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COMPARISON ANALYSIS BETWEEN PHYSIOLOGY, COMFORT AND PERFORMANCE OF FABRICS AND FITS FOR SPORTSWEAR

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Abstract: Sportswear clothes are designed with consideration of performance, comfort, and functionality for those people taking part in physical exercise with design factors changing with varying levels of exercise intensity. The most frequent types of fabrics used include polyester-cotton blend which comes in two major designs; compression and loose designs. This work will focus on defining the characteristics of each material and fit in terms of comfort and physiological performance.

Every material and fit have advantages and disadvantages. Polyester-cotton blends are soft and comfortable although they retain moisture after prolonged exercise periods. Polyester allows for better moisture removal and faster drying as well as being durable. Compression design ensures proper muscle support and reduces exhaustion although when tight it can create discomfort for the user. Loose design improves airflow and flexibility but provides little stability during rigorous exercises.

Finally, materials and designs should be chosen depending on personal comfort perception, exercise level, and period. However, the use of polyester sportswear is considered the best because of its moisture management and performance.

Index Terms **–** Sportswear, Polyester, Cotton, Compression, Breathability, Comfort, Performance

I. INTRODUCTION

Sportswear can be defined as apparel specifically engineered to prioritize comfort, performance, and functionality for individuals engaged in various physical activities. It is built to provide athletes with unrestricted movement, enabling them to maintain focus and efficiency during training or competition.

Proper moisture control directly influences an athlete's ability to remain cool and dry, which in turn affects thermoregulation, skin comfort, and overall endurance. Beyond moisture management, breathability and comfort, both fabric properties and garment fit significantly impact the overall efficiency of sportswear. Accordingly, the primary focus of this study is a 2x2 comparative evaluation between two fabrics and two fits which are 100% Polyester & 100% Cotton and compression & loose-fit.

The analysis examines these four combinations through the lenses of physiological responses: -

- Breathability (Air circulation and flow which determines the temperature regulation of the wearer's body and outside environment.
- Comfort (The perception of physical comfort of the wearer while the sport is ongoing and paused)

- Moisture management (The ability to retain moisture as well as evaporate it into the outside climate.)

By drawing on existing literature, this study will analyze how fit interacts with the inherent properties of 100% polyester and 100% cotton and influences an athlete's experience and output.

II. REVIEW OF LITERATURE

Factors Affecting the Sweat-Drying Performance of Active Sportswear—A Review

This review paper studies the technical knowledge gaps in existing literature related to the drying performance of active sportswear fabrics. The authors state how quick drying is one of the most crucial factors in the comfort and performance of active sportswear clothing. It helps to keep the wearer dry and comfortable by effectively wicking away sweat and moisture from the body. This review paper provided us with a critical analysis of the impact of various fabric attributes, physiological, and environmental factors on moisture drying management and performance.

The paper discusses the important properties a garment must have in order to be a safe, protective and efficient sportswear, it also covered the effects of fabric drying on human physiology and how environmental factors affect the drying performance of active sportswear fabrics. The review article states how more research needs to be conducted to figure out the relationships between different fabric properties and how statistical modelling can be used to predict how well active sportswear fabrics dry.

Influence of Sportswear Made from Polyester and Man-Made Cellulosic Fibers on the Energy Cost of Physical Effort

This research paper focused on the comparative study between the influence of different types of sportswear made from cellulosic v/s polyester fibers on the energy cost of the effort of the volunteers in while active physical performance. The research was conducted using 3 types of garments made from knitted fabrics (100% TENCEL, a blend of TENCEL / PES, 100% PES) The researchers also tested two biophysical parameters: thermal and water vapor resistance. The research was conducted with the help of 10 male volunteers during the span of 4 days, with specific tasks set for each day.

The results of the study confirmed that physical effort has a big influence on skin temperature and humidity. The study also confirmed that the garment type had a visible effect on the moisture of the skin, Overall, the paper revealed that the blend of TENCEL / PES had the most favorable effect on the energy cost of physical work, as well as on the time of restitution, endurance and efficiency of the volunteers.

The use of cotton as a sportswear material: a critical analysis

The authors talk about how cotton has been a less prioritized fabric in the sportswear industry over the last years due to strong competition from synthetic fibers like polyester. This paper suggests how there is an urgent need to develop cotton products that use the advantages of its properties.

The paper mentions how the exceptional ability of cotton fibers to absorb moisture can become a negative attribute in the sportswear apparel due to the fact that cellulosic fibers like cotton and viscose absorb moisture easily but retain it within, making liquid transportation difficult.

In case of wicking in cotton products, the paper states there are two processes that operate simultaneously (capillary penetration and diffusion of the liquid into the fibers). The paper suggests that the issues with cotton as an active sportswear garment would be that wet cotton fabrics can make the wearer feel cold and the slow drying may provide more time for odors to build up due to bacterial action on the precipitation.

Cotton has excellent comfort properties in its dry state, in order to come in the same level of high-tech synthetic materials, the absorption capacity must be reduced (without affecting the advantages). The study concluded with the solution of blending and the use of water-repellent treatments for the fibers to reduce absorbency.

Influence of Sportswear Fabric Properties on the Health and Performance of Athletes.

The main focus of this research paper was the effect of fabric and their properties on the physiological responses of athletes. The study was conducted as a comparative analysis between three types of fabrics i.e. 100% cotton, 65/35 polyester-cotton blend, 100% polyester to measure static thermal properties such as thermal conductivity, thermal resistance, and thermal diffusion.

The researchers conducted this research using the help of 7 male volunteers which were selected after through medical and physical screening. To promote fair findings between the fabrics, the volunteers' age range was 18-20 years, weight range 65-75 kg and of 171-180 cm height. The volunteers covered a distance of 2.35km while wearing 3 different commercial sportswear garments made of single jersey knitted fabrics with 100% cotton fibers, 65/35 polyester-cotton blend fibers and 100% polyester fibers.

The result of this study concluded the sample with 100% polyester fibers demonstrated better physiological responses and performance by athletes compared to the other two fabric types. The study also concluded that the sample made of 100% cotton fibers, which used to be favorable for sportswear, showed some shortcomings in terms of moisture management.

Evaluating the Impact of Environmental Exposure on the Performance of Polyester Sportswear Materials

This paper aims to study the effects of aging on sportswear materials made from recycled and conventional polyesters. The research states that the design of sportswear materials has not yet received adequate scientific attention, they also state that the ideal materials for sportswear are those fabrics that quickly absorb moisture, dry rapidly, do not significantly change other properties, and possess antibacterial properties to prevent unpleasant odors and potential infections. The research in this paper focuses on the changes in the physical–mechanical properties of materials used for football sportswear due to material ageing, focusing on eight important material properties. Their main objective was to gain a comprehensive understanding of how material performance evolves over time to support the development and selection of sportswear materials.

The results of this paper show that fabric aging leads to a reduction in porosity in both recycled materials and conventional polyester materials, the reason being due to the dimensional shrinkage of the material. Recycled polyester showed the highest porosity value.

Effect of sportswear on performance and physiological heat strain during prolonged running in moderately hot conditions

This paper examines the impact of different upper-torso sportswear technologies on the performance and physiological heat strain of well-trained and national-level athletes during prolonged running in moderately hot conditions. It states that despite rapid advancements in sportswear technology, there is a lack of information on the impact of recent commercial garments as well as their effects on the physiology and performance of national level athletes. This study is mainly aimed to investigate the impact of upper-body sportswear garments (sweat-wicking t-shirts, compression t-shirts, and t-shirts with aluminum dots) on the performance and physiological heat strain experienced by national-level athletes during moderate-intensity exercise in hot conditions.

The research concluded that the tested upper-body sportswear garments did not confer substantially different advantages in terms of heat dissipation/gain and performance during endurance (one-hour run) exercise in moderate heat.

Compression Sportswear Improves Speed, Endurance, and Functional Motor Performances: A Meta-Analysis.

The main objective of this research paper was to confirm whether compression sportswear can enhance exercise performances or not by examining the effects of compression sportswear on exercise performances including speed, endurance, strength and power, functional motor performance, and sport-related performance. They stated that beyond facilitated recovery post-exercise, the overall effect of compression sportswear on exercise performances has not been quantitatively investigated. Additionally, the authors determined whether different types of participants and compression garments modulated positive effects on specific exercise performances. They expect the research to provide information on whether compression garments positively influence ongoing movement executions and whether these effects are differentiated by certain exercise functions, physical levels, and types of garments.

The research was conducted following the PICOS (Preferred Reporting Items for the Systematic Reviews and Meta-Analysis) format, for effect size calculations, they used the SMD (standardized mean difference). To assess potential methodological quality issues, they measured the PEDro (physiotherapy Evidence Database) scores by completing yes-or-no responses. The research findings revealed that wearing compression garments slightly improved speed and endurance, whole-body suits were effective in improving speed performance. They discussed how investigating the effects of compression garments on various populations such as adolescents, older adults, or neurological patients may be necessary by focusing on identifying optimal types of compression garments for increasing their exercise performances.

Investigation of the impact of comfort perception on the overall comfort of tight-fitting sportswear
This research studies about the physical comfort (heat, humidity comfort, sensory comfort etc.) and impact of tight-fitting sportswear. It states that compression sportswear is valued for
its excellent functional characteristics and about how it can not only improve muscle support and reduce sports fatigue by providing a reasonable pressure distribution, but also optimize sports performance to some extent.
Although tight-fitting garments offer several advantages, they also present drawbacks. This study focuses on the wearer's physiological response to compression garments under various conditions. It highlights that while compression can be beneficial, excessive compression may cause discomfort and negatively affect performance and wearer satisfaction.

Comfort in sportswear
This paper primarily focuses on developing a predictive scheme for evaluating wearer physiological and physical comfort in sportswear. Wearer comfort is subjective and varies considerably across individuals due to perception of comfort being influenced by personal preferences, body type, activity type, and environmental conditions. To address this variability, the proposed scheme incorporates both objective fabric and garment parameters.

The study further concludes that ventilation such as openings, buttons, zippers, breathable fabric panels, and cuts plays a critical role in regulating body-environment temperature and humidity within the garment. The effectiveness and necessity of these features are directly correlated with the intensity of the physical activity and the specific comfort thresholds of the wearer. By mapping ventilation requirements to activity levels, the study aims to provide sportswear designers with a framework for optimizing garment construction to enhance thermal comfort, reduce physiological strain, and improve overall athletic performance without compromising functional support.

Investigating the Impact of Sportswear Design on the Psychological States of University Students in Physical Education Courses
This research examines sportswear as both a functional textile product and an aesthetic garment, focusing on two key variables: color as an aesthetic attribute and garment fit as an ergonomic attribute in relation to physiological response. The study used 100% polyester fabrics in red and gray, with garment fit developed from anthropometric data using a standard loose-fit pattern. Experimental trials assessed wearer perception and physiological outcomes across both color and fit variations.

The results indicate that while color influenced visual appeal, garment fit played a significant role in volunteers' self-confidence, perceived comfort and overall satisfaction. The study also highlights the importance of ergonomic design in sportswear development, suggesting that garment fit should be prioritized alongside aesthetic choices to enhance athletic experience.

III. METHODOLOGY

The research methodology is based on a thorough review of existing studies and industry reports. By bringing together findings from previous research, this study focuses on key performance factors such as moisture management, breathability, durability and range of motion. This analysis looks to provide clear insights about how garment fit affects fabric properties, influencing comfort and athletic efficiency. This information will help guide design choices for performance apparel.

Properties of Polyester

Polyester is one the leading choices for sportswear material due to its lightweight, durable, moisture-wicking and quick-drying properties which are amongst one of the most crucial properties for sportswear [1]. Its ability to retain shape, resist wrinkles and adapt to blends is a few of main reasons in becoming an ideal option in the sportswear apparel industry.

Other materials, let's take cotton for example, lack behind in a key element required for sportswear. Cotton holds up to 7% water by weight whereas Polyester holds less than 0.4%—meaning it dries 5x faster and also due to polyester taking ample amount of time to soak up even a single drop of water [2]. Polyester is engineered for the demands of athletic wear. Its resilience to physical stress and sweat gives it an edge over most alternatives.

Properties of cotton

Cotton has been a less prioritized fabric in the sportswear industry over the last years due to strong competition from synthetic fibers [3]. Usually for sportswear, fabrics like polyester, spandex and other synthetic blends are used, these fabrics are not bio-degradable and raise questions on if they are still the right choice for use.

Cotton is a good choice due to it being super comfortable, it's hypoallergenic properties which are helpful for wearers with sensitive skin and its breathability being helpful in hot and humid climates which is a crucial point for the comfort of sportswear. Cotton's excellent property of absorbency which becomes a negative point due to potential discomfort can be overcome by using finer yarns as the porosity of a fabric significantly affects its drying ability by allowing moisture to pass through the skin to the outer environment or water-repellent treatment [3,4,5,6].

Properties of Compressed Garments

A compression garment (e.g. a swimming costume) is a high-elasticity textile constructed to apply slight, gentle pressure to the body. Unlike ordinary stretch fabric, compression fabric provides a consistent squeeze that supports muscles and veins. It improves blood circulation of the athlete.

The compression assists on holding the muscles tights leading to decrease in excess vibration and muscle stability. One of its key properties in active physical exercising is that it enhances performance, facilitates recovery and prevents fatigue [7].

Properties of Loose-Fit Garments

Loose-fit garments (e.g., Football jerseys) are the garments that are usually flowy and stick to the wearer's skin as less as possible (mostly only on the shoulder and neckline). This fit has excellent breathability and moisture evaporation ability due to the circulation of air.

Loose-fit sportswear is ideal in low to medium intensity sports which require a high range of movement and flexibility as it offers space for motion. These are especially ideal for comfort in hot and humid environments as the air flow prevents excessive sweating and regulates body temperature.

3.5 Advantages & Disadvantages

Table 1

	Advantages	Disadvantages
Cotton	Excellent absorbency, breathability and hypoallergenic properties.	Moisture retention becomes a negative factor due to discomfort and irritation to the skin.
Polyester	Moisture-wicking and quick drying ability adds on its ability to retain shape.	Non-biodegradable and potentially problematic on sensitive skin.
Compressed garment	The compression helps in speed, stability and blood-circulation. [7]	Excessive compression can lead to suffocation and discomfort. [8]
Loose-fit Garment	Air-circulation and comfortability especially in hot and humid environments.	Potential tripping and safety hazard as it could be stuck to equipment, might affect aerodynamics.

3.6 Polyester vs cotton

Table 2

	Polyester	Cotton
Breathability	Moderate breathability due to it being a synthetic fabric.	Excellent breathability due to its natural fiber structure.
Moisture Management	Excellent moisture-wicking properties.	Its moisture retention becomes a negative factor.
Comfort	Can cause irritations after wearing it continuously for a long time.	Soft and hypoallergenic, excellent comfortability.

3.7 Compression vs Loose-fit

Table 3

	Compression	Loose-fit
Breathability	Restricted air-flow due to the lack of space between the fabric and skin.	Excellent air-circulation due to the flowy nature of this fit.
Performance	Helpful in muscle-stability and blood-circulation.	Safety hazard depending on the nature of the sport and restricts aerodynamics affecting the speed and energy cost of the athlete.
Comfort	Could cause irritation and suffocation after longtime use especially in a humid environment.	The air circulation keeps the wearer drier and cooler, preventing excessive sweat.

IV. RESULT

In accordance to the comparison above, the results for the fabric point out that technically cotton should be better due to it being breathable, hypoallergenic and sustainable but Its moisture retention gives it a huge disadvantage since that is one of the most important properties for a sportswear garment. Polyester is non-biodegradable and prone to cause irritation to sensitive skin but in relation to performance and moisture management polyester is the better choice due to its ability to regulate the body to outside climate's temperature.

In accordance to the comparison above, the results for the fit point out that both the fit have their own advantages and disadvantages and should be chosen according to the activity/sport, and comfort perception of the wearer [9]. Compression fit is best for its help in performance and its comfortability & breathability depends on the amount of time of wearing it and the individual's confidence and choices [10]. Whereas loose-fit is best for its breathability due to the air-flow and lack of skin-to-fabric contact and is a good choice depending on the intensity of the activity/sport.

V. CONCLUSION

The expected result of this study was 100%polyester and compression fit due to the fact it's one of the most popular choices in today's sportswear market and while the result did point towards that expected result but it also revealed the disadvantages for each that should be taken into consideration for our environment and comfortability especially for the fabric.
Yes, polyester might be a good choice due to its moisture-wicking properties which is a negative point for cotton but if we look at things beneficial for the environment and body cotton should be taken into account in becoming a focused choice. Other research papers have mentioned how cotton's biggest negative properties in relation to sportswear (moisture-retention) can potentially be fixed with using finer yarns or water-repellent treatments.
Overall, all 4 aspects have their advantages and disadvantages and should be chosen according to the individual's skin-type, comfortability, performance, wear time and the intensity of the sport and the perception of comfort according to the individual.

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