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Assessment of protection attributes of sustainable functional apparel prototype developed using CAD for female fishmongers in Aba, Nigeria

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Abstract

The study focused on the Assessment of the Protection Attributes of Functional Apparel Prototype developed using CAD for female fishmongers in Aba, Nigeria. The purpose of the study was to determine the acceptability of the prototype by different size categories. Specifically, the study determined the mean ratings of fishmongers on the protection attributes of the developed prototype; determine the mean ratings of judges on the protection attributes of the developed prototype; and to compare the mean ratings of female fishmongers and judges on the developed prototype. Three research questions and two hypotheses guided the study. The study area was Aba, Nigeria. The Research design employed was descriptive survey. The population was 438 fishmongers and 109 respondents that served as judges. A multi-stage technique was adopted at different stages of data collection. The sample size was 209 for fishmongers, and 85 for judges. Two sets of instruments were used for data collection. Descriptive statistics like frequency, percentages, mean and standard deviation were used to analyse research questions while t-test was used to test the hypotheses at .05 level of significance. The findings revealed that the female fishmongers and judges scored the functional apparel very good with mean above 3.00 on all the protection attributes. There was no significant difference in the mean ratings of fishmongers and judges on small, medium and large sized based users on protection attributes of the functional apparel prototype. It was concluded that the developed apparel prototype protected the regular apparel of female fishmongers from ice and blood spill from the fish. It was therefore recommended among others that CAD should be used by lecturers and apparel designers in developing work wear.

KEYWORDS: PROTECTION, ATTRIBUTES, SUSTAINABLE, FUNCTIONAL, APPAREL, PROTOTYPE, CAD, FISHMONGERS.

Introduction

The apparel industry is developing rapidly and attracts great opportunities and challenges to textiles and clothing enterprises. Over the last 20 years, most industries have seen a transition from traditional product development that was local, face to face and sequential to one that is more global, more virtual and more concurrent (Eppinger and Chitkara, 2006). Therefore, fashion industries are faced with the challenge of product development using modern equipment and at the same time making it a sustainable fashion.

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Sustainable fashion refers to clothing that is designed, manufactured, distributed and used in ways that are environmentally friendly (Dreamer, 2019). This means that fashion has to embrace modern industrial techniques and focus toward visualizing people, individual people, interacting with their garments in way that are healthy and meaningful. Sustainable fashion should address the emotional, expressive, and physical qualities that garments can provide for consumers, meeting needs and desires, the resulting satisfaction leads to greater use and a longer functioning cycle (Hethorn, 2009). It involves diminishing environmental well-being through waste and pollution and improve it through lowering carbon emissions and improving bio-friendly practices in garment and fashion we create. Riyajain, (2021) sees sustainable fashion as a fashion concept that is friendly for the environment and society at large. The concept also includes the complete process of bringing that particular item to its rightful owner in a manner that does not harm the environment or people making them and everything that is a part of the chain in apparel production.

Apparel production that used to be a manual process from a designer producing a concept sketch to drafting the patterns by hand and then to final construction of a sample garment has now graduated to a digital process. Digital process involves the use of extensive Computer Aided Design (CAD) tools to create a standard set of patterns for different apparel design. In line with the above statement, Fixson and Marion, (2012) noted that modern day new product development in terms of efficiency, allow designs to be repeated and transmitted quickly, thereby saving time and cost before product launch, which is essential in the apparel industry. Therefore, information and digitalization are inevitable for their development through the use of Computer Aided Design (CAD).

Computer Aided Design is the use of computer technology for the process of design and design documentation (Palak, 2014). It also involves the use of specialized programs to create designs and design components on the computer. Computer Aided Design (CAD) is also known as Computer Aided Drafting which describes the process of drafting with a computer. Computer Aided Design (CAD) system consists of information technology hardware, a specialized software depending on the particular area of application and peripherals which in certain applications are quite specialized (Bilalis, 2000). The core CAD system is the software which makes use of graphics for product representation, database for storing the product models and deriving the peripherals for product presentation. It also provides the users with input tools for the purpose of streamlining design, drafting, documentation and manufacturing processes (Yaw, 2013). Its users do not change the nature of the design process but as the name implies, it aids the product designer. The designer is the main actor in the implementation phase. The first applications of Computer Aided Design (CAD) were 2D drafting applications, while now most of them are 3D solid and parametric representation of the real parts.

There are different types of Fashion designing software like the Bernina My Label 3D fashion pattern software, Edraw-Fashion Design software, Digital Fashion Pro, Cameo V5 Apparel Software, Etelestia Pattern making, Fashion designing and sewing software, Designer Pro Apparel Edition, Fashion Start App, Fashion toolbox, Fashionable studies for Mac, Dress assistant and Optitex (Esper, 2012). According to Abecasis-Moedas (2006) in Santos (2014), Computer Aided Design (CAD) allows the designer to create a design on the screen, store, retrieve and adapt images, patterns and colours as desired and the completed design is shown on the screen. It also allows for design models to be worked on and updated to current fashion.

Recently, Computer Aided Design (CAD) software has improved to the extent that there are tools for simulating the construction of a virtual prototype, implementing the 2D pattern data and cloth animation algorithms to construct the sample garment on a virtual 3D model. This advanced to Computer Aided Design (CAD) technology that has more visual apparel design and analysis, from concept to prototype.

Prototype in apparel is the first design of an apparel product from which other forms can be copied. Glock and Kunz, (2000) asserts that it is cut and sewn from the first pattern obtained for the product to assess the styling and fit. Engineering a prototype involves the creation of physical products to respond to customer needs (Illrich and Eppinger, 2004). It embraces sequential activities and tasks which translate customer needs into product design. Apparel design has progressed to the stage of offering 3D virtual simulations. This simulation typically requires the designer to specify 2D pattern piece locations in relation to the body like the front, back, right and left and at the same time identify and match seams that are sewn together during construction. The 2D patterns are then placed on a 3D model and a simulation of the assembly and drape results in a virtual prototype.

Virtual prototyping is using virtual reality to create product prototypes and their properties. It is carried out with a computer. Virtual Prototyping is a technique in the process of product development. It contains Computer-Aided Design (CAD) and Computer-Aided Engineering (CAE) software to validate a design before committing to making a physical prototype (Puri, 2013). It is carried out by creating (usually 3D) computer generated geometrical shapes and either combining them into an assembly or testing different automated motions. Virtual prototyping permit designers to gauge and enhance product performance virtually. With simulations associated to requirements, designers can ensure that their end product meets defined requirements. 3D can reduce the prototyping cost as designers can now decide whether or not to take a product to the market. It helps to reduce the cost of rejecting a style in terms of material, labour and time (Puri, 2013). The virtual prototype can be closely examined with many variations in perspective and rotation of the 3D model allowed (Stewart, 2008). Virtual prototyping has the ability to enhance sample approval process considerably with initial pattern construction and fit problems identified and corrected on the digital flat pattern before any fabric is cut. Azar, 2012 spelt out some examples of virtual tools such as Bernina My Label 3D fashion pattern software, Modaris 3D Fit by Lectra, Vidya by Assyst, V-stitcher by Browzwear, PDS version 10, Tuka 3D by Tukatech, 3D CAD system staprim from Russia and Assol 3D CAD being equipped with all these functions can be employed in the design of functional apparel to meet the needs of the persons in diversified occupations.

Functional Apparel is defined as user-requirement specific and designed or engineered to meet the performance requirement of the user under extreme conditions (Guptaa, 2011). The apparel serves as a protection for the wearer from hazardous environments. Challenges associated with handling of tools, skin irritation, water/ice splash on body/cloths; blood spills on body and clothes demand protection and safety functions in apparel design. The protection is achieved by blocking the penetration and permeation of the substance through the fabrics in clothing (ATIRA,2022).

In addition to the functionality aspect of apparel, all functional apparel must fulfil certain requirements which are common to all users. Work profile of the user must serves as protection for the wearer from environmental conditions as well as work or task-related conditions that expose the wearer to certain risk in operation (Barker, 2007). Fishmongers require better work clothing against environmental hazards at the same time the clothing has to meet the requirement of functional clothing which include mobility, fit, comfort, protection/safety, utilitarian, aesthetic and expressive attributes.

Fishmongers are people that prepare and sell fish products, iced or un-iced to members of the public. They have a deep understanding of the fish species, preparation methods and detailed product knowledge (Crown, 2016). In the context of this study, fishmongers are people that sell iced or frozen fish only. Studies carried out by Adebayo and Pitman (2017) revealed that the major marketers of frozen fish are women, therefore attention should be given to their role while discharging their duties in diversified mediums. Women have been reported to play a vital role in processing and marketing fish (Olufayo, 2012 in Cloffe and Akinrotimi, 2015). These women are trained in selecting and purchasing, handling, gutting, cutting, filleting, displaying, merchandizing and selling their product. Some operate in shops, markets and streets.

This group of people handle cold fish with their bare hands which may affect their cold tolerance based on factors like body-size, body-shape, subcutaneous fat, physical fitness, age, gender, smoking habits, previous cold injury, drugs and alcohol (Chernyshov, 2000). The nature of their occupation attracts constant touch with water or ice. In the process of discharging their duties, fish blood and ice splash on their garments which may affect their health in one way or another. Most importantly, the appropriate way to take protective measures against cold and liquid spills exposure, outdoor as well as indoor is by choosing the appropriate clothing (Holmer, 2005).

It has been observed that female fish mongers in Abia State market do not wear appropriate protective clothing when discharging their duties. This has led to many of them smelling as a result of fish blood spills on their garments. It has also been observed that what they wear to market do not grant them adequate mobility needed for the occupation thereby leading to inefficiency in task delivery. In addition, do not protect them from the effect of the water/ blood spillage while discharging their duties.

Inappropriate a reduction in dexterity to fishmongers (FAO, 2017). While ensuring good thermal protection, clothing should not be too thick, too stiff or too heavy. Clothing should also not be too tight in order not to hinder internal air circulation or prevent blood circulation. Clothing for such occupation requires water repellent apparel that prevents the passage of liquid through the clothing layer. Careful development of protective apparel guarantees good comfort and performance during cold exposure and increases the physical work load energy expenditure (Kirsi et al., 2010).

Furthermore, research works like the development of functional apparel for cosmetologists in Lagos, Nigeria (Thompson, 2010) and the development of functional laboratory coat for clothing and textile students in tertiary institutions in the south-east zone of Nigeria (Ugwu, 2010) have been carried out in Nigeria on the development of prototype for functional apparel using diversified process model but employing other techniques of pattern drafting without giving required attention to Computer Aided Design (CAD) techniques as the world is embracing innovative technologies in solving apparel design issues. Based on this gap, this study was tailored towards closing this gap by using Computer Aided Design (CAD) software to develop a prototype for female fishmongers in Abia State. After the production of the work apparel, the fit was evaluated by experts such as Clothing and Textiles lecturers, functional apparel producers and the users.

Objectives of the Study

The purpose of the study was to determine the acceptability of the prototype by different size categories. Specifically, the study:

1. determined the mean ratings of fishmongers on the protection attributes of the developed prototype.
2. determined the mean ratings of judges on the protection attributes of the developed prototype.
3. compared the mean ratings of female fishmongers and judges on the developed prototype.

Research Questions

1. What are the mean ratings of fishmongers on the protection attributes of the developed prototype?
2. What are the mean ratings of judges on the protection attributes of the developed prototype?
3. What are the difference in the mean ratings of female fishmongers and judges on the developed prototype?

Hypotheses

The following hypotheses were tested at the 0.05 level of significance:

HO_1: There is no significant difference in the mean ratings of female fishmongers on small, medium and large size-based users on protective attribute required of functional apparel.

HO_2: There is no significant difference in the mean ratings of judges on small, medium and large size-based users on protective attribute required of functional apparel.

HO_3: There is no significant difference in the mean ratings of female fishmongers and judges on small, medium and large size-based users on protective attribute required of functional apparel.

Methodology

Research Design

This work was a research and development study and employed the research and development design by Gall, Gall and Borg (2010). In addition to the design process, descriptive survey design was adopted for the study as a technique for obtaining data from respondents through the use of questionnaire. Osuala (2005) opined that descriptive survey designs is the design appropriate for collection of data based on the opinion of the respondents.

Area of the study

The study was carried out in Abia State in South-East Nigeria. Abia State is selected for the study because the senatorial districts are business oriented. Also, markets where women sell iced fish are located in the different Local Government Areas. The major city in Abia State is Aba where fabrics and tailoring material business flourish and this aided the researcher in sourcing materials for the development of functional apparel for fishmongers. Aba is also noted for its large garment production business.

Population for the Study

The population was 438 fishmongers and 109 respondents that served as judges. The judges were seven respondents from fishmongers excos, 24 Home Economics lecturers and 68 functional apparel producers.

Sample and Sampling Technique

The sample size for female fishmongers was 209 and this group was used to obtain mean body measurements for the development of the pattern in phase 1 of the study. The sample size of the judges that evaluated the fit of the developed prototype was eight five (85). The ratio of eight five was statistically determined in line with the sample size of each strata using Bowley's proportionate allocation formula in Pandey and Verma (2008).

A multi-stage technique was adopted at different stages of sample selection in order to meet the different research interests and needs of the female fishmonger population for the study.

The sample size was determined statistically using Taro Yamane (1967) in Rafael (2014) formula. Uzoagulu (2011) testified that sample computed statistically is more reliable and tolerable than determining the sample by mere approximation.

Instruments for Data Collection

Two different instruments were used for data collection in the study.

a. Functional Apparel Design Assessment Instrument for Fishmonger (FADAF)
b. Functional Apparel Design Assessment Instrument for Judges (FADAJ)

This section of the instruments was presented on a 5-point semantic differential scale where "5" indicates excellent, "4" indicates very good, "3" good, "2" indicates bad, and "1" very bad. Each of the evaluation was carried out at a single session to minimize differences in fit due to anthropometric changes and other factors in the study participants. The FADAF instrument helped to achieve objective one as it created enabling situations for the female fishmongers to express how the work apparel fits them on the attribute of protection.

Functional Apparel Design Assessment Instrument for Judges (FADAJ)

The instrument gave the researcher information on how the Home Economics Lecturers, Functional apparel producer and female fishmonger exco officials evaluated the fit of the work apparel on protection attribute.

Validation of the Instruments

The instrument of the study was subjected to face validation by five experts, three from Home Economics Department, University of Uyo, two from Department of Home Science, Michael Okpara University of Agriculture, Umudike. They were given the purpose of the study, the research questions and the hypotheses. These experts were asked to review the items in the instrument for clarity, relevance, appropriateness of language and expressions including appropriateness of the instructions to the respondents. Modifications were made to accommodate the suggestions made by the experts. These instruments are standardized instruments adapted from Fowler (2003) and Barker (2007).

Reliability of the Evaluative Instruments (FADAF/FADAJ/)

An instrument is reliable to the extent that it measures consistently (Siegle, 2013). The Evaluative Instruments were pilot-tested on six models and 20 judges before conducting the main study, and reliability values were obtained for the two groups of evaluators. Three female fishmongers were chosen specifically as models from a group of fishmongers who fit into the prototype functional apparel sizes of small, medium and large designed for the preliminary testing procedures. The models wore the prototype apparel, performed a movement test and completed a wearer acceptability questionnaire. The instrument was divided into different sections comprising demographics and safety/protection attribute. These models rated the functional prototype apparel after wearing the apparel to carry out certain movements. The judges in turn scored the protection attributes and general performance of the functional apparel on the three size-based models, small, medium and large. Data obtained were used to determine the internal consistency of the instruments. The reliability was established using Cronbach coefficient alpha to determine the reliability coefficient. The reliability coefficients were .892 and .834. For research purpose a minimum reliability of .70 is required for the instrument (Siegle, 2013). Based on these criteria the instrument is reliable as the attribute protection has coefficient values above .70.

Development Procedures

The produces for the development of the female fishmonger's apparel were incorporated in three phases. Procedures for phase 1 involved needs assessment of female fishmongers;

determination of design criteria based on specification; generation of creative ideas for the work apparel and selection of final design idea. For phase III, procedures involved idea sketch, development of specification sheet, developing the prototype patterns using Bernina My Label Software by adjusting the measurement of the three-quarter coat in the software drawer to match the mean body measurements of female fishmongers and construction of the prototype apparel in three size categories of small, medium and large.

Fig 1: Bernina My Label Software

Fig 2: Three Quarter Coat in Bernina Drawer

Fig 3: Female Fishmonger Wearing the Developed Protective Apparel on Business

Wear test which involved auxiliary field test of prototype revision of the prototype to correct deficiencies observed and construction of new sets of apparel procedures; for phase III of the study involved evaluation of the protective attribute by users' models and three groups of judges using FADAF and FADAJ instruments. The research assistants, female fishmongers, model and judges were given instructions prior to the collection of data for the study.

The rating of the functional apparel on each of the models was done by the judges. A set of copies of the FADAJ instrument was given to each of the judges for scoring the protective quality of the apparel on the models representing, small, medium and large size category. The copies of the questionnaire were returned at the closure of the exercise. The responses from the judges for each female fishmonger were gathered and the average score was used for the analysis.

Each of the nine models was given the FADAF instruments to go through before completing it. The movement assessment interview was conducted by the researcher for the models. After each movement, subjects rated themselves on a 5-point Likert scale to determine how easy or difficult it is to perform the movements wearing the functional apparel product. After the interview session, subjects were allowed adequate time to rate the functional apparel product on protection attribute in a laboratory setting. The subjects were given the apparel to perform task in a field setting and to rate the prototype apparel function and performance on the parameters outlined for evaluation.

Method of Data Analysis

Descriptive statistics of frequencies, mean and standard deviation were used to answer the research questions. t-test was used to test hypothesis three while analysis of variance (ANOVA) was used to test hypotheses one and two at 0.05 level of significance.

The mean values of both female fishmongers and judges were determined on the 5-point Likert and semantic differential scales. A mean value of 2.50 and above was considered satisfactory. Mean scores on any variables <2.50; was considered unsatisfactory Scoring range: 4.50–5.00 = Excellent, 4.49–3.50 = Very good, 3.49–2.50 = Good, Bad 2.49–1.50 = Very bad, 1.49–.50 = Very bad.

Results

Table 1 reveals that seven adjective sets were used to measure protection variable of the functional apparel on a 5-point semantic differential scale where "1" was associated with a very bad attribute and "5" was associated with an excellent attribute. The bipolar adjective sets included "easy to move in/hard to move in", "portable/not portable", "safe/unsafe", "provide protection/lack of protection", "lightweight/heavyweight", "sturdy/not sturdy", "functional/non-functional". Bad scores were tallied from ratings of 1.0 to 2.49 while good scores were tallied from ratings 2 .50 to 5.0. Table 1 further displays the mean and standard deviations on each adjective set. All of the adjective sets were rated good showing that the design met the parameter of protection. Items one and two displayed the means above 4.00 while means of other items fall within acceptable range above 3.00. The mean cluster was 3.93 which reveal that the functional apparel meets the parameter of protection.

Table 1: Mean Rating of female fishmongers on protection attribute of functional apparel *n* = 200

S/N	Items	X̄	*SD*	Remark
1	Easy to move in/hard to move in	4.33	.590	Very good
2	Portable/ not portable	4.26	.724	Very good
3	Safe/not safe	3.72	.634	Very good
4	Provide protection/lack of protection	3.85	.602	Very good
5	Lightweight/ heavy weight	3.67	.701	Very good
6	Sturdy/ not study	4.00	.763	Very good
7	Functional/ not functional	3.66	.734	Very good
	Cluster mean	**3.93**	**.68**	**Very good**

Table 2 shows the mean ratings of judges on the protection/safety function of the prototype apparel. The Table further reveals that protection/safety variables were measured by judges by rating seven bipolar adjective sets on a 5-point semantic differential scale. From the mean and standard deviation values further presented in Table 2, it shows that all of the adjective sets were scored very good by the judges. Three items were excellently scored and the scores ranges from 4.55 to 4.58, 5 items were scored very good with values ranging from 4.17–4.36. The high positive scores recorded by judges indicate that the functional apparel product adequately satisfied the protection/safety function of the functional apparel.

Table 2: Mean rating of judges on protection attributes of functional apparel *n* = 85

S/N	Items	X̄	*SD*	Remark
1	Easy to move in/Hard Move to in	4.58	.740	Excellent
2	Portable/Not Portable	4.56	.661	Excellent
3	Safe/Unsafe	4.34	.665	Very good
4	Provide protection/Lack of Protection	4.36	.458	Very good
5	Lightweight/Heavyweight	4.55	.591	Excellent
6	Sturdy/Not Sturdy	4.26	.863	Excellent
7	Functional/Non-functional	4.17	.812	Excellent
	Cluster mean	4.00	.68	Very good

Data in Table 3 shows a higher positive rating for judges than female fishmongers on the variables on safety/protection. All of the variables displayed have values greater than 4.00 for judges and greater than 3.50 for female fishmongers. All the two groups of evaluators indicated that the functional apparel was “easy to move in”, “provide protection” and “provides adequate functionality”.

Table 3: Differences in the mean rating of fishmongers and judge's protection of functional apparel $n_1 = 9$, $n_2 = 85$

S/N	Items	X_1	SD	X_2	SD	MD ($x_1 - x_2$)	Remark
1	Easy to move in	4.33	.590	4.58	.740	-0.25	
2	Portable	4.26	.724	4.56	.661	-0.3	
3	Safe	3.72	.634	4.34	.665	-0.62	
4	Provide protection	3.85	.602	4.36	.458	-0.51	
5	Lightweight	3.67	.701	4.55	.591	-0.88	
6	Sturdy	4.00	.763	4.26	.863	-0.26	
7	Functional	3.66	.734	4.17	.812	-0.51	
	Cluster Mean Div.					-0.48	MD*

Note: MD = Minor difference

The result represented in Table 4 shows the summary of one-way analyses of the difference in the mean ratings of fishmongers on small, medium and large size-based users on protection/safety required of functional apparel. The result shows in all the items there were no significant difference. On the whole, since the P-significant value of .501 is greater than .05, the null hypothesis which stated that there is no significant difference in the mean ratings of fishmongers on small, medium and large size-based users on parameter required of functional apparel is therefore accepted.

Table 4: One-way analysis of variance of difference in the mean ratings of fishmongers on small, medium and large size-based users on protection required of functional apparel

S/N	Item	Source of Variation	Sum of Squares	df	Mean Square	F	P-Sig.	Decision
1	Easy to move in	Between Groups	.603	2	.302	.101	.961	NS
		Within Groups	6.226	6	1.038			
		Total		8				
2	Portable	Between Groups	.770	2	.385	.010	.239	NS
		Within Groups	5.226	6	.871			
		Total	6.829	8				
3	Safe	Between Groups	1.001	2	.501	.102	.211	NS
		Within Groups	4.221	6	.704			
		Total	5.222	8				
4	Provide protection	Between Groups	1.000	2	.500	.620	.102	NS
		Within Groups	8.001	6	1.336			
		Total	9.001	8				
5	Lightweight	Between Groups	.906	2	.457	.067	.982	NS
		Within Groups	7.231	6	1.205			
		Total	8.137	8				
6	Sturdy	Between Groups	1.016	2	.508	.010	.349	NS
		Within Groups	5.623	6	.937			
		Total		8				
7	Functional	Between Groups	1.018	2	.509	.010	.660	NS
		Within Groups	6.921	6	1.154			
		Total	7.047	8				
	Cluster value					**.131**	**.501**	**NS**

The result represented in Table 5 shows the summary of one-way analyses of the difference in the mean ratings of judges on small, medium and large size-based users on protection/safety required of functional apparel. The result shows that there were no significant in all the variables as the P values were greater than .05. On the whole, since the P-significant value of .297 is greater than .05 alpha, the null hypothesis which stated that there is no significant difference in the mean ratings of judges on small, medium and large size-based users on parameter required of functional apparel is therefore accepted.

Table 5: One-way analysis of variance of difference in the mean ratings of judges on small, medium and large size-based users on protection/Safety required of functional apparel

S/N	Item	Source of Variation	Sum of Squares	df	Mean Square	F	P-Sig.	Decision
1	Easy to move in	Between Groups	2.341	2	1.171	.341	.606	NS
		Within Groups	91.343	82	1.114			
		Total	93.684	84				
2	Portable	Between Groups	1.422	2	.711	.424	.303	NS
		Within Groups	96.261	82	1.174			
		Total	97.683	84				
3	Safe	Between Groups	.942	2	.471	.462	.533	NS
		Within Groups	89.211	82	1.088			
		Total	90.152	84				
4	Provide protection	Between Groups	.861	2	.431	.068	.224	NS
		Within Groups	85.781	82	1.046			
		Total	86.642	84				
5	Lightweight	Between Groups	.637	2	.319	.090	.169	NS
		Within Groups	86.429	82	1.054			
		Total	87.066	84				
6	Sturdy	Between Groups	.606	2	.303	.012	.144	NS
		Within Groups	87.602	82				
		Total	88.208	84				
7	Functional	Between Groups	1.001	2	.501	.301	.703	NS
		Within Groups	86.711	82	1.057			
		Total	87.712	84				
	Cluster value					**.242**	**.297**	**NS**

Table 6: t-test analysis of the difference between the mean responses of fishmongers and judges on how apparel fits when protection/safety Fishmongers (n_1 = 9), Judges (n_2 = 85)

S/N	Items	Fishmongers (1)		Judges (2)		t-cal	*p* -sig.	Decision
		Mean	*SD*	Mean	*SD*			
1	Easy to move in	4.33	.590	4.58	.740	.581	.784	NS
2	Portable	4.26	.724	4.56	.661	.222	.742	NS
3	Safe	3.72	.634	4.34	.665	.555	.805	NS
4	Provide protection	3.85	.602	4.36	.458	.634	.921	NS
5	Lightweight	3.67	.701	4.55	.591	.284	.811	NS
6	Sturdy	4.00	.763	4.26	.863	.612	.926	NS
7	Functional	3.66	.734	4.17	.812	.457	.925	NS
	Mean value	**3.93**	**.68**	**4.00**	**.68**	**.435**	**.748**	**NS**

This hypothesis sought to compare the mean ratings of the two groups of respondents on the protection components of the functional apparel. t-tests were run to compare the total protection ratings for functional apparel by female fishmongers and judges. In all the seven items on the protection rating scale, there were no significant differences found. This implies that the P values of the seven variables were greater than .05. The null hypothesis was therefore accepted in all the items. Therefore, the null hypothesis of there is no significant difference between the mean ratings of female fishmongers and judges on small, medium and large size-based users on parameters required of functional apparel is retained.

Discussion of Findings

The protection variables were positively rated with scores ranging from 3.66–4.33 for the three sets of female fishmongers and 4.17–4.58 for judges. In all the seven variables tested, there were no significant differences found all the variables (P>.05). Furthermore, there was no significant difference between the mean ratings of female fishmongers and judges. This shows that the design was successful. It further denotes that the functional apparel design was perceived to be protective, functional and was well constructed. This finding agrees with Fowler's (2003) findings with police officers' ballistic clothing which was perceived to be functionally protective. Since the variable "protection" received the lowest positive score indicating that the mean is not on the negative side of the scale. The findings are also in line with assertion of Kirsi et al., (2010) on the effect of cold protective clothing on and perception of performance that careful development of protective apparel guarantees good comfort and performance during cold exposure and increases the physical work load energy expenditure. The protective apparel developed for the fishmongers was able to prevent liquid, ice and fish blood from penetrating into the fibre of the work wear. This goes to support the findings Jeol (2007) in Tanko and Anigbogu, (2012) that protective devices are designed to interpose an effective barrier between object and environment. Tanko and Anigbogu (2012) supported this fact by stating that protective apparel should ensure adequate protection from the hazards to which the workers will be exposed.

Conclusion

It is therefore concluded that Computer Aided Design can be employed in developing functional apparel for female fishmongers. Irrespective of the design of the work wear it must meet the functional requirement of the job and must be able to protect the user from hazardous environment. The three-quarter coat developed for female fishmongers was able to protect their inner garment from the spill of fish water and blood as the fabric repels liquid.

It is also paramount that the material selection has to be breathable, permeable and at same time possess the characteristics of repelling liquid. The fabric chosen for the fishmongers work wear met these characteristics as the apparel was able to protect their inner garment from smelling. Therefore, in using any software in developing functional apparel, it is very paramount to look for one that meets the design criteria in its collection. In the case of this study Bernina My Label was chosen because the design criteria accepted by fishmongers was found in their drawer collections.

Recommendations

1. Since many of the subjects, both from the female fishmonger and judge populations, expressed satisfaction with the functional apparel attributes, there is need to make available the findings of the study to Clothing and Textiles lecturers and students in high institutions and fishmonger's organisations in order to create awareness about current research in the functional apparel workforce.
2. Home Economics lecturers and students should utilize the software to approach design problems in Clothing, Textiles, and Interior Design/Decoration aspects of the Home Economics programme.
3. Knowledge and skills are vital to resolving issues in functional apparel research, therefore practical illustrations and awareness must be created for the understanding of apparel design concepts in developing occupational clothing for diverse groups.

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