Physiological Comfort in Sportswear: A Comprehensive Review

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***Abstract*—Physiological comfort is the cornerstone of sportswear performance, directly influencing athletic endurance, recovery, and consumer acceptance. Unlike conventional clothing, sportswear is engineered to manage heat, sweat, and mechanical stress under dynamic conditions, demanding a multidimensional approach that integrates material science, garment engineering, and user centered design. This review synthesizes literature on fibres, fabrics, finishing technologies, and evaluation methods with specific emphasis on physiological comfort. Synthetic fibres such as polyester, nylon, and elastane dominate the market due to their strength and durability, yet natural and regenerated fibres such as cotton, wool, modal, and Tencel continue to play an essential role in providing soft hand, breathability, and environment compatibility. Fibre blends and knitted structures further enhance moisture management, stretch, and thermal regulation. Functional finishes including moisture management agents, antimicrobial treatments, and phase change materials (PCMs) have transformed fabrics into multifunctional systems capable of adaptive thermal balance and hygienic freshness. However, challenges persist in wash durability, environmental safety, and the mismatch between laboratory tests and real-world user perceptions. Emerging technologies such as microencapsulation, smart textiles, and zonal comfort mapping offer promising pathways to improve comfort and sustainability. By consolidating current knowledge and identifying research gaps, this review provides a framework for future innovations in designing sportswear that optimizes physiological comfort while addressing global sustainability imperatives**

***Index Terms*—Sportswear, Physiological comfort, Thermal regulation, Moisture management, Sensorial comfort**

I. INTRODUCTION

The rapid evolution of sportswear reflects the intersection of material innovation, consumer lifestyle shifts, and performance demands. Unlike conventional apparel, sportswear is expected to withstand repeated mechanical stress, regulate body temperature, and effectively manage perspiration ensuring both comfort and style. In this context, physiological comfort the state in which clothing enables the body to sustain thermal balance, preserve skin dryness, and allow freedom of movement has emerged as the most crucial factor in sportswear design and consumer satisfaction (Suhaimi et al., 2025). Sportswear is classified under Sportech, a category of technical textiles developed specifically for athletic and recreational purposes, where performance attributes are blended with aesthetic appeal. The global sportswear market continues to expand at a remarkable pace, propelled by rising health awareness, the popularity of athleisure, and consumer demand for multifunctional and sustainable apparel (Technavio, 2024). Consequently, physiological comfort has shifted from being a secondary consideration to becoming a central driver of innovation in fibres, fabrics, and textile finishes. Addressing this demand requires an understanding that comfort is not a singular concept but a combination of interrelated factors that determine the overall user experience and performance outcomes.

The literature consistently emphasizes that comfort in sportswear is multidimensional, encompassing thermo-physiological, sensorial, psychological, and ergonomic aspects (Islam et al., 2023). Thermo-physiological comfort plays a vital role by ensuring

optimal heat and moisture transfer, preventing overheating or excessive cooling during physical activity. Sensorial comfort is influenced by tactile factors such as softness, smoothness, and fabric drape, while ergonomic comfort relates to fit, stretch, and the ease of body movement. Psychological comfort, which is shaped by aesthetics, brand identity, and cultural norms, further affects consumer preferences and confidence during athletic performance. In response, researchers have investigated a spectrum of strategies to enhance physiological comfort, ranging from fibre modification and fabric engineering to the integration of advanced finishing technologies. Moisture management treatments facilitate effective sweat absorption and evaporation, while phase change materials (PCMs) provide dynamic thermal regulation by storing and releasing latent heat. Microencapsulation techniques extend these benefits, enabling controlled release of cooling agents, antimicrobial compounds, or fragrances for multifunctional performance. Despite these advances, persistent challenges include reduced functionality after repeated laundering, concerns over environmental sustainability, and discrepancies between laboratory testing and real-world consumer experiences. Given these complexities, a comprehensive review is essential. This paper critically examines current innovations in fibres, fabrics, finishes, and evaluation methods with a particular focus on physiological comfort in sportswear, while also identifying limitations and outlining future directions for sustainable, multifunctional, and consumer-oriented solutions

II. PHYSIOLOGICAL COMFORT IN SPORTSWEAR: CONCEPTUAL FRAMEWORK

Comfort is an inherently multidimensional concept that integrates physical, psychological, and ergonomic factors. In the context of sportswear, physiological comfort refers to the ability of clothing to support the body's natural thermoregulation and movement, while minimizing stress and discomfort during physical activity (Islam et al., 2023). It is not a static attribute; rather, comfort changes dynamically as the wearer transitions through phases of warm-up, exertion, and recovery. Researchers generally categorize comfort into four key dimensions: thermo-physiological, sensorial, ergonomic, and psychological.

2.1 Thermo-Physiological Comfort

Thermo-physiological comfort relates to the body's thermal balance and moisture regulation during activity. When exercise elevates metabolic heat, sweat glands secrete fluid to cool the body via evaporation. Sportswear must therefore ensure efficient heat and moisture transfer, avoiding both overheating and chilling. Fabrics with high air permeability, vapor transport, and quick-drying properties are critical for maintaining homeostasis. Failure to manage thermal comfort may lead to dehydration, heat stress, or impaired performance (Nasrin et al., 2023)

2.2 Sensorial Comfort

Sensorial comfort, sometimes referred to as tactile comfort, concerns the wearer's skin fabric interactions. Attributes such as softness, smoothness, flexibility, and the absence of irritation or prickle sensations determine whether a garment feels pleasant to wear. Fibres like modal and tencel offer superior sensorial comfort compared to polyester, while rough seams or coarse fabrics can cause friction-related discomfort, particularly in endurance sports (Ajmeri & Bhattacharya, 2017). Sensorial comfort often influences consumer acceptance even more strongly than technical performance, especially in athleisure and yoga wear

2.3 Ergonomic Comfort

Ergonomic comfort refers to how clothing interacts with body movement and posture. Sportswear must accommodate stretching, bending, and repetitive motions without restricting mobility or causing excessive pressure. Stretch-recovery properties, seam placement, and compression balance are all determinants of ergonomic comfort. Advances in seamless knitting, 3D body scanning, and pressure mapping have improved the ability to design garments that adapt to body movements, reducing friction and enhancing performance (Guru et al., 2022)

2.4 Psychological Comfort

Psychological comfort reflects the wearer's mental and emotional responses to clothing. It encompasses perceptions of fit, aesthetics, color, style, and cultural alignment. Research indicates that the psychological dimension of comfort can influence athletic confidence and perceived exertion. For example, color psychology studies have shown that red sportswear

can enhance competitiveness and performance perception, while well-fitted yoga garments improve body confidence (Mantachie & Das, 2014; Goldschmied et al. 2023; Moha Azli et al., 2023). Psychological comfort is also shaped by social factors such as brand reputation and sustainability, which influence how consumers "feel" about their apparel beyond physical attributes

2.5 Interactions Between Comfort Dimensions

While these dimensions are often studied separately, they are deeply interrelated in practice. For example, thermo-physiological comfort depends not only on fibre selection but also on ergonomic fit, which determines how effectively sweat evaporates. Similarly, sensorial comfort interacts with psychological comfort, as fabrics perceived as soft and luxurious enhance both physical and emotional satisfaction. Understanding these interactions is critical for designing sportswear that achieves holistic comfort across diverse conditions

III. FIBRES FOR PHYSIOLOGICAL COMFORT

3.1 Synthetic Fibres

The physiological comfort of sportswear is fundamentally shaped by the selection of fibres and the engineering of fabric structures, both of which directly influence performance and wearer satisfaction. Fibres contribute intrinsic physical and chemical properties that regulate thermal balance, control moisture transfer, and affect tactile sensations, while fabric structures determine porosity, stretch, and drape. By manipulating knit constructions and blending fibres, designers can tailor sportswear to suit specific activities and climatic conditions. Synthetic fibres dominate the market because of their strength, dimensional stability, and durability, making them the foundation of performance apparel. Polyester remains the most widely used due to its low moisture absorption, quick-drying capacity, and thermal stability. Technological advances in cross-sectional modifications, such as hollow and trilobal polyester, have further enhanced its wicking ability and ventilation efficiency (Turukmane & Daberao, 2023). Nylon, valued for abrasion resistance and smooth texture, offers superior durability but reduced vapor permeability, which can hinder thermal comfort. Lycra (spandex/elastane) is indispensable for ergonomic comfort, supplying the stretch and recovery needed in compression garments, yoga wear, and high-mobility sports (Hu & Lu, 2015). More recently, polypropylene has emerged as a lightweight, hydrophobic option for thermal base layers, while graphene-infused synthetics represent cutting-edge fibres with enhanced thermal conductivity, antibacterial action, and durability (Gibbons, 2018)

3.2 Natural and Regenerated Fibres

Although synthetics dominate, natural fibres continue to play an important role in promoting physiological comfort, particularly in terms of sensorial qualities and thermo-physiological regulation. Cotton provides breathability and softness, ensuring immediate comfort, but its high-water retention can cause discomfort during intense sweating. Wool, especially merino, has carved a niche in cold-weather sportswear due to its insulation, odor resistance, and ability to retain heat retention in damp conditions. However, without adequate processing, it may cause irritation to sensitive skin. These limitations have driven interest in regenerated fibres such as modal and tencel (lyocell), which combine performance benefits with eco-friendliness. Tencel stands out for its excellent vapor permeability, biodegradability, and moisture absorption, positioning it as an attractive choice for sustainable sportswear. Studies have shown that blending Tencel with jade fibres enhances its cooling capacity and antibacterial activity, directly improving physiological comfort (Chen et al., 2015). Such fibres not only improve wearer experience but also align with consumer demand for environmentally responsible products

3.3 Blended and Recycled Fibres

Blending strategies bring together the strengths of both synthetic and natural fibres while minimizing their weaknesses, creating versatile fabrics for diverse sporting applications. Cotton-Lycra and polyester-Lycra blends balance breathability, stretch, and resilience, making them ideal for activities requiring flexibility and recovery. Modal-Lycra and Tencel Lycra blends enhance softness, drape, and wicking performance, while retaining durability. Increasingly, recycled blends are being adopted as part of the sportswear industry's sustainability agenda. Recycled polyester has been shown to perform comparably to virgin polyester in terms of comfort perception,

underscoring its suitability as an eco-friendly alternative (Claussen et al., 2023). Similarly, recycled polyester-cotton blends demonstrate promising thermo-physiological comfort, though their tensile strength may be slightly reduced compared to virgin counterparts (Samyuktha & Ramakrishnan, 2020). Together, these innovations highlight the growing synergy between performance, comfort, and sustainability in next-generation sportswear.

3.4 Innovations in Comfort-Oriented Fibres

New fibre developments extend the boundaries of comfort. Oxidized hemp fibres demonstrate improved wicking and reduced moisture retention, offering sustainable alternatives for activewear (Milanovic et al., 2021). Carbon fibre blends with cotton or polyester enhance durability and insulation for specialized sports such as mountaineering (Abd El-Hady & Abd El-Baky, 2011). Smart fibres with graphene coatings are being developed to provide conductivity and adaptive thermal regulation, enabling the integration of physiological monitoring into sportswear (Vasile et al., 2023)

IV. FABRIC STRUCTURES AND COMFORT PERFORMANCE

Fabric architecture plays a critical role in determining air permeability, moisture transport, and elasticity, thereby directly influencing physiological and ergonomic comfort in sportswear. Knitted fabrics dominate this sector because of their inherent stretch, recovery, and porosity, which collectively support thermo-physiological regulation and wearer mobility (Das et al., 2025). Within knitted structures, variations such as single jersey, rib, and interlock offer different balances between elasticity and stability, allowing designers to select appropriate constructions for specific performance needs. For instance, plain-knit polyester-Lycra blends demonstrate superior stretch and recovery, making them ideal for high-mobility applications, while plated knitted fabrics are engineered with hydrophilic inner layers for effective moisture absorption and hydrophobic outer layers for rapid evaporation, thereby enhancing both comfort and sweat management (Saravanan et al., 2016). Compression garments, often developed using warp knitting or circular knitting, are designed to exert controlled pressure on the body to improve blood circulation, minimize muscle vibration, and facilitate efficient sweat evaporation. Further advancing ergonomic comfort, seamless knitting technologies reduce chafing and strategically align stretch zones with body movements, resulting in garments that not only optimize performance but also improve the overall wearing experience (Cheng et al., 2021; Cheng et al. 2022)

V. MOISTURE MANAGEMENT AND THERMAL REGULATION FOR PHYSIOLOGICAL COMFORT

The regulation of heat and moisture constitutes the most critical determinant of physiological comfort in sportswear. During physical exertion, metabolic heat production rises substantially, and perspiration serves as the body's principal cooling mechanism. Inefficient transport and evaporation of sweat disrupt thermal balance, potentially leading to discomfort, skin irritation, or even impaired athletic performance. Accordingly, high-performance sportswear must integrate fibres, fabric structures, and functional finishes that collectively enable efficient sweat wicking, rapid drying, and adaptive thermal regulation.

5.1 Sweat Physiology and Heat Transfer Mechanisms

Sweating is mediated by eccrine glands distributed across the body, with higher concentrations on the chest, back, and underarms. While evaporation of sweat provides effective cooling, its accumulation within garments increases discomfort and energy expenditure. Moisture transport in textiles occurs through absorption into fibres, capillary wicking within yarn interstices, and evaporation at the fabric surface. Concurrently, heat dissipation takes place through conduction, convection, radiation, and evaporative cooling (Islam et al., 2023). Sportswear that fails to adequately support these mechanisms may result in overheating, dehydration, or post-exercise chilling

5.2 Fibre Influence on Moisture Management

The choice of fibre plays a pivotal role in determining moisture management characteristics. Hydrophobic fibres such as polyester and polypropylene facilitate wicking and rapid drying, whereas hydrophilic fibres such as cotton exhibit superior absorption but slower drying rates. Wool demonstrates unique

thermoregulatory behaviour, absorbing up to 30% of its weight in moisture without imparting a clammy sensation, rendering it suitable for colder conditions. Regenerated fibres such as Tencel exhibit high moisture absorption and vapor permeability, surpassing polyester in comfort, though their relatively lower durability often necessitates blending (Taştan Özkan et al., 2023)

5.3 Fabric Structures for Wicking and Drying

Fabric construction significantly influences moisture management efficiency. Knitted fabrics with higher porosity and capillarity enhance vertical wicking and drying rates (Nasrin et al., 2023). Advanced designs such as plated knits and multilayer structures provide effective moisture management by incorporating a hydrophilic inner layer that absorbs sweat and a hydrophobic outer layer that promotes evaporation. Compression fabrics further improve sweat transfer through sustained skin contact, although excessive pressure must be avoided to prevent thermal discomfort (Dhurai et al., 2023)

5.4 Moisture Management Finishes (MMFs)

Functional finishes further augment fabric performance in regulating moisture. Hydrophilic finishes enhance wettability, dispersing sweat across larger surface areas to accelerate drying. Guru and Choudhary (2020) demonstrated that micro-polyester fabrics treated with MMFs retained one-way moisture transport properties even after multiple laundering cycles. Fabric weight (GSM) also influences liquid transport, as higher GSM fabrics enhance one-way transport but may compromise air permeability if finishes are applied excessively (Guru et al., 2021)

5.5 Advanced Thermal Regulation with PCMs

Phase change materials (PCMs) represent a transformative approach to thermal comfort by providing dynamic thermal buffering. These materials absorb, store, and release latent heat during solid liquid or solid–solid phase transitions, thereby stabilizing skin temperature during activity and post-activity phases. In sportswear applications, PCM microcapsules incorporated into fibres or coatings contribute to adaptive thermal balance by cooling the wearer during activity and retaining warmth during rest (Horrocks & Textile Institute, 2009). Recent developments in polyurethane-based solid solid PCMs (SSPCMs) have overcome the leakage issues of traditional PCMs, enhancing their applicability for knitted performance fabrics (Das et al., 2025)

VI. CRITICAL REVIEW OF LITERATURE AND RESEARCH GAPS

While substantial advancements have been made in the development of fibres, fabrics, and finishes aimed at enhancing physiological comfort, several limitations and research gaps remain evident. These shortcomings underscore the necessity for more integrated, sustainable, and user-focused approaches to sportswear design.

6.1 Fibre and Fabric Limitations

Synthetic fibres such as polyester and nylon continue to dominate sportswear applications due to their durability, affordability, and ease of processing. However, their widespread use raises significant environmental concerns, particularly relating to microplastic pollution. In contrast, natural and regenerated fibres such as cotton, tencel, and modal provide superior moisture absorption and enhanced tactile comfort but are hindered by lower durability and slower drying rates, reducing their suitability for high-intensity sports applications. Existing research often evaluates single-fibre systems in isolation rather than blended fibre configurations under dynamic, real-world conditions, thereby creating a gap between laboratory findings and the practical requirements of end-users

6.2 Durability of Functional Finishes

Functional finishes including antimicrobial treatments, moisture management agents, and phase change material (PCM) microcapsules significantly contribute to physiological comfort, yet their limited durability remains a challenge. Many treatments exhibit substantial reductions in effectiveness after 20–30 wash cycles, whereas consumer expectations typically extend to 50–100 wash cycles over a garment's lifespan. Additional concerns include nanoparticle leaching, which poses both environmental and health risks, and the limited longevity of fragrance or cooling finishes. Consequently, there is a pressing need for the development of eco-friendly, wash-resistant, and long-lasting finishing technologies.

6.3 Consumer Preference versus Technical Performance

Academic research predominantly emphasizes thermo-physiological performance metrics, whereas consumer purchasing behaviour particularly in the rapidly expanding athleisure segment prioritizes aesthetics, brand image, and affordability. This misalignment frequently results in a disconnect between technical innovation and market adoption. To bridge this gap, more interdisciplinary research is required, integrating material science with consumer behaviour studies to ensure that innovations are both technologically effective and aligned with user expectations.

Previous studies examining sportswear performance in urban and semi-urban regions of Mumbai have revealed notable inconsistencies in comfort attributes across diverse climatic conditions. While garments generally demonstrated effective moisture-wicking properties, thermal comfort was often compromised, particularly in warmer environments where users reported sensations of heaviness, clinginess, and discomfort due to perspiration accumulation. Conversely, in colder conditions, thermal regulation was comparatively more favourable, though still accompanied by limitations that hindered optimal performance. These findings, supported by statistically significant outcomes, highlight a clear gap between consumer expectations and the functional realities of existing sportswear. The evidence underscores the necessity for apparel manufacturers to adopt advanced, climate-responsive, and breathable textile innovations aimed at enhancing both wearability and user satisfaction. (Navalgund & Dedhia, 2025)

6.4 Sustainability Challenges

Although sustainability has emerged as a central theme in contemporary sportswear research, its practical implementation remains limited. Recycled polyester represents a promising option but continues to face challenges associated with microplastic shedding and inefficient recycling processes. Biodegradable fibres such as hemp and lyocell demonstrate potential in terms of eco-friendliness but require enhancements in mechanical strength and moisture management to compete effectively with synthetic alternatives. Furthermore, much of the current research neglects to address the full garment lifecycle, from raw material sourcing to disposal or recycling, thereby hindering progress toward genuine circular economy practices within the sportswear industry

6.6 Scope for Future Research

Several opportunities exist to address the current research gaps in sportswear design, particularly through innovations that combine functionality, sustainability, and consumer appeal. The development of multifunctional fabrics remains a key priority, with growing interest in blends and finishes that integrate multiple comfort functions such as antimicrobial protection, phase change materials (PCMs) for thermal regulation, and moisture management into durable and eco-friendly systems. Zonal comfort mapping, supported by advanced techniques like 3D knitting and seamless construction, offers further potential by enabling garments with localized zones for sweat management, ventilation, and movement flexibility. In parallel, green finishes derived from plant-based, enzymatic, or biodegradable agents present promising alternatives to synthetic chemicals, addressing both environmental and health concerns. Evaluation approaches are also evolving, with hybrid methodologies that integrate laboratory protocols, wear trials, and wearable sensor technologies to establish standardized and more realistic comfort assessment frameworks. Finally, consumer-centered innovation will be essential, requiring the incorporation of aesthetics, cultural preferences, and psychological comfort into technical design processes to ensure that scientific advancements resonate with user expectations and market demands

VII. CONCLUSION

Physiological comfort is central to sportswear performance, influencing endurance, recovery, and consumer satisfaction. It encompasses thermo-physiological, sensorial, ergonomic, and psychological dimensions that collectively define the user experience. Fibre selection is critical in this regard: synthetic fibres such as polyester, nylon, and elastane dominate for their durability, elasticity, and quick-drying properties, while natural and regenerated fibres including cotton, wool, modal, and Tencel offer softness, breathability, and eco-friendliness. Blended fibres and advanced knitted or seamless structures provide a balance of stretch, moisture management,

and tactile appeal, enhancing both functional and aesthetic comfort.

Functional finishes and advanced technologies further augment these properties. Moisture management treatments, antimicrobial coatings, UV protection, and phase change materials (PCMs) significantly improve thermo-physiological regulation. However, durability and sustainability remain concerns, as many finishes degrade after laundering and may raise environmental risks. Laboratory evaluations, though widely used, often fail to capture real-world perceptions, highlighting the need for hybrid approaches combining lab testing, wear trials, and smart sensing technologies.

Looking ahead, innovation must integrate performance with sustainability. Priorities include adopting recycled or biodegradable fibres, developing multifunctional textiles, and utilizing 3D knitting, seamless construction, and comfort mapping for zonal adaptability. Smart integration through responsive fibres and wearable electronics will enable adaptive comfort and real-time monitoring. Equally, consumer-centered design is essential to align technical advances with aesthetics and psychological appeal, ensuring broader market acceptance.

In conclusion, achieving holistic physiological comfort in sportswear requires interdisciplinary collaboration between textile engineers, material scientists, designers, and consumer researchers. By addressing durability, sustainability, and consumer acceptance, the next generation of sportswear can move beyond performance apparel to become multifunctional, adaptive, and environmentally responsible. Such advances will redefine not only athletic performance but also the everyday comfort and lifestyle of global consumers

REFERENCES

[1] Abd El-Hady, R. a. M., & Abd El-Baky, R. a. A. (2011). Enhancing the Functional Properties of Sportswear Fabric based Carbon Fiber. Asian Journal of Textile, 1(1), 14–26. https://doi.org/10.3923/ajt.2011.14.26

[2] Das, A., Hasan Apu, M. M., Akter, A., Al Reza, M. M., & Mia, R. (2025). An overview of phase change materials, their production, and applications in textiles [Review article]. Results in Engineering, 25, 103603. https://doi.org/10.1016/j.rineng.2024.103603

[3] Ajmeri, J. R., & Bhattacharya, S. (2017). Single Jersey Modal Fabrics-Better Choice for Sportswear Applications. Journal of Textile Engineering & Fashion Technology, 2(6). https://doi.org/10.15406/jteft.2017.02.00081

[4] Chen, Y., Yan, Y., Wu, B., & Tao, J. (2015). Summer Sportswear Fabrics Research of Jade Fiber and Comprehensive Evaluation. 2015 8th International Symposium on Computational Intelligence and Design (ISCID), 1, 81–84. https://doi.org/10.1109/ISCID.2015.269

[5] Cheng, P., Wang, J., Zeng, X., Bruniaux, P., Tao, X., & Chen, D. (2021). Research on sensory comfort of tight-fitting sportswear based on intelligent models. Journal of Engineered Fibers and Fabrics, 16. https://doi.org/10.1177/15589250211068035

[6] Cheng, P., Wang, J., Zeng, X., Bruniaux, P., & Tao, X. (2022). Intelligent research on wearing comfort of tight sportswear during exercise. Journal of Industrial Textiles, 51(3). https://doi.org/10.1177/15280837221094055

[7] Claussen, L., Lloyd, A., Ruiz, D., & Havenith, G. (2023). Recycled versus virgin polyester sportswear can a difference be perceived in actual use? International Journal of Fashion Design, Technology and Education, 1–9. https://doi.org/10.1080/17543266.2023.2247427

[8] Dhurai, B., Prakash, N., K R, S., S, V., & K S, H. P. (2023). Construction of Compression Garments for High Performance Sports. International Journal of Research Publication and Reviews, 4(4), 1528–1532.

[9] Erkan, G., Türkoğlu, G. C., Karavana, S. Y., Sariişik, A. M., Ütebay, B., Bakadur, A. Ç., & Popescu, A. (2021). Encapsulation Lavender Oil by Spray Drying for Sportswear. TEXTEH Proceedings, 2021, 148–154. https://doi.org/10.35530/TT.2021.23

[10] Gibbons, S. (2018, March 28). The power of graphene in sportswear. WTiN.Com. https://www.wtin.com/article/2018/march/260318/the-power-of-graphene-in-sportswear/?channelid=1120

[11] Guru, R., & Choudhary, A. K. (2020). Influence of Functional Finishes and Polyester

type on Comfort Properties of Active Sportswear. Journal of Textile and Apparel Technology and Management, 12(4). https://jtatm.textiles.ncsu.edu/index.php/JTATM/article/view/16408

[12] Guru, R., Kumar, A., & Kumar, R. (2021). Functional Textile for Active Wear Clothing. In Textiles for Functional Applications. IntechOpen. https://doi.org/10.5772/intechopen.96944

[13] Guru, R., Varshney, R. K., & Kumar, R. (2022). Compression and Recovery Functional Application for the Sportswear Fabric. Elasticity of Materials. https://doi.org/10.5772/intechopen.101316

[14] Horrocks, A. R., & Textile Institute. (2009). Handbook of technical textiles (2nd ed.). Cambridge: Woodhead Publishing.

[15] Hu, J., & Lu, J. (2015). Recent developments in elastic fibers and yarns for sportswear. In Textiles for Sportswear,53–76. https://doi.org/10.1016/B978-1-78242-229-7.00003-5

[16] Islam, M. R., Golovin, K., & Dolez, P. I. (2023). Clothing Thermo-physiological Comfort: A Textile Science Perspective. Textiles, 3(4), 353–409. https://doi.org/10.3390/textiles3040024

[17] Lakra, V., & Deshpande, A. (2020). Factors Influencing Preference toward Sportswear Brands among Consumers in India. Annals of Tropical Medicine and Public Health. https://doi.org/10.36295/ASRO.2020.231755

[18] Mahila.M & Dr. Kumaran M.P. (2021), A Study on Consumer Behaviour on Sport Shoes with Special Reference to Coimbatore City. International Journal of Creative Research Thoughts, 9 (4), 4154 4524. ijcrt.org/papers/IJCRT2104541.pdf

[19] Goldschmied, N., Furley, P., & Bush, R. (2023). Critical review of uniform color effects in sports. International Review of Sport and Exercise Psychology, 16(1), 311–336. https://doi.org/10.1080/1750984X.2020.1857295.

[20] Mantachie, M., & Das, A. (2013). Chronophysiological comfort of high active sportswear-II. Research Journal of Textile and Apparel, 17(3), 50–60

[21] Milanovic, J. Z., Milosevic, M., Korica, M., Jankovic-Castvan, I., & Kostic, M. M. (2021). Oxidized Hemp Fibers with Simultaneously Increased Capillarity and Reduced Moisture Sorption as Suitable Textile Material for Advanced Application in Sportswear. Fibers and Polymers, 22(7), 2052–2062. https://doi.org/10.1007/s12221-021-0450-y

[22] Mohd Azli, N. N., Misnon, M. I., Ibrahim, N., & Ismail, S. I. (2023). Yoga sportswear design, functional attributes and wear comfort properties: A review. Journal of Physical Education and Sport, 23(8), 2073–2085. https://doi.org/10.7752/jpes.2023.08238

[23] Nasrin, S., Mandal, S., Islam, M. M., Petrova, A., Agnew, R. J., & Boorady, L. M. (2023). Factors Affecting the Sweat-Drying Performance of Active Sportswear A Review. Textiles, 3(3). https://doi.org/10.3390/textiles3030022

[24] Navalgund, S., & Dedhia, E. (2025). A study of consumers' experiences with sportswear. International Journal of Innovative Research in Technology, 12(3), 1–7. ISSN: 2349-6002.

[25] Samyuktha, V., & Ramakrishnan, G. (2020). Development of Eco-Friendly Sportswear using Recycled Polyester/Cotton Fibers. International Research Journal of Engineering and Technology (IRJET), 07(06), 171–175.

[26] Saravanan, D. K., Shobanasree, P. C., Vibha, G., Lavanya, M., Anisha, P. P. P., & Siranjeevi, G. (2016). An Overview on the Influence of Fabric Structural Parameters in Sports Intimate Apparels. International Conference on Information Engineering, Management and Security, 28–32. https://docslib.org/doc/3682851.

[27] Suhaimi, S. A., Ruznan, W. S., Hussain, R. N. J., Mohd Nor, M. A., & Ahmad, M. R. (2025). Thermoregulatory Comfort Properties of Sports Jersey Fabric: A Review. Journal of Mechanical Engineering, 22(1), 191–206. https://doi.org/10.24191/jmeche.v22i1.4563.

[28] Taştan Özkan, E., Kaplangiray, B., Şekir, U., & Şahin, Ş. (2023). Investigation of the thermal comfort of the sportswear by standing thermal manikin and thermal imaging techniques. Journal of Engineered Fibers and Fabrics, 18. https://doi.org/10.1177/15589250231180248

[29] Technavio. (2024). Global Spartech textiles market 2023–2028. Technavio Research.

[30] Turukmane, R., & Daberao, A. (2023). Review Textile Fibres for Sports Applications. Journal of the Textile Association, 84, 21–23. https://doi.org/10.56716/4/2284.

[31] Vasile, S., Georgievska, M., Copot, C., & De Raeve, A. (2023). Comparative Analysis of Elastic Polyester Sportswear Fabrics with Printed Graphene Patterns. Materials, 16(5), Article 5. https://doi.org/10.3390/ma16052028