in this research.

The McGinnis' scale has been widely used by researchers. For instance, Aoyagi, McLellan and Shephard (1998) adopted it to measure thermal comfort of protective clothing worn by men underwent endurance training and heat acclimation on psychological strain. This scale has been demonstrated to be highly reliable for both thermal stress assessment and in severe climates as a check on subject safety, and it

works well not only in hot and cold environments but either inside or outside the range of body temperature controlled by sweat evaporation (Hollies, 1975). Hollies also indicated that subjective scales like that of McGinnis permit maximum use of human perception ability, and are the easiest to apply to real clothing problems.

Comfort Sensation Scale

To examine overall comfort, the researcher adopted a comfort sensation scale by Li et al. (1988) which was broadly related to tactile experience (see Appendix M). The original scale was described by Hollies et al. in 1979, whereas Li et al. included "prickly" and "itchy" that was described by Geldard in 1972. That scale consisted of 5 sensation levels: "no sensation", "partially", "mildly", "definitely", and "totally", as well as 19 sensational descriptors: "snug", "loose", "heavy", "lightweight", "soft", "stiff", "staticky", "sticky", "non-absorbent", "clammy", "damp", "hot", "cold", "clingy", "sultry", "prickly", "rough", "scratchy", and "itchy". Li et al. successfully applied the scale to the investigation of physiological responses and psychological sensations in wearer trials with knitted sportswear. Because this study used a thermal comfort scale separately, "cold" and "hot" were excluded from the comfort sensation scale.

Data Analysis

The research produced both qualitative and numerical data. Since qualitative data

were subjected to content analysis to yield symbolic and functional values, this part focuses on quantitative data that were mainly organized and computed in SPSS (v.10). A p value of .05 was used for all the statistical tests.

Frequency Analysis

Frequency tables were run to describe demographic characteristics with respect to age, marital status, household gross income, employment status, education, occupation, health status, and maximum price of an item of exercise clothing that the participants would be willing to pay, as well as purpose of exercise enrollment and exercise intensity. Participants' body measurements and their current exercise clothing in terms of fit and materials were also analyzed in frequencies. Similarly, frequencies were calculated for the responses to the prototype, such as satisfaction with each essential value, thermal comfort, and comfort sensation descriptors.

Comparing Means

Participants' current exercise clothing was sorted according to either the fit or materials of tops. With tops of different fit or materials being the independent variable respectively, the means of participants' satisfaction with current exercise clothing were compared. Similarly, participants' mean exercise intensity was compared while the independent variable was exercise participation for making friends.

Correlation Analysis

A Pearson correlation test was conducted to examine if there was any relationship between two variables that were suspected to be related, such as "household income" and "maximum price of exercise clothing"; "education" and "maximum price of exercise clothing"; "exercise intensity" and "satisfaction with current exercise clothing", "exercise intensity" and demands for "modesty". In addition, it was also used to find out any possible relationship between essential values, and between participants' responses to the fulfillment of essential values.

CHAPTER FOUR

RESULTS

In this chapter, the results are presented under the major headings of demographic characteristics, anthropometric characteristics, categorization into ASTM D5586 sizes, the use-situation, exercise purpose and intensity, current exercise clothing and participants' satisfaction, functional and symbolic values, design features and textile properties, and responses to the prototype.

Demographic Characteristics

The original 20 participants were recruited from 3 fitness centres. Seventy percent of them went to one centre regularly. Their age range was between 55 and 75 years old. The 55-to-65 age group accounted for 50% of the participants while another 30% were between 66 and 70 years of age (see Table 1). As to their marital status, 40% of them were married and 30% indicated that they were widowed. The remaining 30% were divorced, separated or never married (see Table 1).

With regard to educational attainment, it was notable that 65% of the participants had a Bachelor's or higher degree (see Table 1). Another 25% completed some college, technical training, or vocational school. Nearly 58% of those older women had annual household gross income about $50,000 and above while 26% between $30,000 and $49,999. The majority of the participants (65%) were retired, but 20% still engaged in

part-time jobs (see Table 1).

Among the 20 participants, 60% thought that they were in excellent health with no physical limitations (see Table 1). Minor limitations were noticed by 35% of them. In terms of the price level that they would like to pay for one piece of active sportswear, 37% of the women were willing to pay over $40 for it while 31.6% preferred the price to be between $30 and $39. Additionally, about 26% chose the $20-to-$29 price range. The Pearson correlation test did not support any statistical relationship between the maximum price that participants would pay for exercise clothing and their household income or education. As to occupations, 50% of the participants held clerical positions and 25% did teaching-related jobs.

When the 6 dropouts were excluded, the 14 participants showed the following demographic characteristics. About 64.3% of them were 66 to 75 years old; 35.7% were married and another 35.7% were widowed; 71.4% had at least a Bachelor's degree; 71.4% of the annual household income was at least $50,000; 64.3% of them were retired or held clerical positions. Nearly 40% of them would pay maximally $30 to $39 for one item of activewear.

Table 1

Demographics of the Original 20 Participants and the Final Sample of 14 Participants

		Valid Percentage (%)	
Demographic Items	Choices	N = 20	N = 14
Age group	55-60	25.0	14.3
	61-65	25.0	21.4
	66-70	30.0	35.7
	71-75	20.0	28.6
Marital Status	Single/Never Married	5.0	7.1
	Married	40.0	35.7
	Divorced/Separated	25.0	21.4
	Widowed	30.0	35.7
Educational Attainment	High School Graduate	10.0	14.3
	Some College or Technical School	25.0	14.3
	Bachelor's Degree or Higher	65.0	71.4
Annual Gross Household	$10,000--$19,999	5.3	0
Income	$20,000--$29,999	10.5	7.1
	$30,000--$39,999	15.8	7.1
	$40,000--$49,999	10.5	14.3
	$50,000 and above	57.9	71.4

Table 1 *(Continued)*

Demographic Items	Choices	Valid Percentage (%) N = 20	Valid Percentage (%) N = 14
Employment Status	Full-time Employed	10.0	14.3
	Part-time Employed	20.0	14.3
	Retired	65.0	64.3
	Other	5.0	7.1
Health Status	Excellent Health	60.0	50
	Good Health	35.0	50
	Average Health	5.0	0
Maximum Acceptable Price	$10.00-$19.99	5.3	0
for an Item of Sportswear	$20.00-$29.99	26.3	30.8
	$30.00-$39.99	31.6	38.5
	$40.00-$49.99	21.1	15.4
	$50.00 or more	15.8	15.4
Occupation	Clerical	50.0	64.3
	Teaching/Art-related	25.0	7.1
	Medical/Health-related	15.0	14.3
	Business	5.0	7.1
	Scientific/Industrial	5.0	7.1

Anthropometric Characteristics

Participants' height ranged from 58 to 67 inches with a mean of 64.2 inches (*SD* = 2.2) (see Table 2). Fifty five percent of them were 65 inches or taller while 30% were 63 or 64 inches high. In terms of bust girth, the range was between 33 and 45.5 inches. The average was 37.5 inches (*SD* = 3.7). Thirty percent of the participants had bust measurement between 35.5 and 37 inches. Another 30% had bust measurement smaller than 35.5 inches. As to waist circumference, 60% was within 30 and 34 inches while the range went from 27 to 41 inches (*SD* = 3.7). An additional 25% were between 27 and 29 inches. Their hip measurement ranged from 36 to 47.5 inches, and 40.6 inches was the average (*SD* = 2.8). One-half of the participants had hip girth between 39 and 41 inches.

As discussed in the previous chapter, during sample recruitment, the criteria about body measurement range was expanded to ensure an adequate sample size. In spite of the compromise, the mean body measurements of the entire research sample fit well into the original anthropometric range (see Table 2).

Table 2

The Original Criteria and Participants' Actual Body Measurements in Inches (N = 20)

Body Location	Original Range	Actual Mean ± SD	Actual Range
Height	61 -- 66	64.2 ± 2.2	58 -- 67
Bust	35 -- 40	37.5 ± 3.7	33 -- 45
Waist	31 -- 35	32.1 ± 3.7	27 -- 41
Hip	37 -- 42	40.6 ± 2.8	36 -- 47.5

Categorization into ASTM D5586 Sizes

After comparing participant's body measurements at bust, waist, hip and height with the ASTM D5586 measurement tables, the researcher assigned each participant into a figure type and size that had closest measurements to her actual ones. The 20 participants represented a variety of ASTM D5586 sizes: Half-size 18.5, 20.5 and 22.5, Women 34 and 36, Junior 9 and 17, Misses Petite 14 and 18, Misses 12, 14, and 16, Misses Tall 10 and 12, and Junior Petite 9. Table 3 showed in detail each participant's body measurements and the ASTM D5586 size into which she was categorized. The data revealed that 17 of the 20 women had at least 3 body measurements within one-inch difference from those of their corresponding ASTM size.

Regarding the distribution of figure types and sizes, 35% of the sample was categorized into Misses 12, 14, and 16. The second largest figure type was Misses Tall 10 and 12, and Half Size 18.5, 20.5 and 22.5, each held 15% of the sample. Ten percent of

them were in Misses Petite 14 and 18. Altogether, Misses and Misses Petite accounted for 45% of the participants. More Specifically, Misses 14, 16 and Misses Tall 10 took 15%, 15%, and 10% of the sample respectively while the remaining 60% was evenly distributed into other size categories. Figure 2 showed the distribution of participants' ASTM D5586 sizes in percentage.

Among the final sample of 14 participants, three were classified into Misses 16, two were Misses 14 and one was Misses 12 (see Table 3). In total, Misses figure type constituted 42.9% of the sample, followed by Misses Tall 10 14.3%. The rest of the participants were evenly distributed in Half-size 18.5and 22.5, Women 34, Junior 9, Misses Petite 14, and Junior Petite 9. Notably, Misses and Misses Petite figure types altogether accounted for 50% of the sample.

Table 3

Participants' Body Measurements in Inches Compared with ASTM D5586 Measurements (N = 20)

		Height		Bust		Waist		Hip	
Subject #	ASTM Size	Actual	ASTM	Actual	ASTM	Actual	ASTM	Actual	ASTM
01	HF 22.5	64	63	45.5	45.8	39	42	47.5	47.3
02	W34	63	64	38.5	38.9	34	34.3	41.5	40.5
03	M16	66	65.6	37	37.2	33	32.6	43	40
04	M16	66	65.6	37.5	37.2	33.5	32.6	39	40
05	J9	63	62.5	33	33.6	29	29.3	38	36.8
06	HF 18.5	62	61.8	42.5	42.6	36.5	38.5	42.5	43.8
07	M16	66	65.6	37	37.2	31	32.6	40.5	40
08	MT12	67	67.3	35.5	35.5	31.5	30.7	39	38.9
09	M12	65	64.4	34	34.2	28.5	29.8	40.5	37.8
10*	W36	64	64.4	41.5	40.6	33	36.3	39	42.5

Table 3 *(Continued)*

Subject #	ASTM Size	Height		Bust		Waist		Hip	
		Actual	ASTM	Actual	ASTM	Actual	ASTM	Actual	ASTM
11	MT10	66	66.7	33	33.2	28	28.5	41	37.4
12	MT10	67	66.7	34	33.2	27.5	28.5	36	37.4
13*	M14	65	65	35.5	35.7	27	31.1	38.5	38.9
14	M14	65	65	34.5	35.7	30.5	31.1	39	38.9
15	MP14	61	61.5	36.5	35.7	30.5	31.2	41	38.4
16	M14	65	65	35.5	35.7	32.5	31.1	39.5	38.9
17*	HF 20.5	63	62.6	44.5	43.7	41	39.9	45	45.3
18**	J17	65	64.9	39	39	34	34.6	41	41.2
19**	MP18	63	62.6	39.5	39.6	31	35.2	44	41.6
20**	JP9	58	58.3	35	35.4	30	31.3	36.5	37.5

* these are the participants who dropped out before fitting tests.

** these are the participants who dropped out before the wear test.

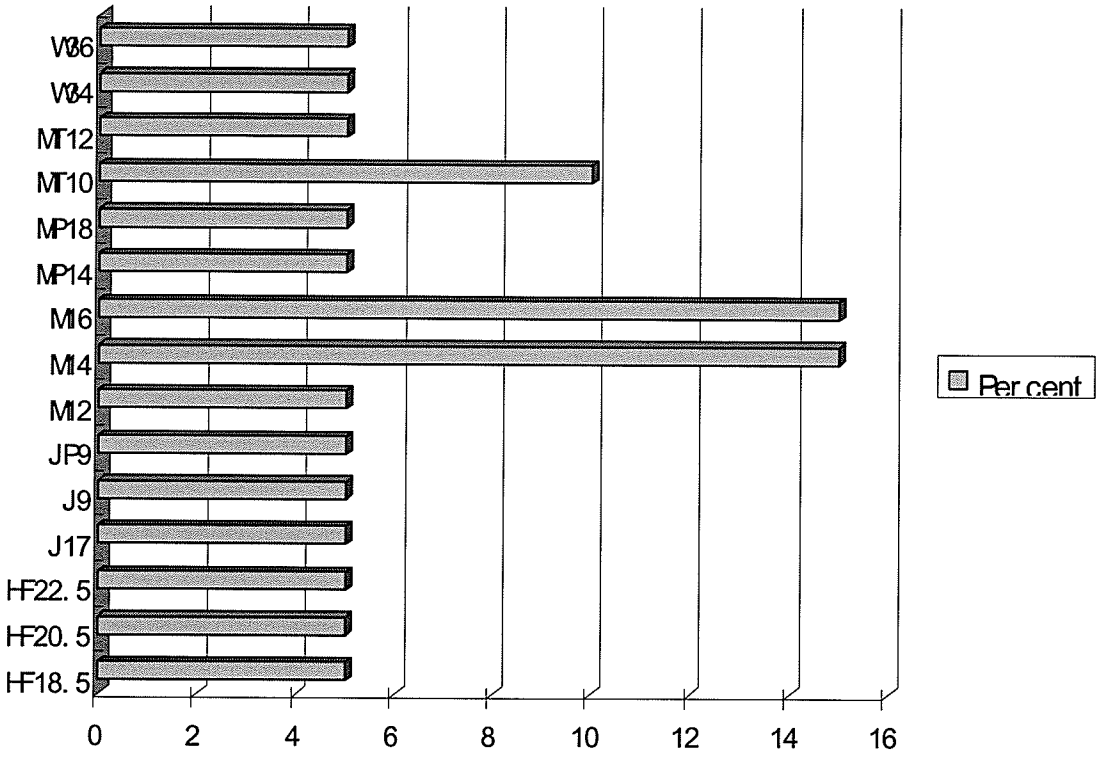


Figure 2. The percentage of distribution of participants' ASTM D5586 sizes.

The derived ASTM D5586 sizes were further grouped into 6 size groups mainly according to the similarity of girth measurements. The difference of girth measurements in groups that had more than one size ranged from 0.2 inches to 2.4 inches, and the average was 1.5 inches (see Table 4). Specifically, group 1 included M12, M14*, MT12, MP14 and JP9. Group 2 included W34, W36, J17 and MP18*. Group 3 consisted of MT10* and J9. Group 4 contained HF20.5 and HF22.5* while group 5 and 6 each included only one size, M16* and HF18.5* respectively (see Table 4). The representative size within each group was marked by an asterisk. The largest group represented by M14 accounted for 35% of the participants while the second largest group represented by

MP18 held 20%. The other four representative sizes were M16, MT10, HF22.5, and HF18.5, making up 15%, 15%, 10% and 5% of the sample respectively.

Table 4

The Difference of Girth Measurements in Selected Size Groups (in Inches)

		Measurement Difference in Inches			
Group #	ASTM Sizes Included	Bust	Waist	Abdomen	Hip
1	M12, 14, MT12, MP14, JP9	1.5	1.5	1.2	1.4
2	MP18, J17, W34, 36	1.7	2.0	2.1	2.0
3	MT10, J9	0.4	0.8	0.2	0.6
4	HF20.5, HF22.5	2.1	2.1	2.4	2.0
	Average	1.4	1.6	1.5	1.5

Table 5

Average Body Measurements in Each Size Group and Representative Sizes (in Inches)

Group	# of Participant	ASTM Size	Height	Bust	Waist	Abdomen	Hip
1	3	M14*	65	35.7	31.1	37.6	38.9
	1	M12	64.4	34.2	29.8	36.4	37.8
	1	MT12	67.3	35.5	30.7	37.4	38.9
	1	MP14	61.5	35.7	31.2	37.5	38.4
	1	JP9	58.3	35.4	31.3	37.1	37.5
	Group Average		64.7	35.4	30.8	37.4	38.6
2	1	MP18*	62.6	39.6	35.2	41.4	41.6
	1	J17	64.9	39	34.6	40.8	41.2
	1	W36	64.4	40.6	36.3	42.5	42.5
	1	W34	64	38.9	34.3	40.4	40.5
	Group Average		64.0	39.5	35.1	41.3	41.5
3	2	MT10*	66.7	33.2	28.5	35.4	37.4
	1	J9	62.5	33.6	29.3	35.6	36.8
	Group Average		65.3	33.3	28.8	35.5	37.2
4	1	HF 22.5*	63	45.8	42	48.2	47.3
	1	HF 20.5	62.6	43.7	39.9	45.8	45.3
	Group Average		62.8	44.8	41.0	47.0	46.3
5	3	M16*	65.6	37.2	32.6	39	40
6	1	HF 18.5*	61.8	42.6	38.5	44.3	43.8

* these are the representative size of each group.

After the fitting process, the six size groups were reduced to four. The new size groups were M14, M16, MT10, and HF18.5. In addition, the two new sizes were created, named MT10B and M16B. Table 6 showed the percentage of participants in the new size groups as well as the range of body measurements that each size group covered. It revealed that MT10 group was the biggest one, accounted for 41.2% of the participants, followed by M14 group (23.5%) and M16 group (17.6%). In terms of girth measurement difference in the new size groups, the range was from 2.1 to 3.2 inches while the average was 2.5 inches (see Table 7).

Table 6

The Percentage of Participants, Included Sizes, and the Range of Body Measurements in Each New Size Group (N = 17, Unit = Inches)

			Measurement Range				
Group	Size Covered	%	Bust	Waist	Abdomen	Hip	Height
MT10	M12, 14, JP9, J9, MT10, 12	41.2	33.2–35.7	28.5–31.3	35.4–37.6	36.8–38.9	58.3–67.3
M14	M16, MP14, W34	23.5	35.7–38.9	31.2–34.3	37.5–40.4	38.4–40.5	61.5–65.6
M16	M16, MP18	17.6	37.2–39.6	32.6–35.2	39–41.4	40–41.6	62.6–65.6
MT10B	MT10	5.9	33.2	28.5	35.4	37.4	66.7
M16B	HF18.5	5.9	42.6	38.5	44.3	43.8	61.8
HF18.5	HF22.5	5.9	45.8	42	48.2	47.3	63

Table 7

The Difference in Girth Measurements of Selected New Size Groups

	Measurement Difference in Inches			
Group	Bust	Waist	Abdomen	Hip
MT10	2.5	2.8	2.2	2.1
M14	3.2	3.1	2.9	2.1
M16	2.4	2.6	2.4	1.6
Average	2.7	2.8	2.5	1.9

The Use-situation

According to personnel in the fitness centers, the temperature was normally maintained at 16°C all year round. The humidity was about 35% to 50%. In one of the centers where most of the participants joined, the aerobic class was held in an open space. The other two centers offered the class in a close studio. All of them were co-ed classes. The modes of exercise were a little different depending on instructors. An aerobic session usually included warm-up, steps, stretch training, weight training, and cool-down exercise etc.

Exercise Purpose and Intensity

The primary motivation of exercise engagement was examined through participants'

agreement with two statements (see Appendix C). To the statement "I go to exercise primarily to stay healthy", participants unanimously agreed with it, among which 95% strongly agreed ($M = 5.0$, $SD = 0.2$). As to the statement "I go to exercise primarily to make friends", 30% of the participants agreed with it while 65% either disagreed or strongly disagreed ($M = 2.5$, $SD = 1.2$).

With respect to exercise intensity, 70% of the participants thought that they were working at least somewhat hard. One-half of them perceived that they were doing hard to very hard exercise. Only 5% worked fairly light. The mean exercise intensity was 14.5 ($SD = 1.6$) based on 6-20 Borg's scale, in which 15 represented "hard". It was also noticed that the mean intensity of those who disagreed with the statement "I go to exercise primarily to make friends" was slightly higher ($M = 14.9$, $SD = 1.8$) than that of those who agreed with it ($M = 14.0$, $SD = 0.9$).

Current Exercise Clothing and Participants' Satisfaction

In terms of the clothing that the participants most often wore to exercise, loose T-shirts seemed to be the most favourable choice for tops. As revealed in the individual interviews, 65% of the participants usually wore loose-fitting short-sleeve T-shirts, compared with 25% wearing form-fitting tops. An additional 10% chose to wear big tank tops. With respect to bottoms, 3/4 to full length tights were the most typical wear because they were worn by 70% of the participants. Moreover, 50% of the women wore shorts at least in summer time. Without considering the length, 90% of the participants wore tights

versus 15% loose pants. Most of them did not specifically buy fitness garments while 10% of them possessed some high performance active sportswear, e.g., aerobic top or pants with wicking property.

As to materials, cotton jersey knit was the most popular fabric for tops (56.3%), followed by polyester/cotton (25%) and then cotton/spandex. For the bottoms, cotton/spandex was the most common fabric (62.5%).

In general, 15% of the participants were dissatisfied with their current aerobic wear while 55% felt satisfied with it. Specifically, those who wore loose tops had a lower satisfaction with their current exercise clothing ($M = 3.3$, $SD = 0.9$, $N = 20$) than those wearing form-fitting tops ($M = 4.2$, $SD = 0.5$, $N = 20$). The mean satisfaction of those wearing cotton/spandex tops was 4.3 ($SD = 0.6$, $N = 16$), higher than that of those wearing 100% cotton ($M = 3.8$, $SD = 0.7$), or polyester/cottons ($M = 3.0$, $SD = 0.8$). In addition, the Pearson test did not reveal any correlation between satisfaction with current exercise clothing and exercise intensity.

Functional and Symbolic Values

Content analysis was used to determine the symbolic and functional values according to the definition by Rosenblad-Wallin (1985). Participants' responses to desired attributes of active sportswear were coded by two coders separately. From the 20 participants' responses, 315 attributes were coded, among which 310 agreements were reached. The intercoder reliability was 98.4%, calculated by using Touliatos and

Compton's formula (1988): number of agreements * 100 / (number of agreements + disagreements).

As described in the previous chapter, the functional and symbolic attributes were grouped, and 23 functional and symbolic values were generated (see Table 8). The 12 functional values were "thermal comfort", "ease of dressing", "convenience design", "ease of movement", "weight of fabric", "fabric performance", "ease of care and maintenance", "fit", "pressure on the body", "durability", "friction against the body", and "keeps me dry". The 11 symbolic values were "self-esteem", "novelty", "show my status", "embellishment", "state of mind", "modesty", "fashion/stylish", "covers imperfections", "appearance and body image", "age appropriateness", and "calls attention".

Table 8

Functional and Symbolic Values

Functional Values	Symbolic Values
Convenience Design	Age Appropriateness
Durability	Appearance and Body Image
Ease of Care and Maintenance	Calls Attention
Ease of Dressing	Cover Imperfections
Ease of Movement	Embellishment
Fabric Performance	Fashion and Stylish
Fit	Modesty
Friction against the Body	Novelty
Keeps Me Dry	Self-esteem
Pressure on the Body	Shows My Status
Thermal Comfort	State of Mind
Weight of the Fabric	

Essential Values

Weight was assigned to each individual ranking of essential values, where a ranking of 1 received 10 points, ranking 2 received 9 points, and so on. The summation of points allocated to each value was compared to find top 10 values with the highest points.

Successively, the 10 essential values for an exercise top were "ease of movement", followed by both "fit" and "ease of care & maintenance", "appearance and body image", "friction against the body", "ease of dressing", "cover imperfections", "fabric performance", "durability", "modesty", and "thermal comfort" (see Table 9). The overall weighted average placed 70.8% of points into functional values, while symbolic values held the remaining 29.2%. In the top 5 ranking, there was only one symbolic value (16.7%).

The Pearson test showed that exercise intensity was negatively correlated with demands for "modesty". ($r = -.499$, $p = .025$, $N = 20$). Moreover, a significant relationship was found between "fabric performance" and "ease of care and maintenance" ($r = .584$, $p = .007$, $N = 20$).

Design Features and Textile Properties

From the essential values, design features and textile properties were translated (see Figure 3). The main design features included " a little form-fitting but not tight", "armhole and neck not too small", "V-neck", "dark color", "vertical decorative or functional lines", "no zipper or label to tickle the skin", "in basic and classic color or style", "short sleeves", "pull-over style", "trims in cheerful color or design", "enforced seams", "top length around the hipline", and "neckline not too big or low", etc. The important textile properties consisted of "a little stretchy", "machine washable", "no need for ironing", "shrinkproof", "good colorfastness", "soft and smooth", "strong enough",

"does not see through", "does not show sweat", "light to medium weight", "breathable", "dries quickly/machine dryable", "wicks moisture", and "pilling resistant".

Table 9

Ranking of Essential Functional and Symbolic Values

Ranking	Essential Values	Points	Functional or Symbolic Value
1	Ease of Movement	151	Functional Value
2	Fit	119	Functional Value
	Ease of Care and Maintenance	119	Functional Value
3	Appearance and Body Image	80	Symbolic Value
4	Friction against the Body	73	Functional Value
5	Ease of Dressing	69	Functional Value
6	Covers Imperfections	65	Symbolic Value
7	Fabric Performance	60	Functional Value
8	Durability	47	Functional Value
9	Modesty	44	Symbolic Value
10	Thermal Comfort	42	Functional Value

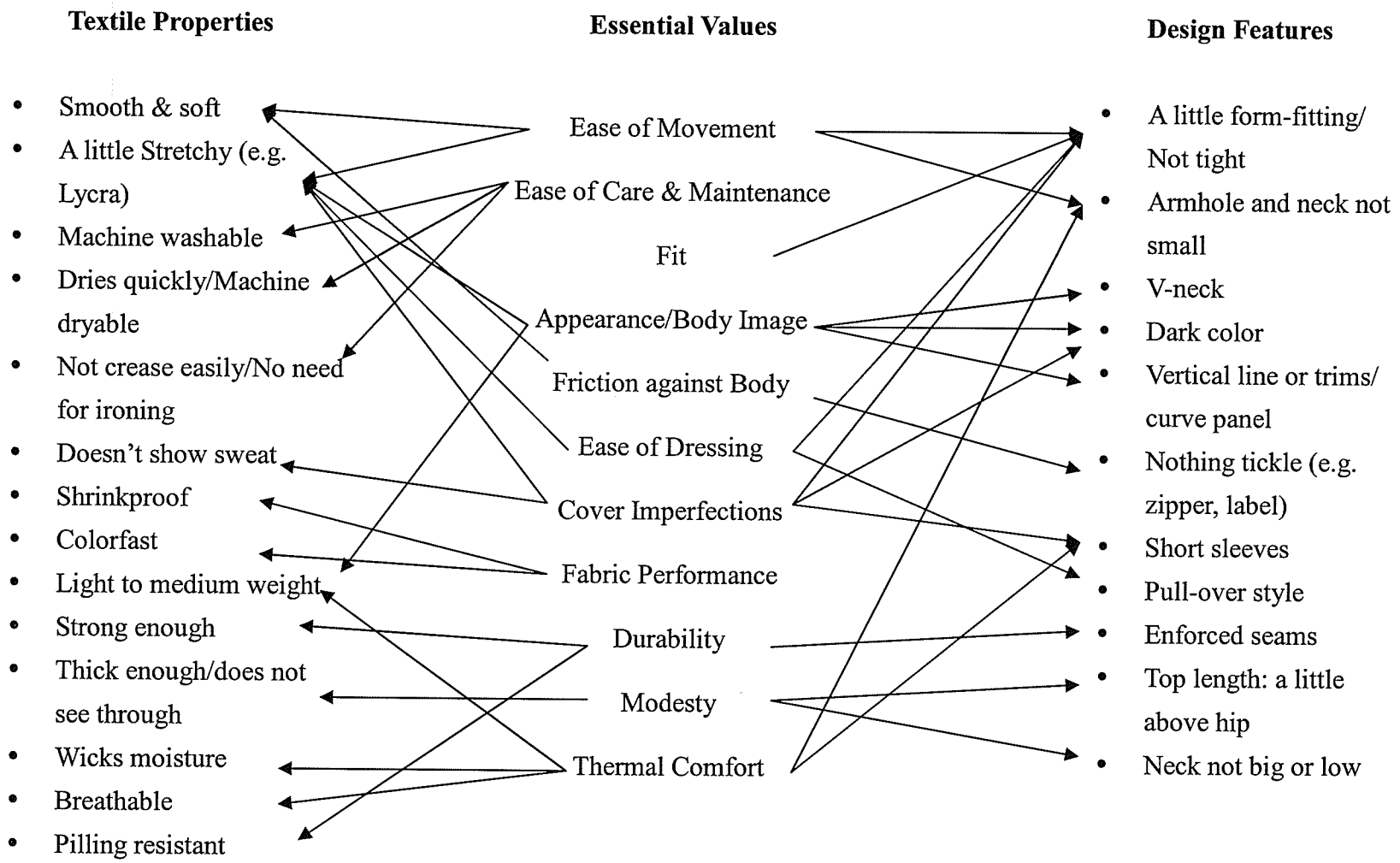


Figure 3. Essential values and their corresponding textile properties and design features.

Responses to the Prototype

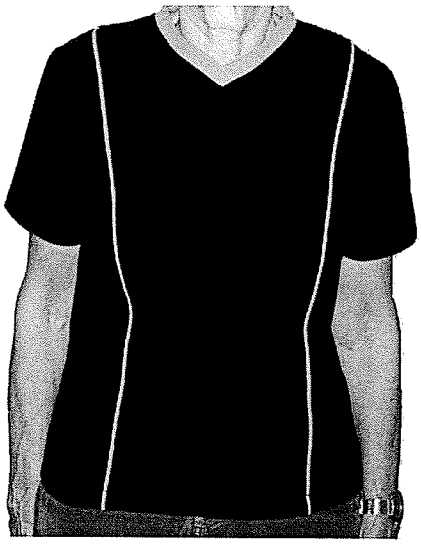
The wear test diary revealed that the average duration of each wearing was about 1 hour. The most common wear and laundry experiences about the prototype were "comfortable to wear", "easy to wash and care", and "free to move". Two participants wrote that they felt too warm during exercise while 3 favourably commented on the style and appearance of the prototype.

Participants' responses to the prototype were collected from the post wear test interviews of 14 participants. Figure 4 showed the prototype on a participant before and after the wear test as well as in a three-participant group. The results of their responses were presented in terms of satisfaction with essential values and comfort sensation about the prototype.

Satisfaction with Essential Values

In general, 42.9% of the participants were very satisfied with the prototype and another 50% were satisfied. With respect to each essential functional or symbolic value, 85.7% of them were satisfied with "ease of movement"; 92.8% with the "fit", "ease of care and maintenance", "appearance and body image", and "ease of dressing"; 100% with "friction against the body", "fabric performance", "durability", and "modesty"; 80.8% were satisfied with "covers imperfections"; and 78.6% with "thermal comfort" (see Table 10). On average, 64.9% of the participants were strongly satisfied with fulfillment of each value while 27.8% were satisfied. Comparatively, there was a slightly higher percentage

of satisfaction with the essential functional values than with the symbolic ones (95.2% vs. 90.9%). In addition, the average satisfaction with each essential value (92.7%) was quite consistent with the general satisfaction (92.9%).



A. Before Wear Test

B. After Wear Test

C. Group View in the prototype

Figure 4. Images of the prototype before and after the wear test as well as in a group view.

Table 10

Participants' Percentage of Satisfaction with the 10 Essential Values (N = 14)

Values	Attributes	Strongly Agree %	Agree %	Disagree %	Strongly Disagree%
Ease of Movement	I move easily when wearing it.	57.1	28.6	14.3	0
Ease of Care/Maintenance	It is easy to wash and care for.	71.4	21.4	7.1	0
Fit	It fits me well.	57.1	35.7	7.1	0
Appearance/Body Image	It looks good on me.	57.1	35.7	7.1	0
Friction against the Body	It does not cut into my body.	71.4	28.6	0	0
Ease of Dressing	It is easy to put on and take off.	57.1	35.7	7.1	0
Cover Imperfections	It covers parts of my body I am not satisfied with.	46.2	15.4	30.8	7.7
	Perspiration does not show when I exercise in it.	69.2	30.8	0	0
Fabric Performance	The color does not run when I wash it.	71.4	28.6	0	0
	It did not shrink.	71.4	28.6	0	0
Durability	It would last for a reasonable length of time.	85.7	14.3	0	0
Modest	It is decent-looking.	78.6	21.4	0	0
	It is not revealing.	85.7	14.3	0	0
Thermal Comfort	It does not feel too warm or cold.	28.6	50.0	14.3	7.1

The Pearson test revealed that there seemed to be certain correlations between participants' responses to some essential values (the significance probability was set at .05). Notably, there was a positive relationship between "fit" and "appearance & body image" ($r = .694, p = .006, N = 14$), "fit" and "modesty" ($r = .673, p = .009$) (see Table 11), "appearance & body image" and "modesty" ($r = .704, p = .005$), "friction against the body" and "fit" ($r = .757, p = .002$), and "friction against the body" and "ease of movement" ($r = .806, p = .000$).

Table 11

Pearson Correlation Results Between Participants' Responses to Essential Values (N = 14)

Variable 1	Variable 2	R Value	P Value
Fit	Appearance & Body Image	0.694	0.006
Fit	Modesty	0.673	0.009
Modesty	Appearance & Body Image	0.704	0.005
Fit	Friction against the Body	0.757	0.002
Ease of Movement	Friction against the Body	0.806	0.000

Comfort Sensation with the Prototype

When they wore the prototype in the aerobic class, 42.9% of the participants felt it thermally comfortable. Another 28.6% thought that it was warm but fairly comfortable, while 14.3% felt cool but still fairly comfortable in it. In total, 85.7% of the participants wearing the prototype were at least fairly comfortable in terms of thermal state.

With respect to comfort sensation descriptors, 35.7% of the participants felt that the prototype was partially snug while 28.6% had no sensation about it; 71.4% of the participants did not feel it loose at all; 42.9% of them did not feel it heavy, but 35.7% felt it mildly; 57.1% had no sensation about the lightweight of the prototype while 28.6% partially felt; 42.9% thought the prototype was definitely soft and another 42.9% either partially or mildly felt the softness; 78.6% of the participants did not feel it stiff or non-absorbent; and 85.7% did not think it sultry. The prototype was not damp or clingy at all to 92.9% of the participants, and not staticky, clammy, prickly, rough or scratchy or itchy to all the 14 participants (see Table 12).

Table 12

Sensation Levels about Comfort Descriptors in Percentage (N = 14)

	Sensation Levels (%)			
Descriptors	No Sensation	Partially	Mildly	Definitely
Snug	28.6	35.7	14.3	21.4
Loose	71.4	14.3	14.3	0
Heavy	42.9	7.1	35.7	14.3
Lightweight	57.1	28.6	7.1	7.1
Soft	14.3	28.6	14.3	42.9
Stiff	78.6	7.1	14.3	0
Staticky	100	0	0	0
Non-absorbent	78.6	14.3	0	7.1
Clammy	100	0	0	0
Damp	92.9	7.1	0	0
Clingy	92.9	7.1	0	0
Sultry	85.7	7.1	0	7.1
Prickly	100	0	0	0
Rough	100	0	0	0
Scratchy	100	0	0	0
Itchy	100	0	0	0

CHAPTER FIVE

DISCUSSION

This chapter is organized under the headings of a general portrait of the sample, theoretical framework, and applicability of ASTM D5586 in the prototype development.

A General Portrait of the Sample

The research results provide a glimpse of some particular characteristics of older women who participated in this research. Compared with the general public of their age, the original 20 participants seem to be well-educated. Sixty-five percent of them have at least bachelor's degree while nationally, only 10.3% older adults aged 55 or over, and 7.2% of older women have comparable level of education (Statistics Canada, 2003a).

Another trait of the research participants is that they have relatively high income. About 57.9% of them have annual household gross income of $50,000 or higher. Comparatively, 46.9% of Canadian household have income within this category (Statistics Canada, 2003b). Notably, about one-third of the participants live alone, and earn at least $50,000 a year.

The older women in this research are serious and regular exercisers. According to their own expression, many of them have been exercising in fitness centres at least three times per week for many years. Their primary purpose of adhering to the exercise habit is to stay healthy as they unanimously agree with the statement "I go to exercise class

primarily to stay healthy". Furthermore, one-half of them consider their exercise intensity to be hard to very hard. Although keeping healthy is their primary purpose, their responses confirm that making friends is a secondary motive. This supports previous research that many older female exercisers use the exercise group as a social outlet and as an opportunity to initiate friendships that extend beyond the gymnasium (Poole, 2001; Traphagan, 1998).

All the research participants consider themselves in good health with no or minor physical limitations. This may be partially attributed to regular exercise which has been shown to significantly enhance well-being and self-perceived health (Blumenthal et al., 1989; Bravo et al., 1996; Moore & Bracegirdle, 1994).

The 6 participants who dropped out do not have distinguishing characteristics in terms of marital status, education, self-assessment of health condition, employment status, occupation, or maximum acceptable price for an item of activewear etc. However, it is noticed that 71.4% of the remaining 14 participants have annual household income above $50,000, compared with 57.9% of the original 20 participants. In other words, those dropouts tend to be in the lower income groups. Moreover, the remaining participants seem to be older because the percentage of those who are between 66 to 75 years old increased from 50% to 64.3%.

In terms of their current exercise clothing, older female exercisers typically wear a loose short-sleeve cotton T-shirt and a pair of exercise tights of different lengths. Since this is the "fashion" in their fitness classes, about one-half of the women feel comfortable

and are content with it. A small number of women who possess some specially designed fitness wear are knowledgeable about the difference between an old T-shirt and a high performance exercise top. However, when the style or material of their tops is independent, the comparison of participants' mean satisfaction with their current exercise clothing reveals that they tend to be more satisfied with form-fitting tops than loose T-shirts or tank tops, and also more satisfied with cotton/spandex fabric than with 100% cotton or polyester/cotton. These imply that although loose cotton T-shirts are the popular exercise clothing in older female exercisers now, cotton/spandex form-fitting tops are more desirable to them. This is consistent with the design feature that the researcher derived from the essential functional and symbolic values.

Although the sample is small, and therefore the results cannot be generalized to the entire population of older female exercisers, it distinguishes some of their characteristics to certain extent. These characteristics may have valuable marketing implications to apparel manufacturers who are interested in catering to this target market. Since research has shown that better-educated older consumers spend more for apparel and have more time to shop for apparel (Lee et al., 1997; Williamson, 1999), clothing expenditure and income are positively related (Abdel-Ghany & Schwenk, 1993; Yang, 1996), and outside-of-home recreational pursuits boost clothing expenditure (Duncan & Horne, 1999), these physically active older women who are well-educated and have relatively high income could be expected to spend more on activewear. Furthermore, as serious exercisers who are concerned about staying healthy, they may be more willing to

purchase well-designed activewear once they realize how it can benefit them during exercise. Therefore, older female exercisers seem to be a potential market. Moreover, the relatively higher satisfaction with form-fitting stretchy tops indicates that this market segment desires activewear that is specially designed for their body fit.

Theoretical Framework

This study reveals older women's demands on activewear in terms of functional and symbolic values. It is discussed under the sub-titles of older women's essential demands on activewear, responses to the prototype, the efficacy of the user-oriented product development model, and other values and their design implications.

Older Women's Essential Demands on Activewear

This study identified 12 functional values and 11 symbolic values for activewear. Since activewear is representative of functional clothing, one may expect that more functional values than symbolic values would be associated with it. The relatively even numbers of functional and symbolic values imply that older women who exercise regularly do not overlook symbolic values of activewear. However, after the participants were asked to select 10 essential values, 8 functional values and 3 symbolic values emerged (because two values have the same ranking, the top 10 ranking actually includes 11 values). Specifically, there are 5 functional values and only 1 symbolic value in the top 5 ranking. In other words, the small proportion of essential symbolic values is mainly in

the lower half of the ranking. Therefore, functional values are much more essential to the participants than symbolic values, which is also reflected by the overall weighted points of functional and symbolic values (70.8% vs. 29.2%). Considering that the research participants are dedicated exercisers, the value they placed on functional values is logical.

On the other hand, the 23 values and the ranking of 10 essential values only reflect demands of a small group of older female exercisers. There is no comparable research to enable the researcher to speculate how older males or young consumers would respond to activewear. Intuitively, one may speculate that older males would express fewer symbolic values and more functional values than older females. For young exercisers, they may place greater importance on symbolic values than functional values. Further research is necessary to investigate gender and age differences in demand for activewear.

The following section describes in detail the essential demands of the research participants who exercise regularly and how their responses relate to the existing body of knowledge.

Comfort

As a broad category, comfort covers several functional values including "ease of movement", "fit", "friction against the body", "thermal comfort" and "keeps me dry. Except for the last one, all these values are essential to the participants because they are ranked number 1, 2, 4, and 10 respectively.

As mentioned in Chapter Two, Hatch (1993) conceptualized comfort state into three dimensions -- thermophysiological comfort, sensorial comfort, and body-movement

comfort. Li (2001) also conceptualized comfort as -- thermal-wet comfort, tactile comfort and body-fit comfort. The conceptualizations by Hatch and Li are fundamentally similar although the dimensions are labelled differently.

In this research, the comfort-related functional values are comparable to the three dimensions expressed by Li: 1) "thermal comfort" and "keeps me dry" correspond to Li's thermal-wet comfort; 2) "friction against the body" corresponds to Li's tactile comfort; 3) "ease of movement" and "fit" correspond to Li's body-fit comfort. The ranking of essential values in this study showed that the order of importance was body-fit comfort, tactile comfort, and lastly thermal-wet comfort. However, according to Li's monograph about clothing comfort in Textile Progress (2001), after conducting surveys and wear trials, thermal-wet comfort was the most important property for sportswear, followed by tactile comfort and body-fit comfort.

The difference between the two findings could be attributed to the particular type of exercise, the research sample and the use-situation in this study. Aerobics requires a range of body movements. It is important that the participants can move freely and comfortably in the activewear. Anything restrictive would cause discomfort. Therefore, it is not surprising that "ease of movement" is the most essential value. Similarly, the importance of "fit" is an expected result because this attribute has been well documented as a major concern voiced by older women. Furthermore, it stands to reason that tactile comfort is an essential value because it would be uncomfortable and even difficult to move when wearing a garment that cuts into the body (especially around the shoulder, neck and

waist), tickles, or irritates the skin. With regard to thermal-wet comfort, heat and moisture management do not seem to be as important to older women as originally expected. The temperature in the fitness centers where they exercise is usually somewhere around 16 °C. Therefore, the heat generated from exercise may actually help them to maintain a comfortable thermophysiological state.

Care and Maintenance

In addition to comfort, serviceability is another primary demand of older women. Three functional values that are closely related to serviceability are all ranked in the top 10 essential values. They are "ease of care and maintenance", "fabric performance" and "durability". Due to the specific use-situation of activewear, older women do not want to have several sets of it. They may purchase one or two sets and use them repeatedly. Therefore, they would desire a set of quality and durable activewear. Considering that the research participants are regular exercisers and they launder activewear much more frequently than other daily attire, their demands on serviceability are fully reasonable.

Ease of Dressing

Ease of dressing is generally considered important to clothing for older adults (Berman, 1999; Rosenblad-Wallin, 1986) because of the fact that older people tend to have reduced mobility, which adds difficulty to dressing and undressing. As older female exercisers in this study are in good health (60% reported having no physical limitations), one may expect that this functional value should not be essential to them. However, it is actually the fifth essential value. This implies that ease of dressing is a preference of

older women which may not be directly related to their physical condition. A possible explanation is clothing that is difficult to put on or move in destroys confidence, as reported by Richards (1981).

Appearance and Body Image

Not only is "appearance and body image" one of very few symbolic values which is deemed essential by the participants, it is also ranked fourth among the ten most essential values, only next to "ease of movement", "ease of care and maintenance" and "fit". This shows that active elderly women care for their appearance. They desire cheerful design to add fashion or style to the garments, which is consistent with several other researchers' findings that older women are interested in stylish clothing (Berman, 1999; Charbonneau, 1999; Chowdhary, 1988, 1989; Kaiser & Chandler, 1984; Khan et al., 1993; Richards, 1981; Robins, 1999). Specifically, they want activewear that flatters their figure. This confirms the findings of Jackson and O'Neal (1994) that older adults tend to choose apparel styles that are more flattering to their image to ameliorate the effects of growing old.

Covers Imperfections

"Covers imperfections" is the second essential symbolic value. This supports research findings that women used apparel to hide shortcomings and conform to standards of beauty (Markee et al., 1990). Although the women in this study exercise hard to keep healthy and fit, some of them did express concerns about thickened midriffs and lack of firmness in their upper arms. Therefore, they want activewear to cover these

"undesirable features". In addition, not showing perspiration is a demand unique to activewear. As serious exercisers, some participants perspire heavily. They feel embarrassed when parts of a garment such as the underarm, the front neck and the back, darken with perspiration.

Modesty

Older female exercisers in this research want to look decent, sensible and they do not want their exercise clothing to be revealing. This could be attributed to the co-ed environment of the fitness centers, which is not appropriate for them to wear revealing exercise clothing. Furthermore, the results of this study also reveal that the importance of modesty is negatively related to exercise intensity. It implies that the harder older women exercise, the more readily they may accept revealing activewear. This agrees with the findings of Sinden et al. that older women who were more physically active had more positive feelings toward stimuli which depict revealing exercise attire (sleeveless T-shirt and shorts) than did those who were less active.

Responses to the Prototype

Responses were collected to examine how well the prototype fulfilled those predetermined essential functional and symbolic values. The high satisfaction rate, 93%, indicates that the prototype has successfully met the participants' demands for activewear.

Ease of Movement and Fit

Overall, participants could move easily in the prototype, with two-thirds being

strongly satisfied with "ease of movement". They did not feel restricted around the armhole and neck. Therefore, "ease of movement" seems to be effectively addressed by the design features including stretchy fabrics, a v-neck that is relatively bigger than a basic crew neck, and a slightly larger armhole.

The form-fitting prototype seems to satisfy older women's demand for fit, because 93.3% of the participants think that it fits them well. The prototype has some shape in the waist, but is not tight-fitting. Responses from the two comfort descriptors "snug" and "loose" also reveal that most participants did not feel the prototype to be loose at all while about one-third of them partially felt it snug. In other words, the slightly snug-fitting prototype fit the participants well. Therefore, although most of them have been wearing loose T-shirts for at least several years, they do prefer well-fitting activewear. This is consistent with their responses to their current exercise clothing that a higher satisfaction rate was associated with form-fitting tops.

The research also manifests the subjectivity of fit and the complexity of the three dimensional human body. It is hard to predict fit based on key body measurements. For example, the corresponding bust and waist measurements of participants 5, 11 and 12 were very similar, except that participant 5 was shorter than the other two (see Table 3). All of them were categorized into the MT10 group. However, the fit testing revealed that the MT10 sample was the best fit for participants 5 and 11, and they were also satisfied with it. As for participant 12, the same garment did not fit her well. The researcher had to make a separate pattern for her by decreasing 6 cm at bust, waist, and hip based on the

MT10 pattern.

The individuality of fit has also been observed from participants 14 and 16. They had very close key body measurements (see Table 3). While participant 14 was dissatisfied with the prototype, participant 16 was very satisfied with it (see Figure 5). A possible reason is that participant 14 has a relatively long waist and hence always prefers longer tops. Although her waist is indeed one-half inch longer than participant 16's, it seems that fit is an issue of individual preference, and it directly affects older women's satisfaction with a garment.

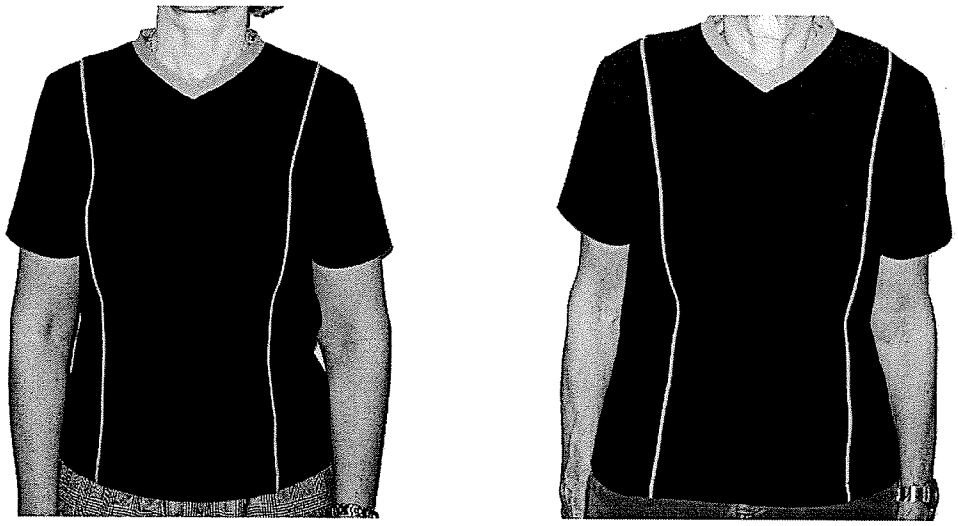


Figure 5. A comparison of two participants in the same size: the left one is dissatisfied with the fit, and the right one is very satisfied with the fit.

Ease of Care and Maintenance, Fabric Performance and Durability

The participants' responses to the prototype show that almost all of them were pleased with the serviceability of the prototype. It was easy to wash, and demanded no

special care, such as ironing. The color did not run. No shrinkage was observed by any participant. Although two weeks might not be long enough to test the durability of the prototype, participants unanimously believed that the prototype would last for a reasonable period of time. To them, the medium weight fabric and the construction of the prototype were sufficiently strong to retain its shape after frequent wash and long wearing. This implies that the design features and textile properties that the researcher used to correspond to those values are feasible, which include pre-shank fabrics and trims, safety stitches on all the seams, and a fabric that is machine washable and dryable, colorfast, and resistant to pilling.

Appearance & Body Image, and Modesty

The prototype has two distinct design features in response to participants' demand for "appearance and body image", namely, contrast color piping to accentuate the princess style line and contrast color cross v-neck to call attention away from the thick body. The results indicate that participants had very favourable comments on the style, especially the piping. They thought that the piping was sharp and indeed made them look slimmer. Therefore, the design features seem to be effective in enhancing older women's appearance. Some of the participants felt positively to the v-neck, which agrees with the findings of Berman (1995) that older adults prefer v-neck style. Their fondness of the piping seems to support Charbonneau's opinion (1999) that for many seniors who grew up in North America during the 1940s when glamour was in favor and style was a dominant influence, they might favor design enhancements such as piping to be

reminiscence of the elegant lifestyle. These embellishments tend to glamorize women's clothing as well as bring confidence to the wearer.

In addition, it is noticed that satisfaction with "fit" and satisfaction with "appearance and body image" had a significantly positive relationship. Therefore, good fit is not only important to the comfort of functional clothing, but also can directly affect older women's body image and self appearance.

Participants' high satisfaction with "modesty" shows that the prototype was modest and decent-looking to all the participants. It was not revealing or "shabby" at all. It looked like a well-designed quality garment. This confirms the efficacy of the following design features and textile properties: 1) the fabric is thick enough that it can not be seen through; 2) the v-neck opening is not big or low; 3) the torso is long enough to cover the waist even when arms are lifted. Moreover, satisfaction with "modesty" was positively correlated to both satisfaction with "fit" and "appearance and body image". It implies that the activewear that older female exercisers consider attractive should be modest-looking, and the decency of the wearer may be evinced by a well-fitting garment.

Friction against the Body, and Ease of Dressing

The tactile comfort of the prototype seems to be very satisfactory as all the participants agreed that it did not cut into their body. Responses to sensation descriptors could provide more detailed evidence of the tactile comfort. Participants unanimously expressed no prickly, rough, scratchy, itchy and staticky sensation. A majority of them felt it being at least partially soft. This supports the feasibility of the relevant design features

and textile properties, e.g. the fabric and trims should be soft and smooth, the armhole and neck opening should fit nicely and comfortably, and no closure such as zippers, buttons, and snaps or labels to irritate the skin during movement. In addition, satisfaction with "friction against the body" seems to be positively related to satisfaction with "ease of movement" and "fit". The strong correlations indicate that tactile comfort greatly contributes to body-fit comfort.

Overall, most of the participants thought that the prototype was easy to put on and take off. The v-neck pull-over style and the stretchy fabrics seem to be effective in achieving the ease of dressing. Although researchers have suggested avoiding pull-over in older adults' clothing in general (Rosenblad-Wallin, 1986), this study reveals that pull-over style and stretchy fabrics work well on activewear for older women.

Covers Imperfections

Most of the participants were satisfied with the fulfillment of this value. It was reworded in two statements: "perspiration does not show when I exercise in it", and "it covers part of my body I am not satisfied with". Every participant agreed with the first statement. This indicates that the black prototype is effective in hiding perspiration stains.

About 60% of the participants were satisfied with the second statement. Therefore, middle-length short sleeves, and torso length about 1 to 2 inches above the hip are generally effective design strategies to camouflage older women's most concerned body imperfections, such as loose muscles in the upper arms and thickened midriff. However, this value has comparatively low satisfaction rating among all the essential values. A

possible explanation may be that the form-fitting prototype, although well satisfies other essential values, tends to show the body silhouette more obviously than a loose big T-shirt. As revealed by their responses to the descriptors "loose" and "snug", a majority of the participants did not think the prototype loose at all while about one-third of them felt it partially snug.

The problem may be improved by increasing the ease around the abdomen. It signifies the importance of abdomen measurement in developing older women's clothing. In the ready-to-wear industry, patternmaking primarily considers the bust ease for upper body, taking for granted that sufficient bust ease could accommodate the abdomen. However, older women have special physical characteristics. In large sizes of ASTM D5586 Half-size and Women's figure types, the abdomen measurement is usually bigger than that the hip measurement, and much bigger than the bust measurement. Traditional patternmaking would result in tops that are either loose-fitting above the waist or tight-fitting around the midriff. Therefore, for older women's upper body garments, it is advisable to consider the abdomen measurement as a key measurement in pattern development.

Thermal Comfort

Most of participants were satisfied with the thermal property of the prototype. At least over 78% of the participants did not have any clammy, damp, clingy, non-absorbent, or sultry sensation. Therefore, the cotton/spandex fabric, v-neck, non-snug fitting style, and short sleeves seem to effectively respond to the value of thermal comfort.

The results of this research show that older female exercisers' thermal state could be very different, and subjective. For example, a majority of the participants were in a comfortable zone when wearing the prototype. A few of them became very hot in exercise and felt the prototype was uncomfortably warm. The different response in terms of thermal comfort may only be attributed to their individual physiological characteristics because there is no evidence to show that exercise intensity correlates with thermal comfort state.

The discrepancy of older female exercisers' thermal sensation implies that it is impractical to expect one fabric to satisfy all. Since older women's response to thermal properties of activewear could be divided into three groups, different fabrics should be used to meet each group's demand for thermal comfort. For the first group which represents the majority of older women, the cotton/spandex knit fabric seems to be a good choice as the prototype provides satisfactory thermal comfort to most participants. For the second group of older women who sweat heavily during exercise, a lighter fabric that dissipates heat and moisture quickly may satisfy them better. For the small number of older women who are very sensitive to cold, a slightly heavier material may be more desirable to them. Moreover, three-quarter sleeves or two-piece tops may be supplemental design choices.

Browsing exercise clothing products in the marketplace, it is obvious that those made of polyester with high wicking properties have been gaining. This high performance attribute is specifically engineered to respond to the thermal-wet comfort

demand of athletes. However, according to this study, good wickability is not a necessity for most of the older female exercisers (85.7%).

The Efficacy of the User-Oriented Product Development Model

The user-oriented product development model (UPD) is the theoretical framework for this study. This approach is not to be confused with the manner in which the ready-to-wear industry develops seasonal lines. In the ready-to-wear industry, the evolution of seasonal styles is usually a response to seasonal color and style forecasts, innovations in textile technologies, and sales records. It may also take into account developments in the social, political, economic, and cultural environments that might influence consumers' tastes, preferences, and purchasing power. The user-oriented product development approach starts from investigating user demands in the use situation. It is used frequently for end uses where safety of the wearer is paramount or where the performance of an activity could be enhanced. Examples of this type of clothing include firefighters' or soldiers' protective clothing systems, and competitive sports clothing.

Even though UPD theory has been successfully used for developing a variety of functional clothing, it has not been applied to end uses such as exercise wear for older women. Findings from this research reveal that the prototype developed according to the UPD theory satisfied about 93% of the participants. It is also observed that the average satisfaction with each essential value was almost equal to the overall satisfaction with the prototype. This consistency may imply that those essential values are indeed salient to

older women who exercise regularly. Satisfaction with the essential functional values was slightly higher than that of the essential symbolic values (95.2% vs 90.9%). This shows that as a product development method for functional clothing, UPD seems to be more effective to respond to functional values than symbolic values.

Besides providing a satisfactory end product, UPD helps to collect ample direct information about physically active older women's particular demands for activewear, e.g., modesty, ease of dressing, and covering body imperfections. It fills in the blank of knowledge about this potential market segment. As discussed in the literature review, no preview research has been conducted to investigate older female exercisers' demands and to develop exercise clothing for them. Limited relevant publications loosely fit into the following clusters: 1) older women's (not necessarily older female exercisers) response to stimuli of exercise clothing (Sinden et al, 2003), 2) basic advice to older exercisers on how to dress properly for exercise (Ting, 1991), 3) older adults' general preference for sportswear in casual situations (Berman, 1995), or 4) general suggestion for developing clothing for older adults (Kallel et al., 1999). Clearly, the existing knowledge is peripheral, not even closely related to this particular research topic.

In spite of the 30% dropout rate after the essential values were collected, the essential demands of the remaining 14 participants are not quite different from that of the original sample. This is revealed in two aspects. First, the mean weighted points of the values from both the dropouts and remainders are very close (see Appendix N). Second, comparison of the essential value ranking from the dropouts, remainders and all the

participants also shows that the 14 participants' essential value ranking is very similar to that of the 20 original participants (see Appendix O). Therefore, the user-oriented product development in this study is not affected by the relatively high dropout rate. In conclusion, UPD is effective in investigating older female exercisers' demands for activewear and in developing prototypes to meet their demands.

Other Values and Their Design Implications

There are 12 functional and symbolic values that were not included in the essential value list. It is necessary to point out that the ranking of essential values only applies to workout tops. For bottoms, the ranking could be very different. Therefore, although the 12 values were not set prior values by the participants in this study, they provide extensive information of older women's broad demands on activewear as well as useful design implications.

Other Functional Values and Design Implications

Among the 23 values, the four functional values excluded from the essential ranking list are "pressure on the body", convenience design", "keeps me dry", and "weight of fabrics". Quite clearly, when the research participants brought up some attributes categorized under the value "pressure on the body", they were aiming at bottoms. As mentioned earlier, the majority of the participants wear tights in aerobics. They expect the exercise bottoms to support the body and hold it nicely. It is rational that this value is not essential for exercise tops because having pressure on the upper body

may not only add difficulty to dressing, but also reveal older women's body shape that they are generally not satisfied with.

"Convenience design" is also more applicable to bottoms than tops. Small user-friendly convenience designs are appreciated by active older women. For example, since some participants have problems with carrying the locker key conveniently and comfortably, an inconspicuous key pocket near the waistband can be very desirable. Moreover, older exercisers need a place to put tissues. This agrees with Rosenblad-Wallin and Karlsson (1986) who suggested that older adults needed special features such as extra pockets to accommodate eye glasses, tissues, etc. In addition, it may be considerate to provide functional accessories, e.g., a matching headband to prevent hair from getting in the face, which may also be decorative and professional-looking.

Because the participants are serious exercisers and aerobics is highly intensive, it is expected that "keeps me dry" would be an essential value. However, the findings of this study reveal that moisture management is not a primary concern to most of older female exercisers. The reason is yet to be studied.

Older female exercisers tend to prefer light to medium weight fabric, which is reasonable for activewear. However, the weight of fabrics by itself does not seem to be very important for research participants in this study because over one-half of them felt the prototype fabric a little heavy compared to what they had been wearing, but it did not affect their satisfaction with the prototype. They even accepted it as a suitable weight because of the comfort. Hence, the element of comfort seems to be a moderating factor in

the participants' sensory response to the prototype.

Other Symbolic Values and Design Implications

The eight symbolic values that were not included in the essential values are "fashion and stylish", "self-esteem", "age appropriate", "state of the mind", "novelty", "embellishment", "shows my status", and "calls attention". They convey important social and psychological connotation of older female exercisers' demands on activewear.

Older female exercisers want to look good and feel good when they wear exercise clothing in gymnasiums. They would like their activewear to be a little stylish, as long as the fashion suits their image and is appropriate to their age. This agrees with the findings of Williamson (1999) that today's older shoppers desire for age-appropriate styles, with no interest in wearing those styles designed for teenagers. Moreover, as far as activewear is concerned, embellishment, novel design, using clothing to impress others or as a social status do not seem to be important to the older female exercisers.

Those symbolic and functional values expressed by the participants imply that striking a balance between fashion and function would be a challenge in developing exercise clothing for older women. For example, revealing and tight-fitting exercise clothing which is appropriate for some young women who exercise regularly is not suitable to older women. However, color and novel design features do lend appeal to exercise clothing. Moreover, because older women do not want to be perceived as conspicuous consumers or call attention to themselves through their clothing, activewear with noticeable brand name logo is not likely to appeal to them.

Applicability of ASTM D5586 in the Prototype Development

The ASTM database purports to be representative of the physical characteristics of older women. An objective of this study is to examine the efficacy of ASTM D5586 in developing activewear for older women. It is discussed under the following subtitles, representative of older women's body characteristics, as well as categorization and sizing.

Representative of Older Women's Body Characteristics

The 20 participants represent a variety of ASTM D5586 sizes: Half-size 18.5, 20.5 and 22.5, Women 34 and 36, Junior 9 and 17, Misses Petite 14 and 18, Misses 12, 14, and 16, Misses Tall 10 and 12, and Junior Petite 9 (see Table 3). Most of the research participants (85%) can be categorized into one size that at least three of the four key body measurements are within one-inch difference from their actual body measurements. Difference would be much smaller if the actual measurements of several women in the same size are averaged. For example, the average actual bust, waist, hip and height measurements of the three women who fall into the MP 16 size are 37.2", 32.5", 40.8", and 66" respectively (see Table 3). The corresponding M16 measurements in ASTM D5586 are 37.2", 32.6", 40", and 65.6". The corresponding differences between the actual body measurements and those in the ASTM standard are all less than one inch. Similarly, for the three participants who fall into the M14 size, the average difference between their actual body measurements and the corresponding ASTM D5586 M14 measurements are 0.3" in bust, 1.1" in waist, 0.1" in hip, and 0" in height. Since ASTM

D5586 is the result of a statistical survey, it stands to reason that it represents actual body measurements more precisely when the sample size is larger.

In terms of figure types and size distribution, Misses (sizes 14-16) and Misses Petite (sizes 14 and 18) account for 40% of the original 20 participants and 50% of the final 14 participants. They seem to be the most common sizes in older women. This agrees with ASTM D5586 database in that among the 55 sizes in ASTM D5586, Misses 14-18 and Misses Petite 14-18 comprised 22.6% of the total subjects. Misses is the most common figure type among the research participants (35% of the original sample and 42.9% of the final sample), so is it in ASTM (17.7%). In addition, consistent with ASTM D5586 that sizes 34, 36 and 38 are the most typical sizes in Women's figure type, this study shows that the 10% of the 20 participants in this figure type are either in size 34 or 36.

In short, when certain size categories in ASTM D5586 are applied to activewear for older women, they seem to have captured the anatomical characteristics of the research participants. Therefore, the researcher deems ASTM D5586 a valuable body measurement database for developing well-fitting clothing for older women, which also supports research findings reported by Campbell (1999).

Categorization and Sizing

Although ASTM D5586 is an age-appropriate database of body measurements, it cannot be readily used by the clothing industry. It is necessary to establish a set of feasible sizing specifications.

In spite of a small sample, this research gives insight into the challenges of categorizing sizes. The 15 sizes were first combined into 6 size groups mainly according to bust, waist, and hip measurements. The measurement ranges in each multi-size group were less than 2 inches (see Table 4). The fit test revealed that 4 of the 6 size groups could offer satisfactory fit to 88.2% of the participants. In the regrouped sizes, the bust measurement difference in each multi-size group ranged from 2.4 inches to 3.2 inches (see Table 7). Therefore, an increment less than 2 inches is unnecessary. Since 14 of the 15 participants were satisfied with the fit of the final prototype, it is reasonable to conclude that the increment of bust, waist, and hip measurements in the sizing specifications could be between 2.5 inches and 3 inches. In other words, a garment may fit a group of older women whose corresponding measurements are within a difference of 2.5 inches to 3 inches. Based on this deduction, 10 to 12 size groups may be able to cover all the ASTM D5586 sizes ranging from 29 inches to 58 inches in bust measurement. These findings seem to support Betzina's sizing. Betzina grouped the ASTM D5586 measurements into ten alphabetical sizes from A to J, including bust measurement from 32 inches to 55 inches (Vogue Patterns, 1999). From size A to D, the increment is 2 inches, D to F is 2.5 inches, and F to J is 3 inches. Since the research findings agree with Betzina's sizing, the researcher would recommend using her size categories as a base for pattern development instead of using the raw data of ASTM D5586 to categorize sizes.

CHAPTER SIX

CONCLUSION, LIMITATIONS AND IMPLICATIONS

This chapter includes conclusion, research limitations and delimitations, and implications for future research.

Conclusion

In this section, conclusions are presented mainly with respect to the research objectives. Contributes of this study is also discussed.

Objective One

The first objective of the research was to apply the theory of user-oriented product development by Rosenblad-Wallin (1985) to the development of active sportswear for older women, with emphasis on: a) identifying the symbolic and functional values that older women associated with active sportswear; b) translating selected essential symbolic and functional values into design features and textile properties for active sportswear; c) incorporating those design features and textile properties into prototype development.

The interviews with individual participants yielded a total of 23 functional and symbolic values (see Table 8) – 12 functional values and 11 symbolic values. The 12 functional values were "thermal comfort", "ease of dressing", "convenience design", "ease of movement", "weight of fabric", "fabric performance", "ease of care and maintenance", "fit", "pressure on the body", "durability", "friction against the body", and

"keeps me dry". The 11 symbolic values were "self-esteem", "novelty", "show my status", "embellishment", "state of mind", "modesty", "fashion and stylish", "covers imperfections", "appearance and body image", "age appropriateness", and "calls attention". After the research participants were asked to select the 10 essential values from the 23, the following list emerged: "ease of movement", followed by both "fit" and "ease of care and maintenance", "appearance and body image", "friction against the body", "ease of dressing", "cover imperfections", "fabric performance", "durability", "modesty", and "thermal comfort" (see Table 9). Therefore, the researcher concludes that the first part of objective one has been met completely. It also provides answers to the first and second research questions.

Based on the 10 essential values, the researcher translated them into engineering details, either in terms of design features or textile properties (see Figure 3). The main design features included " a little form-fitting but not tight', "armhole and neck not too small", "V-neck", "dark color", "vertical decorative or functional lines", "no zipper or labels to tickle the skin", "in basic and classic colors or style", "short sleeves", "pull-over style", "trims in cheerful color or design", "enforced seams", "torso length around the hipline", and "neckline not too big or low", etc. The important textile properties were "a little stretchy", "machine washable", "no need for ironing", "shrinkproof", "good colorfastness", "soft and smooth", "strong enough", "does not see through", "does not show sweat", "light to medium weight", "breathable", "dries quickly or machine dryable", "wicks moisture", and "pilling resistant". The researcher concludes that the second part

of objective one has also been fulfilled and the third research question has been answered.

The researcher created 10 sketches that incorporated the derived design features. After screened by the participant panel meeting, one of the sketches was chosen to be the prototype style (see Figure 4). The main features of the design included a v-neckline, contrast color cross neckband, contrast color piping from shoulder to hem in the front and the back, short sleeve, and slightly form-fitting pull-over style, bodice in black color etc. Prototype fabric selection was guided by the derived textile properties. After testing six common activewear fabrics for air permeability, vertical wicking, pilling resistance, colorfastness, and stretch recovery, the researcher decided to use a jersey knit with 90% cotton and 10% Lycra®. This fabric was stretchy, machine washable and dryable, easy to care, dimensionally stable, colorfast, soft, smooth, strong, non-revealing, medium weight, resistant to pilling, absorbent, and does not show sweat. The trim for the piping and the neckband was of the same fiber content but in a light color. Consequently, the researcher concludes that the third part of objective one has been fulfilled.

Objective Two

Objective two was to use relevant ASTM D5586 body measurements in the prototype development process. The research participants' key body measurements at bust, waist, hip and height were compared with those of ASTM D5586 sizes. Each of them was categorized into a size that had the closest measurements to her actual ones.

The twenty participants fell into fifteen ASTM sizes, namely, Half-size 18.5, 20.5 and 22.5, Women size 34 and 36, Junior size 9 and 17, Misses Petite size 14 and 18, Misses size 12, 14, and 16, Misses Tall size 10 and 12, and Junior Petite size 9 (see Table 3). The findings showed that for the majority of participants, at least three of the four key body measurements of their corresponding ASTM size were within one-inch difference from their actual body measurements. In particular, for sizes such as Misses 14 and 16 that included more than one participant, the ASTM key body measurements were much closer to the participants' actual averages. Consistent with the survey data of ASTM D5586, this study also found that Misses and Misses Petite size 14 to 18 were the most common figure types and sizes in older women.

The 15 ASTM sizes were categorized into six groups according to the similarity of key measurements (see Table 5). Within groups that had two or more sizes, the ASTM size which was closest to the group average measurements was designated to be the group representative. After fit testing, four size groups were retained: HF18.5, M16, M14, and MT10 (see Table 6). Participants' responses to the final prototype revealed that the prototype developed from ASTM D5586 sizes fit them well.

The results indicate that ASTM D5586 has captured the anthropometric characteristics of the older women in this research. As a relatively up-to-date body measurement database, ASTM D5586 seems to be a good resource to develop well-fitting clothing for older women. This provides a satisfactory answer to the sixth research question. The researcher concludes that the second objective has been fulfilled. However,

as this study and other previous studies have suggested, it is still unclear how to establish a practical sizing from ASTM D5586 that can be directly used in the clothing industry.

Objective Three

The third objective was to test the prototype. Prototype testing was conducted at two different stages and levels, pilot testing and a two-week wear testing. The pilot tests entailed two stages, 1) sample fitting on each participant to evaluate the fit as well as its accordance with the original design, and 2) laundry testing to determine how well the appearance and fit would be maintained after home wash. The fitting process resulted in the reorganization of size groups based on participants' fit size. The new size groups were MT10, M14, M16 and HF18.5, as well as two specially altered sizes, M16B and MT10B. After the fit testing, sample garments were tested to ascertain their performance in a home laundering environment. The test results showed that washing in 30°C water yielded the least amount of shrinkage and 50°C the most. There was no color fading or staining on the garments, and there was no need to iron the prototype after drying. The testing led to the decision on the following care instruction for the prototype, "wash garments inside out in cool water, no chlorine bleach, wash and dry under delicate setting". However, the researcher decided to preshrink the fabrics at 50°C water to accommodate extra shrinkage when participants accidentally washed the prototype in a hot water setting.

The second stage was the wear test. Each participant wore the prototype in her

aerobic classes at least three times over the two-week period, and washed it after every wearing. The duration of each wearing was about one hour. Wear and laundry experiences were briefly recorded in the diary provided. Therefore, objective three has been met.

Objective Four

Objective four was to measure the extent to which the prototype corresponded to the essential symbolic and functional values as well as participants' general satisfaction to the prototype. To meet objective four, the researcher conducted a post wear test interview with each participant to elicit responses regarding: (1) their general satisfaction with the prototype, (2) their satisfaction with the fulfillment of each essential value, and (3) their thermal state and comfort sensations when wearing the prototype in fitness classes.

The results showed that 93% of the participants were satisfied with the prototype. As to the fulfillment of each essential value, all the participants were satisfied with "friction against the body", "fabric performance", "durability", and "modesty"; over 85% with "fit", "ease of care and maintenance", "appearance and body image", "ease of dressing", and "ease of movement"; about 80% with "covering imperfections" and "thermal comfort". In terms of thermal state, 86% of the participants were fairly comfortable when they exercised in the prototype. Responses to comfort sensation descriptors showed that nobody felt it "staticky", "clammy", "prickly", "rough", "scratchy" or "itchy". A majority of the participants thought the prototype was "soft", and did not feel it "damp", "clingy", "sultry", "non-absorbent" or "lightweight". In

conclusion, the prototype successfully corresponded to the essential values and the research participants were generally satisfied with it. Therefore, objective four has been fulfilled.

Contributions of This Study

Although the research results cannot be generalized to the entire population of older female exercisers, it distinguishes some characteristics of this potential market segment. This consumer group tends to be well-educated, affluent, interested in well-fitting clothing, and willing to spend on clothing. These characteristics may have valuable marketing implications to apparel manufacturers who are interested in catering to this target market.

This research practically contributes to the existing body of knowledge. It identified older female exercisers' demands for activewear in terms of functional and symbolic values, and the 10 essential values. None of the previous studies could provide this firsthand information. Moreover, this research developed a prototype of activewear from a user-oriented product development approach and examined the participants' responses to it. No similar research has been conducted from a product development angel or on this particular topic. This research also ascertained the applicability of ASTM D5586 to develop well-fitting clothing for older women. These research findings may help manufacturers to target this potential market segment.

Research Limitations and Delimitations

Several delimitations of the research were observed. The research was delimited to the geographical area of the city of Winnipeg. The findings were based on the responses of a convenience sample of 20 participants whose body measurement range was delimited to certain ASTM D5586 figure types and sizes. The participants were recruited from three fitness centers that had programs for older adults. The physical activity was mainly delimited to aerobics. Therefore, the findings could not be generalized beyond the particular area, the group of participants and the specific exercise in this study.

The research encountered practical limitations. First, the product development was confined by the supply channel. Many activewear fabrics were not accessible to the general public. Textile agencies in Winnipeg did not have a full range of activewear fabrics as well. In addition, due to the small quantity of fabrics required to make 20 prototypes, mills might not respond to the order. There was a great possibility that the fabrics were not produced any more when the researcher decided to order it. Moreover, the product development was restricted by mass production capability, and labor cost etc.

In addition, the enlargement of the anthropometric criteria has some effects on the study. The negative aspect was that it significantly increased the difficulty in size categorization and the work volume in pattern development. Moreover, a wider range of body measurements meant smaller size groups, and therefore more limited information could be obtained from size categorization. However, relaxing the criteria is necessary

because it significantly shortened the time-consuming sample recruitment process. By introducing a more variety of ASTM D5586 sizes, the research also provided more insights into the efficacy of ASTM D5586 in capturing old women body characteristics.

Implications for Future Research

From over two years' involvement in the study, the researcher learned from doing. In the following section, the researcher describes some suggestions for improvement to the prototype development, and general implications for future research.

Suggestions for Improvement to the Research

First, the duration of the actual prototype development should be as short as possible so as to eliminate possible confounding variables. In this study, the process took 8 months, which consisted of taking participants' body measurements, categorizing them into ASMT D5586 sizes, sketch design, fabric selection, pattern making, sample making, pilot testing, and production. When participants conducted the wear test, their body measurements might have changed over the period of time.

Second, to develop clothing items using ASTM D5586, it is advisable to make at least one sample for each size group and to test the fit of all the groups. Due to the complexity of older women's body and the individuality of fit, it is difficult to predict the fit of the entire research sample based on the fit of one or two groups.

Third, for functional clothing such as activewear , the fit testing should simulate the

actual use situation. The participants should not only evaluate the "still" fit, but the fit in their "active" state. As suggested by Kallal et al. (1999), fit testing should include standing, seated, and active positions. In this study, most participants tried on the sample as they would fit a garment in stores, although they were encouraged to move as if they were in an aerobic class. It would be better if they could test the fit of the sample garments in the exercise environment.

Lastly, this study examined the exercise motivations of the participants based on their agreement with "exercise to stay healthy" and "exercise to make friends". Future research should take into consideration of other social psychological aspects of exercise and their influences on demand for exercise clothing.

General Implications for Future Research

Additional research needs to be conducted to provide more information about developing activewear for older women. The process and results of this study lead to several practical implications for future research.

The first implication is to repeat the research with other activewear apparel such as exercise pants or jackets. Most of the research participants indicated that they would desire a bottom more than a top. However, due to resource limitations, the researcher decided to develop only an exercise top. Future research on other activewear apparel may provide additional information on older female exercisers' clothing demands and how to satisfy their demands. It will further testify the efficacy of the user-oriented product

development method for developing activewear (Rosenblad-Wallin, 1985).

The second implication is to repeat the study with a larger sample and more sizes, and to adopt a tentative sizing system that has been established from ASTM D5586. This study has a relatively small sample that covers only 15 of the 55 sizes in ASTM D5586. It does not give complete insights into how to categorize the 55 sizes into a series of more manageable sizes to be directly used in the clothing industry. Adopting an established sizing system such as Betzina's sizing (Vogue Patterns, 1999) could be an option. It has been reported to create well-fit patterns and it comes with a corresponding grading rule. By developing products based on such an established sizing system as it is in the real industry situation, future research would be able to examine the effectiveness of the sizing and then perfect it. The research findings would help to set a uniform and feasible sizing for the ready-to-wear industry.

REFERENCES

Abdel-Ghany, M. & Schwenk, F. N. (1993). Functional forms of household expenditure patterns in the United States. *Journal of Consumer Studies and Home Economics, 17,* 325-342.

Aldrich, W. (1991). *Metric pattern cutting.* Glasgow: Harper Colline.

American Society for Testing and Materials. (1994). *Standard tables of body measurements for women aged 55 and older (All figure types)* (D 5586). Philadelphia: Author.

American Society for Testing and Materials. (1997). *Standard test method for pilling resistance and other related surface changes of textile fabrics: Random tumble pilling tester* (D 3512-96). PA: Author.

American Society for Testing and Materials. (2000). *Standard test method for stretch properties of textile fabrics – CRE method* (D 6614-00). PA: Author.

Aoyagi, Y., McLellan, T. M., & Shephard, R. J. (1998). Effects of endurance training and heat acclimation on psychological strain in exercising men wearing protective clothing. *Ergonomics, 41,* 328-357.

Bates, J., & Parkinson, J. R. (1969). *Business economics.* New York: Augustus M. Kelley.

Behling, D. (1994). School uniforms and person perception. *Perceptual and Motor Skills, 79,* 723-729.

Belleau, B. D., Miller, K. A., & Church, G. E. (1988). Maternity career apparel and perceived job effectiveness. *Clothing and Textiles Research Journal, 44*(2),

30-36.

Berman, L. G. (1995). *Elderly women and activewear: Their preferences and fitting problems*. Unpublished master's thesis, Oregon State University, Corvallis, Oregon, USA.

Blumenthal, J. A., Emery, C. F., Madden, D. J., George, L. K., Coleman, R. E., Riddle, M. W., et al. (1989). Cardiovascular and behavioral effects of aerobic exercise training in healthy older men and women. *Journal of Gerontology, 44*(5), M147-157.

Borkan, G. A., Hults, D. E., & Mayer, P. J. (1982). Physical anthropological approaches to aging. *Yearbook of Physical Anthropology, 25*(18), 181-202.

Bravo, G., Gauthier, P., Roy, P. -M., Payette, H., Gaulin, P., Harvey, M., et al. (1996). Impact of a 12-month exercise program on the physical and psychological health of osteopenic women. *Journal of the American Geriatrics Society, 44,* 756-762.

Calhoun, G., & Morse, W. C. (1977). Self-concept and self-esteem: Another perspective. *Psychology in the Schools, 14,* 318-322.

Campbell, L. D. (1998). *Satisfaction with a trouser developed from the Canada Standard Sizing and the ASTM D5586 for women aged 55 or older.* Unpublished master's thesis, University of Manitoba, Winnipeg, Manitoba, Canada.

Canadian Fitness Survey. (1992). *Fitness and aging.* Ottawa: Governmental Canada, Fitness and Amateur Sports.

Canadian General Standards Board. (1989). *Textile test methods: Air permeability test* (CAN/CGSB-4.2.36-89). Ottawa: Canadian General Standards Board.

Canadian General Standards Board. (1990a). *Textile test methods: Colourfastness to washing – accelerated test – launder-ometer* (CAN/CGSB-4.2.19.1-90). Ottawa: Canadian General Standards Board.

Canadian General Standards Board. (1990b). *Textile test methods: Colourfastness and dimensional change in domestic laundering of textiles* (CAN/CGSB-4.2.58-90). Ottawa: Canadian General Standards Board.

Carlson, J. E., Ostir, G. V., Black, S. A., Markides, D. S., Rudkin, L., & Goodwin, J. S. (1999). Disability in older adults 2: Physical activity as prevention. *Behavioral Medicine, 24,* 157-168.

Charbonneau, J. S. (1999). *Ready-to-wear apparel for active women over the age of 55.* Unpublished master's thesis, Colorado State University, Fort Collins, Colorado, USA.

Chowdhary, U. (1988). Self-esteem, age identification, and media exposure of the elderly and their relationship to fashionability. *Clothing and Textiles Research Journal, 7*(1), 23-30.

Chowdhary, U. (1989). Apparel shopping behavior of elderly men and women. *Perceptual and Motor Skills, 68,* 1183-1190.

Chowdhary, U. (1991). Clothing and self-esteem of the institutionalized elderly female: two experiments. *Educational Gerontology, 17,* 527-541.

Chowdhary, U. (1998). Clothing preferences of older consumers. *Perceptual and Motor Skills, 86,* 819-826.

Clark, S. D., Long, M. M., & Schiffman, L. G. (1999). The mind-body connection: the

relationship among physical activity level, life satisfaction, and cognitive age among mature females. *Journal of Social Behavior and Personality, 14,* 221-240.

Clarkson, P. M., & Kroll, W. (1978). Practice effects on fractionated response time related to age and activity level. *Journal of Motor Behavior, 10,* 275-286.

Cook, F. L. & Settersten, R. A. Jr. (1995). Expenditure patterns by age and income among mature adults: Does age matter? *The Gerontologist, 35*, 10-23.

Dahlman, S. (1983). A washbasin for washing when seated. *Applied Ergonomics, 14*(2), 123-131.

Daters, C. M. (1990). Importance of clothing and self-esteem among adolescents. *Clothing and Textiles Research Journal, 8*(3), 45-50.

Department of National Defence. (n.d.). *Test method for vertical wicking* (Requisition No. 8476JE9AG). Ottawa: Author.

Designs on 'older' women (HE 454). (n.d.) West Lafayette, IN: Purdue University, Cooperative Extension Service.

Dillman, D. A. (1978). *Mail and telephone survey.* New York: Wiley.

Dillin, J. (2001, March 1). World confronts an aging population. *Christian Science Monitor, 93*(66), p. 2.

Duncan, K., & Horne, L. (1999). Clothing expenditures of older Canadian households. *Canadian Home Economics Journal, 49*(4), 133-140.

Fanger, P. O. (1970). *Thermal comfort: Analysis and applications in environmental engineering.* New York: McGraw-Hill.

Frederick, C.J., & Shaw, S.M. (1995). Body image as a leisure constraint: Examining the experience of aerobic exercise classes for young women. *Leisure Sciences, 17,* 57-73.

Frings, G. S. (1999). *Fashion: From concept to consumer* (6th ed.). New Jersey: Prentice Hall.

Fritz-Cook, B. D. (1990). *The relationship between older women's attitudes and behavior regarding clothing and fashion and their social participation* [CD-ROM]. Abstract from ProQuest File: Dissertation Abstracts Item: AAC9111705.

Goldsberry, E. (1995, March). Improving apparel sizing for older consumers. *ASTM Standardization News,* 48-50.

Goldsberg, E., & Reich, N. (1989, September). "It either fits or it doesn't: Attempting to Solve the Problem of Garment Fit." *ASTM Standardization News.*

Griffin, R. W., Ebert, R. J., & Starke, F. A. (1996). *Business* (2nd Canadian ed.). Ontario: Prentice-Hall.

Harrison, B. (1986). Spending patterns of older persons revealed in expenditure survey. *Monthly Labor Review, 109*(10), 15-17.

Hatch, K. L. (1993). *Textile science.* New York: West Publishing Company.

Health Canada. (1999a). *Aging vignettes #17: A quick portrait of Canadian seniors.* Retrieved July 18, 2001, from http://www.hc-sc.gc.ca/seniors-aines/pubs/vignette/ vig17_e.html

Health Canada. (1999b). *Physical activity of Canadians: Supplementary tables*

1996/97. Retrieved July 19, 2001, from http://www.hc-sc.gc.ca/hpb/lcdc/bc/nphs/physical/pdf/ nphstabe.pdf

Health Canada. (2000). No. 11: The international perspective. *Canadian Seniors.* Retrieved July 18, 2001, from http://www.hc-sc.gc.ca/seniors-aines/pubs/factoids/en/no11.html

Hill, C. W. L., & Jones, G. R. (1995). *Strategic management: An integrated approach* (3rd ed.). Boston: Houghton Mifflin.

Holland, J. R., & Conaway, F. (1991). Reaching older audiences: Aging America presents communications challenges and opportunities. *The Public Relations Journal, 47*(5), 14-17.

Hollies, N. R. S. (1970). The comfort characteristics of next-to-skin garments, including shirts. *Third Shirley International Seminar on Textiles for Comfort.* Manchester, England.

Hollies, N. R. S. (1975). Psychological scaling in comfort assessment. In N. R. S. Hollies & R. F. Goldman (Eds.), *Clothing comfort: Interaction of thermal, ventilation, construction and assessment factors* (pp. 107-120). Ann Arbor, MICH: Ann Arbor Science.

Hollies, N. R. S., Custer, A. G., Morin, C. J., & Howard, M. E. (1979). A human perception analysis approach to clothing comfort. *Textile Research Journal, 49,* 557-564.

Horne, L., Campbell, L., & Scholz, C. (1999). Older females as a market segment for well-fitting clothing. *Journal of Fashion Marketing and Management, 3,*

236-244.

Howley, E. T. (2000). Physical fitness testing and interpretation. In E. P. Johnson (Eds.), *ACSM's guidelines for exercise testing and prescription.* Baltimore, ML: American College of Sports Medicine.

Institute for Standards Research (1993). *Development of body measurement tables for women 55 and older and the relationship to ready-to-wear garment size* (ISR-06 PCN: 33-000006-18). Philadelphia: ASTM Institute for Standards Research.

Jackson, H. O. (1992). Aging and expenditures on apparel. *Clothing and Textiles Research Journal, 10*(2), 24-28.

Jackson, H. O., & O'Neal, G. S. (1994). Dress and appearance responses to perceptions of aging. *Clothing and Textiles Research Journal, 12*(4), 8-15.

Kaiser, S. B. & Chandler, J. (1984). Fashion alienation: Older adults and the mass media. *International journal of Aging and Human Development, 19*(3), 203-221.

Kallal, M. J., Keiser, S., MacDonald, N., & Mullet, K. (1999). *Apparel design for the active & ageless consumer.* International Textile and Apparel Association.

Karlsson, I. C., & Rosenblad, E. F. (1998). Evaluating functional clothing in climatic chamber tests versus field tests: A comparison of quantitative and qualitative methods in product development. *Ergonomics, 41,* 1399-1420.

Kärrholm, M., Dahlman, S., & Rosenblad-Wallin, E. (1977). Hygiene and clothing problems for elderly people. *Journal of Consumer Studies and Home Economics, 1,* 73-85.

Kaulio, M. A. (1998). Customer, consumer and user involvement in product

development: A framework and a review of selected methods. *Total Quality Management, 9,* 141-149.

Khan, S., Roper, L., & Rogers, M. (1993). Older adults: clothing preferences for thermal comfort in cold weather. *Journal of Consumer Studies and Home Economics, 17,* 187-195.

King, A. C., Taylor, C. B. & Haskell, W. L. (1993). Effects of differing intensities and formats of 12 months of exercise training on psychological outcomes in older adults. *Health Psychology, 12,* 292-300.

Kirkel, R. (1997, May/June). Apparel and aging women—an unmet market. *Aging Today,* 13.

Kratz, G., Soderback, I., Guidetti, S., Hultling, C., Rykatkin, T., & Soderstrom, M. (1997). Wheelchair users' experience of non-adapted and adapted clothes during sailing, quad rugby or wheel-walking. *Disability and Rehabilitation: An International Multidisciplinary Journal, 19*(1), 26-34.

Lee, J., & Hanna, S. D. (1997). Apparel expenditure patterns of elderly consumers: A life-cycle consumption model. *Family and Consumer Sciences Research Journal, 26,* 109-140.

Li, Y. (2001). The science of clothing comfort. *Monographs of the Textile Progress of the Textile Institute, 31*(1, Serial No. 2).

Li, Y., Keighly, J. H., & Hampton, I. F. G. (1988). Physiological responses and psychological sensations in wearer trials with knitted sportswear. *Ergonomics, 31,* 1709-1721.

Lord, S. R., Ward, J. A., Williams, P., & Strudwick, M. (1995). The effect of a 12-month exercise trial on balance, strength, and falls in older women: a randomized controlled trial. *Journal of the American Geriatrics Society, 43,* 1198-1206.

Maguire, J., & Mansfield, L. (1998). No-body's perfect: Women, aerobics, and the body beautiful. *Sociology of Sport Journal, 15,* 109-137.

Maher, P. M., & Sontag, M. S. (1986). *Insulative clothing for older women functioning at reduced household temperatures* (Tech. Rep. No. 471). Michigan, United States: Michigan State University, Agriculture Experiment Station East Lansing.

Malcolm, S., Armstrong, R., Michaliades, M., & Green, R. (2000). A thermal assessment of army wet weather jackets. *International Journal of Industrial Ergonomics, 26,* 417-424.

Markee, N. L., Carey, I., & Pedersen, E. (1990). Body cathexis and clothed body cathexis: Is there a difference? *Perceptual and Motor Skills, 70,* 1239-1244.

Martin, K.A., Leary, M.R., & Rejeski, W.J. (2000). Self-presentational concerns in older adults: Implications for health and well-being. *Basic and Applied Social Psychology, 22,* 169-179.

Martin, R. (1985). All-American: A sportswear tradition. In Fashion Institute of Technology (Eds.), *All-American: A sportswear tradition* (pp. 8-33). New York: Fashion Institute of Technology.

Mercer, S. O., & Garner, J. D. (1989). An international overview of aged women. In S.

O. Mercer, & J. D. Garner (Eds.), *Women as they age* (pp. 13-45). New York: The Haworth Press.

Molloy, D. W., Beerschoten, D. D., Borrie, M. J., Crilly, R. G., & Cape, R. D. T. (1988). Acute effects of exercise on neuropsychological function of elderly subjects. *Journal of the American Geriatrics Society, 36,* 29-33.

Moore, C., & Bracegirdle, H. (1994). The effects of a short-term, low-intensity exercise programme on the psychological wellbeing of community-dwelling elderly women. *British Journal of Occupational Therapy, 57,* 213-216.

Morganosky, M., & Creekmore, A. M. (1981). Clothing influence in adolescent leadership roles. *Home Economics Research Journal, 9,* 356-362.

National Advisory Council on Aging. (1999). *1999 and beyond: Challenges of an aging Canadian society.* Ottawa: Services Canada.

Neal, E. G., Schwenk, F. N., & Courtless, J. C. (1990). Apparel expenditures of older consumers. *Family Economics Review, 3*(4), 12-17.

Paillard, M. & Nowak, K. B. (1985). Use exercise to help older adults. *Journal of Gerontological Nursing, 11*(7), 36-39.

Pankratz, S. L. (1995). *Predicting mature female consumers' perceived health and importance of product attributes with selected indicators of mechanistic change.* Unpublished master's thesis, University of Manitoba, Winnipeg, Manitoba, Canada.

Picken, M. B. (1957). *The fashion dictionary.* New York: Funk & Wagnalls Company.

Poole, M. (2001). Fit for life: Older women's commitment to exercise. *Journal of*

Aging and Physical Activity, 9, 300-312.

Powitz, R. W., & Balsamo, J. J. (1999). Measuring thermal comfort. *Journal of Environmental Health, 62,* 37-38.

Pyka, G., Lindenberger, E., Charette, S., & Marcus, R. (1994). Muscle strength and fiber adaptations to a year-long resistance training program in elderly men and women. *Journal of Gerontology A: Biological Science and Medical Science, 49,* M22-M27.

Richards, M. L. (1981). The clothing preferences and problems of elderly female consumers. *The Gerontologist, 21,* 263-267.

Rikli, R., & Busch, S. (1986). Motor performance of women as a function of age and physical activity level. *Journal of Gerontology, 41,* 645-649.

Robins, C. (1999, March 22). When the price, and the fit, are right. *Daily Camera,* 8C.

Rosenblad-Wallin, E. (1985). User-oriented product development applied to functional clothing design. *Applied Ergonomics, 16*(4), 279-287.

Rosenblad-Wallin, E. (1988). The design and evaluation of military footwear based upon the concept of healthy feet and user requirement studies. *Ergonomics, 31,* 1245-1263.

Rosenblad-Wallin, E., & Karlsson, M. (1986). Clothing for the elderly at home and in nursing homes. *Journal of Consumer Studies and Home Economics, 10,* 343-356.

Rosenblad-Wallin, E., & Kärrholm, M. (1987). Environmental mappings as a basis for

the formulation of clothing demands. *Applied Ergonomics, 18,* 103-110.

Rubin, R. M., & Nieswiadomy, M. (1994). Expenditure patterns of retired and nonretired persons. *Monthly Labor Review, 117*(4), 10-12.

Shaw, J. M., & Snow, C. M. (1998). Weighted vest exercise improves indices of fall risk in older women. *Journal of Gerontology A: Biological Science and Medical Science, 53,* M53-M58.

Sinden, A. R., Martin Ginis, K. A., & Angove, J. (2003). Older women's reactions to revealing and nonrevealing exercise attire. *Journal of Aging and Physical Activity, 11,* 445-458.

Slater, K. (1985). *Human comfort.* USA: Thomas Sprinfield.

Solomon, M. R., & Douglas, S. P. (1985). The female clotheshorse: From aesthetics to tactics. In M. R. Solomon (Ed.), *The psychology of fashion,* 387-401. Lexington, Massachusetts: Lexington Books.

Sperling, L., & Karlsson, M. (1989). Clothing fasteners for long-term-care patients: Evaluation of standard closures and prototypes on test garments. *Applied Ergonomics, 20,* 97-104.

Statistics Canada. (1999). *A portrait of seniors in Canada.* Ottawa: Statistics Canada.

Statistics Canada. (2000). *Population by sex and age.* Retrieved June 20, 2001, from http:// www.statcan.ca/english/Pgdb/People/Population/demo10a.htm

Statistics Canada. (2002). *Age Groups (12) and Sex (3) for Population, for Canada, Provinces and Territories, 1921 to 2001 Censuses - 100% Data.* Ottawa: Statistics Canada, July 16,2002. 2001 Census of Canada. Catalogue number

97F0003XCB01002.

Statistics Canada. (2003a). *Detailed Highest Level of Schooling (20), Age Groups (13B) and Sex (3) for Population 15 Years and Over, for Canada, Provinces, Territories, Census Metropolitan Areas and Census Agglomerations, 2001 Census - 20% Sample Data.* Ottawa: Statistics Canada, March 11, 2003. 2001 Census of Canada. Catalogue number 97F0017XCB01001.

Statistics Canada. (2003b) *Household Income Groups (22) in Constant (2000) Dollars and Household Type (11) for Private Households, for Canada, Provinces, Territories, Census Metropolitan Areas and Census Agglomerations, 1995 and 2000 - 20% Sample Data.* Ottawa: Statistics Canada, May 13, 2003. 2001 Census of Canada. Catalogue number 97F0020XCB01005.

Tarkata, B. A. (1996). Relationship among body-self relations, exercise involvement, and exercise clothing attitude for women in regular exercise programs (Doctoral dissertation, Virginia Polytechnic Institute and State University, 1996). *Dissertation Abstracts International, 56*(10-B), 5841.

Tate, S. L. (1999). *Inside fashion design* (4th ed.). New York: Longman.

Textile Protection and Comfort Center. (n.d.). *Vertical wicking test.* Retrieved July 12, 2003, from North Carolina State University, College of Textiles, Textile Protection and Comfort Center Web site: http://www.tx.ncsu.edu/tpacc/comfort/vertical_wicking.html

Thoren, M. (1996). Systems approach to clothing for disabled user: Why is it difficult for disabled users to find suitable clothing. *Applied Ergonomics, 27*, 389-396.

Ting, A. J. (1991). Running and the older athlete. *Clinics in Sports Medicine, 10,* 319-325.

Touliatos, J., & Compton, N. H. (1988). *Research methods in human ecology/home economics.* Ames: Iowa State University Press.

Traphagan, J. W. (1998). Reasons for gateball participation among older Japanese. *Journal of Cross Cultural Gerontology, 13,* 159-175.

Vogue Patterns. (1999, March/April). *Sandra Betzina introduces today's fit.* pp. 934-39.

Vierck, E. (1990). *Fact book on aging.* California: ABC-CLIO, Inc.

Watkins, S. M. (1995). *Clothing: The portable environment* (2nd ed.). Ames: Iowa State University Press.

Weiland, B. (1990, November). Colors with confidence. *Sew News,* 66-71.

Williamson, R. (1999, February 24). Targeting the mature consumer with fashion. *Women's Wear Daily,* 16-17.

Wolfe, M. G. (1998). *The world of fashion merchandising.* Illinois: Goodheart Willcox.

Woodson, E. M., & Horridge, P. E. (1990). Apparel sizing as it relates to women age sixty-five plus. *Clothing and Textiles Research Journal, 8*(4), 7-13.

Yang, Y. W. (1996). Income elasticities for clothing expenditures: A comparison among different occupational groups. *Consumer Interests Annual, 42,* 447-452.

Zimmer, Z., & Chappell, N. L. (1996). Distinguishing the spending preferences of seniors. *Canadian Journal on Aging, 15,* 65-83.

APPENDIX A

Announcement to Recruit Research Participants

Developing Active Sportswear for Older Women

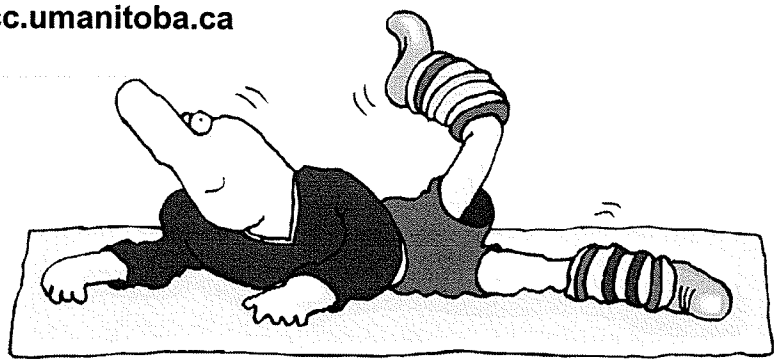
I am a graduate student in the Department of Clothing and Textiles at the University of Manitoba. For my Master's thesis, I am investigating older women's desired attributes in active sportswear. Prototypes of active sportswear will be developed based on those attributes. I am seeking volunteers to participate in the research. If you have the following characteristics, I sincerely invite your participation.

- Women 55 and older
- Regularly attend the aerobic classes at this fitness center
- Continue to enroll in the same class until March 2003
- In good health and living independently
- Residents of the city of Winnipeg Height is between 61 and 66 inches, bust is between 35 and 40 inches, waist is between 31 and 35 inches, and hip is between 37 and 42 inches

If you are interested and would like more information, please feel free to contact me, Haiyan.

Email: **umzhan16@cc.umanitoba.ca**

Phone: **474-9914**



APPENDIX B

Consent Form

UNIVERSITY
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Faculty of Human Ecology

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Developing Active Sportswear for Women 55 Years or Older

Consent Form

Thank you for participating in Haiyan Zhang's research on active sportswear development for active women 55 years or older. Your participation involves:

- A one-hour interview at your home to collect information on your preferences for active sportswear and general information about you, the type of exercise that you do, and the clothing you current wear for exercise.
- A two-hour group interview at your fitness centre to decide on design features for the prototype. At a later date, the group will meet to select the final design for the prototype.
- When the prototypes are delivered, with your consent, photos of you clothed in the prototypes will be taken from front, back, and side views. The photos will be taken from the neck down so that your face will not show.
- A three-week wear test, in which you will be asked to wear each of the two prototypes to your exercise class at least three times. After each time you wear the prototype for an exercise class, you will record your wear test experience in a diary and rate comfort sensation on two scales.
- A post-wear-test interview at your home, in which you will be asked some questions about your overall reaction to the test sportswear and the extent to which it satisfies your initial requirement. It will take about one and a half hours.

All the interviews will be tape-recorded with your approval. If you do not want the interview to be taped, I will take notes of the interviews instead. I may show the photos when I present the research findings in a public forum. Similarly, the

photos could be included in manuscripts for publication. If you decline to be photographed, your eligibility to participate in this research will not be affected whatsoever. At the end of the research, you are welcome to keep the two prototypes if you wish. You will also receive a summary of the research results.

Your participation is very important to the success of the research. However, it is strictly voluntary. You can withdraw at any time; and you have the right to refuse to answer any questions that you feel uncomfortable. All the information that you provide will be kept confidential, and can only be identified through your preassigned code. The tape-recording will be destroyed at the completion of the project. Minimal risks may exist because you have to do exercise during the interview. Since it is in your normal exercise class, there is no specific risk associated with this research.

After reading the information stated above, if you agree to participate in this research, please sign your name below.

_____	_____
Participant Signature	Date
_____	_____
Haiyan Zhang, B.Sc.	Lena Horne, Ph. D. (Thesis Advisor)

APPENDIX C

Individual Interview Schedule for User Demand

INSTRUCTIONS:

Thank you for your participation in my research. This morning/afternoon, I will ask you a number of questions related to the kind of exercise you do, the clothing you currently wear to exercise, your preferences for active sportswear, and your exercise setting. If you do not feel comfortable with any question, you can skip it. In the end, I will ask you to fill out a questionnaire which tells me some demographic information about you.

The interview will take about one hour. I will be taping the interview so I can listen to your answers carefully later. Do you mind if I tape our interview? I would like to assure you that your name will not appear in any reports of this research. My advisor and I will be the only persons who have access to the information you give. Your response can only be identified through your participant code. I will be happy to answer any questions you may have about the research project at the end of the interview.

Date: _____
Participant Number: _____

QUESTIONS FOR INDIVIDUAL INTERVIEW

1. *Please indicate your level of agreement with the following statements by checking under the one that best describes your opinion:*

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
I go to exercise classes primarily to make friends	_____	_____	_____	_____	_____
I go to exercise classes primarily to stay healthy	_____	_____	_____	_____	_____

2. *According to the following scale (show the scale below), could you please tell me how hard or light your exercise is? (Please check on the proper number)*

6	
7	Very, very light
8	
9	Very light
10	
11	Fairly light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Very, very hard
20	

3. Can you show me the clothing that you most often wear to exercise?

4. According to this scale (show the following scale), could you please tell me how satisfied you are with your current exercise clothing? (Please check on the number that best describes the degree of your satisfaction with it.)

    1 Very dissatisfied
    2 Dissatisfied
    3 Neither satisfied or dissatisfied
    4 Satisfied
    5 Very satisfied

5. What is it about the current exercise clothing that you find satisfactory or dissatisfactory?

6. Now, I would like you to tell me what you would expect from the active sportswear that I am going to design for you.

Participant Number: _____

DEMOGRAPHIC INFORMATION

Instructions:

Check only ONE answer for each of the following questions unless otherwise indicated. If you select "other", please specify your answer right after the colon.

1) What is your age category?

   a. 55-60
   b. 61-65
   c. 66-70
   d. 71-75
   e. 76-80
   f. 81-89
   g. 90 or older

2) What is your marital status?
   a. Single, never married
   b. Married
   c. Divorced/Separated
   d. Widowed
   e. Other:

3) What is your educational attainment?
   a. Did not graduate from high school
   b. High school graduate
   c. Some college, technical training, or vocational school after high school
   d. Bachelor's degree or higher
   e. Other:

4) What is your employment status?
   a. Full-time
   b. Part-time
   c. Retired
   d. Other:

5) Which category best describes your gross (before taxes) household income for 2001?
   a. Under $9,999
   b. $10,000-$19,999
   c. $20,000-$29,999
   d. $30,000-$39,999
   e. $40,000-$49,999
   f. $50,000 and above

6) Which answer best describes your health and physical limitations?
   a. I consider myself in excellent health with no physical limitations
   b. I am in good health with only minor physical limitations
   c. I am in average health for my age, with some physical limitations
   d. I have several health limitations, but keep active
   e. I have physical limitations that require me to limit my daily activities.

7) What is the maximum price that you would pay for active sportswear?
   a. $10.00-$19.99
   b. $20.00-$29.99
   c. $30.00-$39.99
   d. $40.00-$49.99
   e. $50.00 or more
   f. Other:

Instructions:

Please write down your answer to the following question:

What is (was) your occupation?

_____

APPENDIX D

Group Interview Schedule

Group Interview Schedule

INSTRUCTIONS:

Thank you for coming to the second stage of my research. In the first interview, each of you told me what you would like to be included in active sportswear. I have analyzed your answers and come up with a list of product attributes. Today, I would like you to work as a group to decide on the most important attributes. I have determined to make a top for you. Therefore, when you answer the following questions, please consider the top only. Take as much time as you need. As before, if you do not feel comfortable with any question, you can skip it. Your names will not be revealed to anyone.

Now, each of you has a list of attributes in front of you. For each attribute, I have provided examples. You may need to read carefully the examples to help you better understand it.

1. Can you pick out 10 attributes that you think are essential to an exercise top?

   (Now, look at the 10 attributes that you just picked out)

2. Can you rank the 10 essential attributes according to their importance? Please write the number 1 beside the one that is most important to you, and so on.

That completes today's questions. Thank you all for the time and cooperation. Our next meeting will be one month from now when I finish the design sketches. Do you have any questions for me?

Ranking Sheet 1

Rank	Attributes
_____	Ease of dressing
_____	Self-esteem
_____	Convenience design
_____	Thermal comfort
_____	State of mind
_____	Ease of movement
_____	Weight of fabric
_____	Novelty
_____	Fabric performance
_____	Ease of care & maintenance
_____	Embellishment
_____	Modesty
_____	Fit
_____	Fashion/Stylish
_____	Covers imperfections
_____	Pressure on the body
_____	Appearance & body image
_____	Age appropriateness
_____	Calls attention
_____	Keeps me dry
_____	Friction against the body
_____	Shows my status
_____	Durability

Ranking Sheet 2

Rank	Attributes
_____	Self-esteem
_____	Ease of movement
_____	Weight of fabric
_____	Novelty
_____	Friction against the body
_____	Shows my status
_____	Ease of care & maintenance
_____	Embellishment
_____	Thermal comfort
_____	State of mind
_____	Fabric performance
_____	Modesty
_____	Fit
_____	Fashion/Stylish
_____	Covers imperfections
_____	Pressure on the body
_____	Durability
_____	Appearance & body image
_____	Ease of dressing
_____	Age appropriateness
_____	Calls attention
_____	Keeps me dry
_____	Convenience design

Example Sheet of Functional and Symbolic Values

Age appropriateness:
Does not look like a 20-yr-old
Looks similar to other people of my age

Appearance& body image:
Well shaped
Looks slim & fit
Flatters or suits an older woman's figure
Looks good or attractive
Looks as nice as young women

Calls attention:
Impresses others
Does not conform to what others are wearing
Nice to stand and show off

Convenience design:
Keeps keys in the garment
Puts Kleenex

Covers imperfections:
Covers age spots or varicose veins
Covers floppy arms/stomach
Perspiration does not show on the garment

Durability:
Long wearing: not fragile
The garment holds its shape

Ease of care & maintenance:
Machine washable and dryable
Washes easily: no need to wash separately
Easy to care and keep: no special care/no iron
Dries quickly

Ease of dressing:
Easy-to-open closure/pullover
Easy to put on & take off

Ease of movement:
Easy to move arms
Doesn't bind around the neck
Allows maximum movement
Give

Embellishment:
Cheerful design & color or two-tone
Easy-to-match color
Trims: bindings around the cuff or neck

Fabric performance:
Shrink proof
Color fast: no color transfer

Fashion/Stylish:
Have some style
Same fashion as compared to young people
Not out of date easily
Fashion that suits me

Fit:
Fits nicely
Fits arms comfortably

Friction against the body:
Does not cut into the body
Moves with the body
Does not itch or tickle the skin

Keeps me dry:
Absorbs moisture
Quick evaporation of perspiration
Breathable

Modesty:
Not revealing or see through
Does not look like undergarments
Cover up more
Looks decent: not shabby
Not funny looking

Novelty:
A little special looking/not plain or bored
Looks different

Pressure on the body:
Supports the body
Holds the body nicely

Self-esteem:
I feel good about myself
I feel I look nice
Motivates me to work better or harder
Looks professional
Shows that I am hard working

Shows my status:
Properly communicates my socio-economic status: not too high class or high tone

State of mind:
I feel good in it
I feel excited about exercising
I feel presentable

Thermal comfort:
Doesn't feel cold on the skin
Feels comfortable in hot weather
Dissipates heat

Weight of fabric:
Light/medium/heavy weight
Light in summer & heavy in winter

APPENDIX E

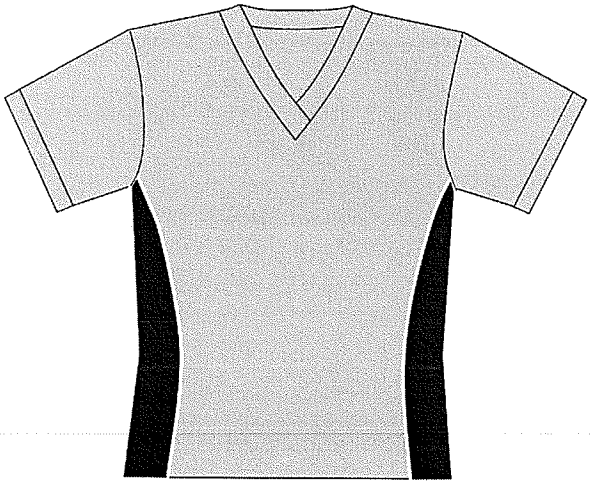
Design Sketches

Sketch 1

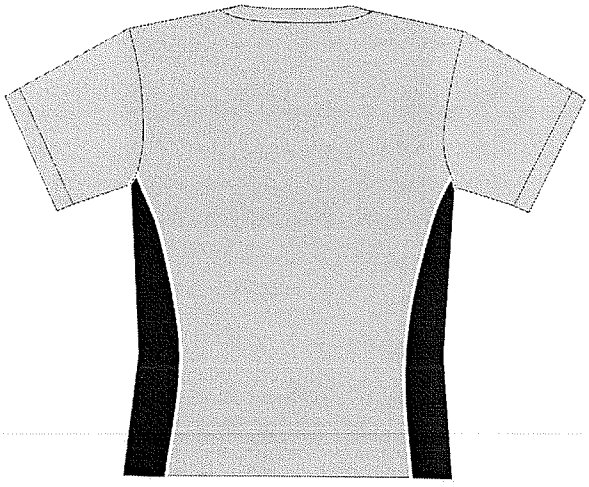
Front View

Back View

Sketch 2



Front View



Back View

APPENDIX F

Characteristics of Selected Fabrics

Characteristics of Selected Fabrics for Textile Tests

Name	Fibre Content	Lin. Weight	Width	Characteristics
Fabric A	100% Polyester	8 oz	60"	- Kwik Wik finish to enhance the moisture absorbing - Built-in deodorant Ultra-Fresh finish
Fabric B	100% Polyester	8.1 oz	60"	- Moisture wicking structure - Built-in deodorant Ultra-Fresh finish
Fabric C	100% Polyester	8.1 oz	60"	- Kwik Wik finish to enhance the moisture absorbing - Built-in deodorant Ultra-Fresh finish
Fabric D	100% Polyester	8 oz	60"	- Kwik Wik finish to enhance the moisture absorbing - Built-in deodorant Ultra-Fresh finish
Fabric E	100% Polyester	8 oz	60"	- Wicking finish
Fabric F	90% Cotton 10% Lycra	12 oz	60"	

APPENDIX G

Fabric Testing Results

1 -- Testing Results of Air Permeability, Colorfastness, Vertical Wicking I, and Stretch Recovery

Tests		Fabrics									
		A	B		C		D		E		F	
Air Permeability	$Cm^3/cm^2.S^{-1}$.	307.4	224		220		257.6		247.4		21.2	
Colorfastness to Washing	Shade Change	5	4-5		4-5		5		4-5		4-5	
	Stain/Wool	5	5		5		5		5		5	
	Stain/Acrylic	5	5		5		5		5		5	
	Stain/Polyester	5	5		5		5		4-5		5	
	Stain/Nylon	4-5	5		5		4-5		4		4-5	
	Stain/Cotton	5	5		5		5		5		5	
	Stain/Acetate	3	5		5		2-3		3-4		5	
Vertical Wicking I	Fabric Direction		↑	↔	↑	↔	↑	↔	↑	↔	↑	↔
	(cm/15min)		10.9	9.6	9.8	10.5	7.5	6.9	9.4	8	4.5	7.0
Stretch Recovery	Fabric Direction	↔	↔		↔		↔		↔		↔	↑
	Stretch (%)	98.8	103.4		87.4		115		112.6		161	117.4
	Growth (%)	6.0	8.6		6.8		13.2		10.6		17.6	12.2

2 -- Testing Results of Vertical Wicking II and Pilling Resistance

Tests	**Time (Minutes)**	**Fabric A**		**Fabric C**		**Fabric D**		**Fabric F**	
Vertical Wicking II		↑	↔	↑	↔	↑	↔		
	1	4.57	4.07	4.23	4.2	3.87	3.97		
	5	8.1	6.93	7.4	7.03	6.3	6.13		
	10	10.37	8.83	9.17	8.77	7.8	7.43		
Pilling Resistance	10	1.5		4		3		5	
	30	1		3.5		1		5	

APPENDIX H

Fitting Records from Pilot Tests

Fitting Test Records (N = 17)

Participant	Original Size	Fit Size	Length	Neck	Sleeve	Chest	Back	Bust	Waist	Shoulder	Piping
01	HF22.5	HF18.5	✓	✓	✓	- 1.5cm	- 1.5cm	✓	- 2.5cm	- 1.5cm	4cm bust
05	J9-MT10	MT10	✓	✓	✓	- 1cm	- 1cm	✓	✓	- 2cm	4cm bust
16	M14	MT10	✓	✓	- 4cm Hem	- 0.5cm	- 0.5cm	- 2.5cm	-2.5cm	- 0.5cm	4cm bust
11	MT10	MT10	✓	✓	✓	- 1.25cm	- 1.25cm	✓	✓	- 1.5cm	4.5cm bust
08	MT12-M14	MT10	✓	✓	- 5cm Hem	- 0.5cm	- 0.5cm	✓	✓	✓	4cm bust
14	M14	MT10	+2.5cm	✓	✓	- 0.5cm	- 1cm	✓	✓	- 1.5cm	5cm bust
09	M12-M14	MT10	✓	✓	✓	- 2.5cm	- 2.5cm	✓	✓	- 2.5cm	4.5cm bust
*20	JP9-M14	MT10	✓	✓	✓	- 2cm	- 2cm	- 3cm	- 3cm	-2cm	4.5cm bust
*19	MP18	M16	✓	✓	✓	- 1.5cm	- 1.5cm	✓	✓	- 2cm	4.5cm bust
03	M16	M16	+2.5~4cm	✓	✓	- 1.5cm	- 1.5cm	✓	✓	- 2cm	5cm bust
18	MP18	M16	✓	✓	✓	-0.5cm	-1cm	✓	✓	-1cm	3.5~4cm
07	M16	M14	+4cm	✓	✓	✓	✓	✓	✓	- 05~1cm	4.5cm bust
04	M16	M14	+4cm	✓	✓	✓	✓	✓	✓	✓	4cm bust
*15	MP14-M14	M14	✓	✓	✓	- 1cm	- 1cm	✓	✓	- 2cm	5cm bust
02	W34-MP18	M14	+2.5cm	✓	✓	- 0.5cm	- 0.5cm	✓	✓	✓	4cm bust
12	MT10	MT10→ MT10B	✓	✓	- 4cm Hem	- 1cm	- 1cm	- 6cm	- 6cm	- 1cm	5cm bust
06	HF18.5	M16→ M16B	✓	✓	✓	- 0.5/1cm	- 0.5/1cm	✓	✓	- 1.5cm	4.5cm bust

*: Participants who attended the pilot tests but dropped out from the research afterwards.

APPENDIX I

Wear Test Booklet

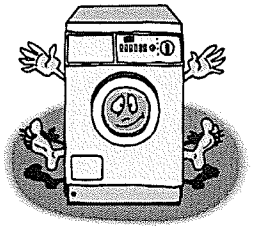
Wear Test Instructions

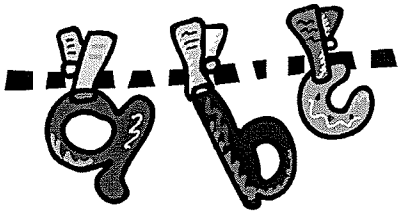
- Maximum duration of the wear test is 2 weeks.
- Please wear the garment in your **aerobic** class at least **3 times** and wash it 3 times over the two weeks.
- Please record your wear and laundry experience in the diary after each wear and wash.
- Once the garment has been worn and washed for 3 times, please call me as soon as possible to arrange a post wear test interview.

Meanwhile, if you have any question, please feel free to call me at 269-7847. Thank you for your support to my research!

Laundry and Care Instructions

- Turn garment **inside out**; machine wash in **cool** water
- **No chlorine bleach**
- Tumble **dry at low temperature**
- Wash and dry **with like colors**
- Iron if needed at low temperature





WEAR TEST DIARY

(Please record your experience in the diary after each wear and wash)

Participant: # _____ Date: _____

Duration of Wear:

_____

Wear Experience:

_____

_____

_____

_____

_____

Next Page →

Laundry/Care:

_____

_____

_____

_____

Comments:

_____

_____

_____

APPENDIX J

Interview Schedule of the Post Wear Test

POST WEAR TEST INTERVIEW

Participant # _____
Date: _____

INSTRUCTIONS:

Many thanks for your consistent support of my research. Since you have worn the garment at least 3 times during the past two weeks, I would like to know your response to it.

The interview will take about one hour. As before, you do not have to answer any question that you feel uncomfortable. To help me listen to your response carefully later, I am going to tape the interview. Do you mind? (If not, turn on the tape recorder.)

Now, please put on the prototype first.

These are the essential attribute statements about active sportswear that came from the focus group meeting. (Give the satisfaction scale sheet to the participant.) Please think about how well the prototype satisfies each of them while you are looking at them.

- Can you please indicate your level of agreement with each attribute statement by checking only one level in each row?

I will be asking you to respond to a number of questions related to your wear and laundry experience. If you would like to refer to your diary to refresh your memory, by all means do so.

- Can you please tell me which of the following description best represents how warm or cold you felt when you wore the prototype in your aerobic class? *(Show the participant the thermal comfort scale sheet.)*

(Next, show the comfort sensation scale to the participant.)

- For each descriptor in the left, can you check a sensation level that most accurately expresses your sensation when wearing the prototype to do aerobics? *(Explain the meaning of the five-scale levels to the participant.)*

- Do you have any comment on the laundry and care of the prototype?

- Is there anything else that you want to tell me about the prototype?

- How satisfied are you with the prototype in general according to this scale? *(Show the following scale to the participant)*

    1) Very dissatisfied
    2) Dissatisfied
    3) Satisfied
    4) Very satisfied

- What is it about the prototype that you find satisfactory or dissatisfactory in addition to those covered in the attribute list?

- Do you have any question about my research?

- Do you have any suggestion to future research on this topic?

This is the end of your participation in this research. Thank you very much for your constant support and cooperation during the entire research procedure. I hope you find it interesting.

APPENDIX K

Post Wear Test Interview – Satisfaction Scale

Please rate how well the prototype satisfies each attribute in the list based on the following scale. Check (✓) <u>ONLY ONE</u> in each row.

Attributes	Strongly Agree 4	Agree 3	Disagree 2	Strongly Disagree 1
I move easily when wearing it.	____	____	____	____
It is easy to wash and care for.	____	____	____	____
It fits me well.	____	____	____	____
It looks good on me.	____	____	____	____
It does not cut into my body.	____	____	____	____
It is easy to put on and take off.	____	____	____	____
It covers parts of my body which I am not satisfied with.	____	____	____	____
Perspiration does not show when I exercise in it.	____	____	____	____
The color does not run when I wash it.	____	____	____	____
It does not shrink.	____	____	____	____
It would last for a reasonable length of time.	____	____	____	____
It is decent-looking.	____	____	____	____
It is not revealing.	____	____	____	____
It does not feel too warm or cold.	____	____	____	____

APPENDIX L

Post Wear Test Interview – Thermal Comfort Scale

Please check (✓) <u>ONLY ONE</u> description that best represents your response when you wore the prototype for exercise:

When I wore the prototype for exercise, I felt:	
1	So cold I was helpless
2	Numb with cold
3	Very cold
4	Cold
5	Uncomfortably cold
6	Cool but fairly comfortable
7	Comfortable
8	Warm but fairly comfortable
9	Uncomfortably warm
10	Hot
11	Very hot
12	Almost as hot as I could stand
13	So hot I was sick and nauseated

APPENDIX M

Post Wear Test Interview – Comfort Sensation Scale

For each of the descriptors in the left column, please check (✓) in each row <u>ONLY ONE CELL</u> that most accurately expresses your sensation when doing aerobics in the prototype:

Descriptors	**No Sensation**	**Partially**	**Mildly**	**Definitely**	**Totally**
Snug	_____	_____	_____	_____	_____
Loose	_____	_____	_____	_____	_____
Heavy	_____	_____	_____	_____	_____
Lightweight	_____	_____	_____	_____	_____
Soft	_____	_____	_____	_____	_____
Stiff	_____	_____	_____	_____	_____
Staticky	_____	_____	_____	_____	_____
Non-absorbent	_____	_____	_____	_____	_____
Clammy	_____	_____	_____	_____	_____
Damp	_____	_____	_____	_____	_____
Clingy	_____	_____	_____	_____	_____
Sultry	_____	_____	_____	_____	_____
Prickly	_____	_____	_____	_____	_____
Rough	_____	_____	_____	_____	_____
Scratchy	_____	_____	_____	_____	_____
Itchy	_____	_____	_____	_____	_____

APPENDIX N

Mean Weighted Points of Values

Functional Values	Mean Weighted Points ± SD		Symbolic Values	Mean Weighted Points ± SD	
	Dropouts	Remainders		Dropouts	Remainders
Ease of Movement	6.7 ± 3.7	7.9 ± 2.6	Self-esteem	4.0 ± 4.7	0.4 ± 1.1
Weight of Fabric	0.7 ± 1.6	1.2 ± 2.2	Novelty	0.2 ± 0.4	0.5 ± 1.0
Friction against the Body	3.3 ± 4.5	3.8 ± 4.0	Shows My Status	0 ± 0	0 ± 0
Ease of Care & Maintenance	5.2 ± 2.9	6.3 ± 3.2	Embellishment	0 ± 0	0.5 ± 1.9
Thermal Comfort	1.7 ± 2.9	2.3 ± 3.2	State of Mind	0.3 ± 0.8	1.5 ± 2.5
Fabric Performance	3.2 ± 4.1	2.9 ± 2.7	Modesty	2.5 ± 3.3	2.1 ± 3.0
Fit	6.8 ± 2.2	5.6 ± 4.2	Fashion & Stylish	2.2 ± 3.4	1.6 ± 2.9
Pressure on the Body	1.3 ± 2.2	1.5 ± 3.1	Covers Imperfections	5.2 ± 4.2	2.4 ± 3.3
Durability	3.3 ± 2.4	1.9 ± 2.7	Appearance & Body Image	2.2 ± 3.4	4.8 ± 4.1
Ease of Dressing	3.3 ± 3.3	3.5 ± 3.4	Age Appropriateness	0.5 ± 1.2	1.8 ± 2.3
Keeps Me Dry	2.3 ± 3.5	1.5 ± 2.0	Calls Attention	0 ± 0	0 ± 0
Convenience Design	0.2 ± 0.4	0.9 ± 1.5	Sum of Symbolic Values	17 ± 9.9	15.6 ± 7.2
Sum of Functional Values	38 ± 9.9	39.3 ± 7.2			

APPENDIX O

Essential Value Ranking of Dropouts and Remainders

Essential Value Ranking

Dropouts (N = 6)	Remainders (N = 14)	All Participants (N = 20)
1. Fit	1. Ease of Movement	1. Ease of Movement
1. Ease of Movement	2. Ease of Care/Maintenance	2. Ease of Care/Maintenance
2. Ease of Care/Maintenance	3. Fit	Fit
Covers Imperfections	4. Appearance/Body Image	3. Appearance/Body Image
3. Self-esteem	5. Friction against the Body	4. Friction against the Body
4. Friction against the Body	6. Ease of Dressing	5. Ease of Dressing
Durability	7. Fabric Performance	6. Covers Imperfections
Ease of Dressing	8. Covers Imperfections	7. Fabric Performance
5. Fabric Performance	9. Thermal Comfort	8. Durability
6. Modesty	10. Modesty	9. Modesty
7. Keeps Me Dry	11. Durability	10. Thermal Comfort