Study on the Comfort of 3 Local Hijab Sport Brand on Muslim Woman during Physical Activities

A Baharudin¹², A H A Hafidz¹, N M Roslan¹, I N Zahir¹, N A Norjeferi¹, A Musa¹, M R Ahmad²

¹Universiti Teknologi MARA (UiTM), 72000 Kuala Pilah, Negeri Sembilan, Malaysia.
²Faculty of Applied Sciences, University Teknologi MARA (UiTM), 40450 Shah Alam, Selangor, Malaysia.

*Corresponding Author: azninbahar@yahoo.com

Abstract. This study goals are to identify the most comfortable sport hijab from 3 local brands. The selection of the sport hijab from the brand are identify through a preliminary survey distributed to 90 students from Faculty of Sport Science UiTM Negeri Sembilan. From the survey, types of sport hijab and the length of sport hijab are identified. The purchased sport hijab is then gone through the fabric identification and testing included weighing, burning test and water impact penetration test. The fabric for the sport hijab labelled as Sample A is Nylon, Sample B as Polyester and Sample C as Acrylic. Among this, it is found that Sample B gives the best comfort according to all 3 selected respondent who wear the sport hijab in the physical test activities. The physical test activities are done by the 3 participants running on a treadmill for 20 minutes at 7.5km/h with warming up and warming down at 2.5km/h for 2 minutes. The results obtained from the comfort evaluation were then analyzed using Analysis of Variance (ANOVA).

1. Introduction

Sport is one of the areas where wearing a hijab can pose a range of practical challenges. These challenges can be linked to the potential physical limitations of modest clothing that might restrict movement or be uncomfortable to wear during strenuous physical exercise. Hijab in sport have taken a lot of toll, athlete dropping from competitions like Noor Abukaram, 16, have been banned from participating a running event in Ohio for district level in 2019 [1]. Kalsoom Abdullah, a weightlifter for American Open tournament, 2011[2], just because they are wearing hijab and refuses to take it off to participate the game. This situation might link to the understanding of Islam and there has been no test done on hijab and confirmed that it is safe to be worn during the game [3]. In recent years, the clothing industry has increasingly responded to Muslim women’s desire to find practical solutions that address the difficulties associated with wearing a hijab during physical exercise. This has, for example, led to the development of the sports hijab [4]. When working on the design of hijab sportswear, producers took on board the concerns competing athletes face when wearing a hijab, examining the ways these affected their performance. For instance, Nike produce The Pro Hijab that stretches to adapt to the wearer’s head, and its cut is optimised for sports [5].

Every woman who has worked out in a hijab has gone through the unpleasant experience of the material sticking to their necks, the endless flapping around and the ugly sweat stains. Our everyday
chiffon, cotton or viscose hijabs make us look and feel amazing on other occasions. But when it comes to breaking out a sweat, these mentioned materials are not suitable. Thus, a proper fabric selection for sport hijab is needed. In a fabric the structure and its thickness can influence the heat and moisture transfer and hence thermal comfort [6]. This is because fabric structure and thickness affect the air and moisture air permeability, which play a significant role in heat and moisture transfer [7] which every active sports female need to wear hijab that has a wicking property to ensure that they will not be fainted when doing activities due to ineffective of heat transfer.

In ensuring the comfort of the hijab during a sport activity, a simple test can be done to imitate the actual high performance sport activities like running, cycling, sports games and marathon, by increasing a body core temperature by 1.5°C – 2.0°C where a thermophysical comfort can be measure as the high metabolic system in our body able to generate heat of approximately 800 – 1300W [8]. In this study, a preliminary survey is given out to 90 Muslim women who actively do sport to identify the best style of sport hijab worn by the athletes. Then a test is done with 3 local sport hijab brands to identify the style and the material used suitable for sport hijab in Malaysia.

2. Methodology

2.1 Methods Flowchart

Figure 1 shows the summary of the process flowchart done in the study.

![Figure 1: Process flowchart](image-url)
2.2 Survey
Sports Science program students from Universiti Teknologi MARA, Negeri Sembilan are the focal point in this study because the study needs to have an avid sports person or a person who do sports on daily basis. Aside from that the second most important criteria in respondent is that they are all Muslim. Hence, this study is done by distributing a preliminary survey to 90 students from sport science background. The questions are about general knowledge, perception and the properties of the sports hijab that are usually worn to do sports activities. Textile terms are explained to the participants to give conscious on the questions given. The objective of the preliminary survey is to identify the preferences of the athlete or a person who regularly do sport and wear sport hijab, their styles of wearing the hijab and material choose for the sport hijab. This in the end will help the selection of buying readymade sport hijab from the market.

2.3 Fabric Identification and Testing
In this section the Samples of sport hijab fabric need to be identified. There are three ways of identifying the materials according to the American Society for Testing and Materials (ASTM) which are Burning Test, Solubility Test (ASTM D276-12) and Water Impact Penetration Test (AATCC 42-2007). In burning test, a strip of fabric from all of the sample will be burns and the behaviour of the burning are monitored. How the fabric ignitions, the residues either it leaves a grey ash (natural fibres) or a black beaded (Man-Made Fibres), afterglow and the smells of the burning samples. As for the solubility test, a chart from ASTM is follow. This chart will characterize the chemical that able to soluble the fabric material.

The water impact penetration is conducted by mounting tautly the sample, face-up on an angled surface. A pre-weighed sheet of blotter paper is mounted behind the specimen. A volume of water is sprayed against the face of the specimen then the blotter paper is then re-weighed to determine water penetration. The increase in mass of the blotter paper indicates the mass of water that passed through the test specimen. Lower test results indicate less penetration and better water repellency or resistance of the fabric.

Hence by conducting the fabric identification and test, types of fabric used in the sport hijab either it is man-made fibres, natural fibres or blended of both will influence the comfort of the sport hijab. This include the wicking properties, thermoregulatory, sweat management and tactile of the fabric surface [9]. Measuring fabric thickness of the sports hijab samples are also done in the fabric testing.

2.4 Physical Test wearing Samples A, B, and C
A comfort wear tests was conducted to evaluate the comfort based on the sensory of the human body. Referring to figure 2 and figure 3 different sports hijab samples are bought from 3 different brands which are labelled as Sample A, Sample B and Sample C. The samples are given to 3 participants and they are required to sweat under a controlled environment and activity. The activity is done on a treadmill in a gym with the set surrounding temperature of 28℃. Participants are required to warm up by walking at the speed of 2.5 km/h for 2 minutes, then they are required to jog in 20 minutes at increased speed of 7.5 km/h. Lastly, cooling off are done by walking at the speed of 2.5 km/h for 2 minutes. The evaluations are done in a form of Likert-survey where the participants rate the scale of satisfaction from 1-10 based on the properties that are focused such as wicking, perspiration, breathability, and the hand of the sports hijab sample. The result from the survey is collected and analysed by using Analysis of Variance (ANOVA) under SPSS software.
3. Result and Discussion.

3.1. Evaluating General Information
Based on the survey answered by 90 respondents, all the female respondents do sports in daily bases. Figure 3 shows that majority of the respondent (93.3%) wears hijab during sports activities.

![Figure 3: Percentage of respondents who wears hijab during sport activity](image)

Since the respondents are from Science Sports program the respondents are active in sports, time of playing sport in hours per day also influenced by the respondents which different courses have different time playing sport in hours. As refer to a graph of figure 4, most of the respondents spent time on performing sports activities for 2 hours per day. As the sport hijab worn should always maintained it comfort, not sticking onto the neck, good thermal transfer and have a proper wicking property, 2 hours of sport activities will give the best impression of comfort while wearing hijab during sports.
Through the preliminary survey, three findings are emphasized. Based on the survey distributed, it is found that design influences the selection of sports hijab. As shown in Figure 5, as much as 70% from the total respondents prefer the hijab with awning. This is due to women personality that wanted to look nice in most of the time. So, the hijab with awning is beautifully shaped when it is worn and maintained its shape throughout the activities.

In addition, based on the figure 6, it shows that 66.7% of the participants preferred to tied-at-the-back when wearing “bawal” and “shawl” as for their sport hijab style specifically while performing sport activities. Meanwhile, instant hijab with 66.7% preferred to let-off their sport hijab. This is because it will not hinder the movement of the respondents when performing sport activities compared to the other styling in hijab. Nevertheless, different people have different preferences of comfort on choosing styling of hijab. Figure A, B and C shows the preferred styling based on the survey. The length of the hijab also

![Figure 4: Sports durations according to courses in Sports Science Programs.](image)

![Figure 5: Percentages of preferred hijab features for sport hijab.](image)
influences the movement of the participants when doing sport activities. As refer to figure 7, shows that majority of the participants with 73% preferred medium length of hijab. The long hijab with 40cm length covering the chest area and shoulder area. This makes it difficult for the respondent who wears the hijab during sports to raise their hand in an impulse for example playing badminton or receiving a ball in a netball game. As for the short hijab which is 15cm length does not properly covers the respondent chest. In a study, a physical comfort also plays an important role to influence a person to feels comfortable [10]. Thus, the most suitable length of hijab when doing sports is medium length which is at 30cm.

![Figure 6: Percentage of preferred hijab styling for sport hijab.](image)

![Figure 7: Example of variety of hijab length and the pie chart of respondent selection on the hijab length for sport hijab.](image)
3.2. Fabric Identification and Testing.

3.2.1. Fibre Identification. Table 1 shows the thickness of the fabric samples from the local brand sport hijabs. From the table, Sample B has the thickest value with the thickness of 0.44 in millimeters (mm) compared with the other two samples. The standard that was used to measure thickness was ISO 534. In the recent studies discuss the higher is the thickness, increases the resistance of heat transfer and moisture due to presence of a large amount of excess air in between the fabric structure compared to the fibre content [11]. Hence it can be said that Sample B with the highest thickness, means that the sport hijab able to retain heat and most suitable to be use in the set temperature of 28°C. Nevertheless, the comfort does not rely solely on the thickness, as it also depends on the material used and the design of the sport hijab.

| Sample | Thickness (mm) |
|--------|----------------|
| A      | 0.36           |
| B      | 0.44           |
| C      | 0.39           |

On the other hand, burning test results can be seen in table 2. It shows the types of material for each sample consists of nylon, polyester and acrylic. Based on the theoretical of the burning test, nylon fabric supposedly has smells like plastic when burnt and produce a celery-like smell. Meanwhile, the polyester smells slightly sweet and a combination of smell with a chemical odour. The acrylic burns with a strong flame and smells like acid and have smell of a chemical odour. Hence, the burning test results of the three samples is accurately have similarities with the theoretical from the aspect of its material characteristics. Fibre identification was checked according to the standard method of AATCC Test Method 20A.

From the burning test result, it is confirmed that all the samples are man-made fibres. Man-made fibres (MMF) today are the best selection for sport attire especially for sport hijab. Among the material used are from polyester and nylon. Though acrylic is also MMF, but the development of acrylic is to imitate wools [12]. Acrylics have an exceptionally good drapability, but some of the material if it is made into a garment, it will show or stick to the body silhouette. Where else, polyester and nylon fabric have a similar property as light in weight, versatile when wet and dry, have good stretchiness and moisture wicking properties. Therefore, it can be forecasted based on the material finding, Sample A and Sample B might have a better comfort compared to Sample C.

| Sample | Types of Material | Explanations.                  |
|--------|-------------------|--------------------------------|
| A      | Nylon             | Burns slowly with melting drip in flame. |
|        |                   | Smells like celery.              |
|        |                   | The residue was hard, tough, grey, and tan bead. |
| B      | Polyester         | Burns slowly, continues to melt and drip. |
|        |                   | It has a chemical odour.         |
|        |                   | The residue is hard, tough, tan bead. |
| C      | Acrylic           | Burns rapidly with hot flame, sputtering, drips, melts. |
|        |                   | Smells like acid.                |

Table 3 shows the result of water impact penetration test. This can be seen that Sample C has the heavier weight of water contained in blotting paper which is 2.349 g. As in this test, from the table 3, it shows that the highest percentage of water that penetrate the fabric sample to the blotting paper is
weighed with 59.11% for the Sample C. The results show that both Sample A and B have a water repellence behaviour.

| Sample | Weight of blotting paper before testing (g) | Weight of blotting paper after testing (g) | Weight water (g) | Percentage of water (%) |
|--------|--------------------------------------------|-------------------------------------------|-----------------|------------------------|
| A      | 2.364                                      | 2.562                                     | 0.198           | 8.37                   |
| B      | 2.022                                      | 2.420                                     | 0.398           | 19.68                  |
| C      | 2.282                                      | 3.631                                     | 2.349           | 59.11                  |

3.3. Evaluating Comfort from the Outdoor test.

3.3.1. Evaluation on the Comfort. After outdoor test is done, the results from the survey are collected and analysed using Analysis of Variance (ANOVA). The results are showed in table 4. Through the ranking rated by the participants on sample A, B and C, it shows that the 3 different sports hijab samples have the similarity in the properties focused.

| Properties       | P-Value | Conclusion       |
|------------------|---------|------------------|
| Wicking          | 0.487   | Not Significant  |
| Perspiration     | 0.380   | Not Significant  |
| Comfortness      | 0.520   | Not Significant  |
| Breathability    | 0.864   | Not Significant  |
| Hand             | 0.587   | Not Significant  |

Figure 8 shows the ranking given by participants on wicking, perspiration, breathability, comfort, and hand properties for Sample A. As can be seen in Figure 8, it shows an inconsistency rating among 3 participants. However, from the graph we could see that perspiration and comfort properties have a consistency in value as the different in rating are only 1.
In figure 9, a consistent graph based on the wicking, perspiration, breathability, comfort, and hand properties are obtained for Sample B. In this graph, the participants prone to have similar feelings on Sample B where the participants rated the properties that exist in Sample B are alike. Thus, Sample B shows a better result in comfort compared to Sample A.

![Figure 9: Rating from participant 1, 2, and 3 for Sample B](image)

Figure 9: Rating from participant 1, 2, and 3 for Sample B

Figure 10 shows an unstable graph on wicking, perspiration, breathability, comfort, and hand properties for Sample C. It shows more inconsistent graph which is seen to be having a larger different compared to Figure 8. However, the properties are presence in Sample C but it is rated poorly by the participant 3 yet rated well by the participant 2. Hence, the participants may not have similar agreement on the properties based on the participants' feelings.

![Figure 10: Rating from participant 1, 2, and 3 for Sample C](image)

Figure 10: Rating from participant 1, 2, and 3 for Sample C
4. Conclusion.
In conclusion, the first part of the study shows that majority of the respondent preferred to wear an awning hijab and medium length (30cm) from the chin and have an awning feature when doing sport. As for the 3 different brands, Sample B is found to be the most preferable sports hijab based on the rating that is done. This is because, Sample B promotes a medium length of hijab which is 30 cm corresponding result with the survey that have been done with 30 survey respondents in the first part of the study. On the other hand, material for Sample B is polyester where polyester fabric is high moisture wicking ability and breathable. Hence, Sample B is selected among the participants for the best hijab sportswear that can be worn to perform sports activities.

Acknowledgement
The authors would like to thank the Ministry of Higher Education for the funding under the Fundamental Research Grant Scheme (FRGS/1/2018/STG07/UITM/02/1). The authors would also like to acknowledge the assistance given by the Research Management Centre (RMC), Universiti Teknologi MARA.

References
[1] BBC News. Muslim teen athlete disqualified in Ohio race over hijab (25 Oct 2019) Retrieved on 5th January 2021. https://www.bbc.com/news/world-us-canada-50186728.
[2] Cristina N 2011 Muslim women Athletes Banned from Tournaments get creative with Hijabs ABC News Retrieved on 5th January 2021. https://abcnews.go.com/US/athletic-hijabs-female-muslim-athletes/story?id=13829421
[3] Manal H 2015 Jordanian national football Musimat players: Interrupting Islamophobia in FIFA’s hijab ban Phys. Educ. Sport Pedagogy 20(5) 517-531.
[4] Cook K 2018 Uncovering the Evolution of Hijabs in Women’s Sport The Graduate Review 3 62-67.
[5] Scarano G Nike Debut Pro Hijab for Muslim Athletes Sourcing Journal Retrieved on 5th January 2021 https://sourcingjournal.com/topics/fashion-trends/nike-debuts-pro-hijab-muslim-athletes-63055/
[6] Damayanti and Rahayu N I 2017 Effect of Muslim Women’s Sportwear (Jilbab) to Dehydration Level and Thermoregulation After Exercise IOP Conf. Series: Material Science and Engineering 180 012204.
[7] Ho C P, Fan J, Newton E and Au R 2011 Improving Comfort in Clothing Woodhead Publishing Series, p 161-181.
[8] Awais M, Sybille K, Wolfling B and Classen E 2020 Thermal Simulation of Close-Fitting Sportwear Energies 13 2419.
[9] Oktay P 2008 Clothing Comfort Properties in Textile Industry E-Journal of New World Science Academy 3.
[10] Yazid M G and Sugiura K 2016 Designing a modest sportwear to provide comfort in daily sport activities for Muslim women wearing hijab Keio University Graduate School of Media Design. (Master Thesis).
[11] Marolleau A, Salaun F, Dupont D, Gidik H and Ducept S 2017 Influence of Textile Physical Properties and Thermo-Hydric Behaviour on Comfort Journal of Ergonomics 7(6).
[12] Bajaj P and Surya K 2007 Modification of Acrylic Fibres: An Overview Journal of Macromolecular Science, Part C 27(2).