Analysis of Physiological Effects of Compression Gear on American College and Pro-Level Football Athletes

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Background: From 2012 to 2019, there were approximately 3,455 National Football League (NFL) reported injuries, accounting for concussions, MCL tears, and ACL tears (*Injury Data Since 2015*, 2023). While soft tissue injuries are not reflected in this data, lower extremity strains, such as hamstring strains, are the most common form of injury among NFL athletes (*Transcript of 2019 Player Health and Safety End of Season Briefing*, 2020). The frequency and high burden of these injuries necessitates research and development efforts aimed at understanding injury risk factors, mitigation, and gear impacts, among additional topics (Sclafani et al., 2022; *Transcript of 2019 Player Health and Safety End of Season Briefing*, 2020).

In terms of gear, there is widespread commercial acceptance of compression garments as tools for reducing injury, promoting recovery, and improving performance in athletic activity (Walker, 2016). In the football market, compression girdles provide a compressive fit alongside padding to protect the wearer's hips, thighs, and/or tailbone (*Football Girdle Buying Guide*, n.d.). Physiological benefits include improvements in joint position awareness, reduced muscle oscillatory properties, improved perceptions of muscle soreness, and increased blood flow (Weakley et al., 2022). There is also a commercial belief that, despite a lack of meaningful evidence, compression garments can reduce swelling, increase muscle oxygenation, and reduce perception of fatigue (Walker, 2016).

While studies have been conducted to assess the physiological benefits of compression garments, there remains a large gap in the scientific literature regarding the physiological effects of compression girdles for performance athletes. Therefore, the purpose of this research was to determine the hypothalamus temperature (THY), skin blood flow (SBF), skin temperature (TSK), sweat rate (SWA), temperature sensation, and comfort perceptions of the male human body when wearing a compression girdle.

Method: Three base layer configurations were analyzed, consisting of a compression tank, socks, cleats, and either boxer briefs, a girdle, or a girdle in conjunction with compression tights. The researchers also evaluated each base layer configuration in both practice and play settings (Figure 1). For practice attire, athletic shorts were donned on top of each base layer configuration. For play attire, football uniform pants and jersey shirt were worn on top of each base layer configuration. The compression tank was not worn under the jersey shirt.

Using an ANDI sweating thermal manikin in an environmental chamber, physiological measurements were collected under constant ambient conditions (32˚C, 65%

configuration.

relative humidity, and 0.4 m/s windspeed) to replicate game play. A ManikinPC[2] human thermal model plugin was utilized within the ThermDAC software to replicate real-time physiological and thermoregulatory responses to activity. Each repetition followed a 2.5-hour test protocol simulating the game play of a wide receiver, with MET rates selected for each activity based on the 2011 Compendium of Physical Activities (Ainsworth et al., 2011). The ManikinPC[2] software collected hypothalamus temperature (THY), skin blood flow (SBF), skin temperature (TSK), sweat rate (SWA), temperature sensation, and comfort perceptions throughout each repetition. The measured differences were analyzed according to appropriate statistical analysis procedures including one-way ANOVAs and two-sample post hoc t-tests.

Results: Findings demonstrated an improvement in SBF when wearing the compression girdle either alone or with tights in both the practice and play ensembles compared to wearing traditional boxer briefs (Figure 2). An increase in blood flow carries oxygen molecules to the muscles, therefore leading to efficient muscle recovery times (Murphy, 2017). Results also indicated that compared to boxer briefs, wearing a compression girdle in combination with multiple layers significantly increases THY and TSK, leading to quicker onset of fatigue and heat related illness. SWA differences between garment configurations were negligible. Significant differences ($p<0.05$) were found between garment configurations for comfort and temperature sensations.

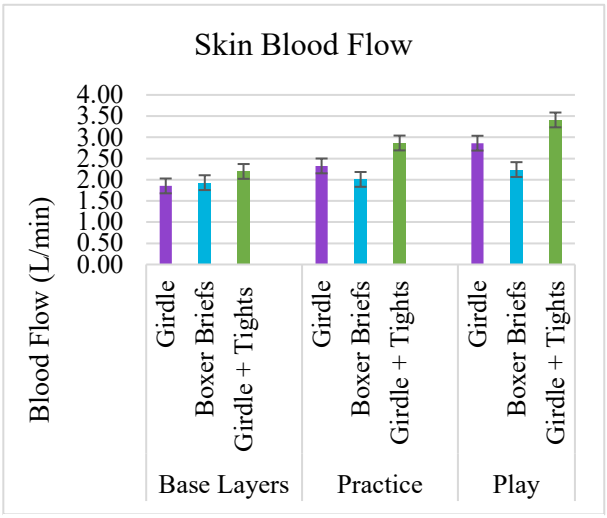

Figure 2. Average SBF for Base Layers, Practice, and Play garments.

When worn alone, with no other layers, the compression girdle was the most comfortable in terms of THY, TSK, SWA, and temperature sensation. Wearing the compression girdle in combination with tights leads to the greatest skin blood flow, however, it is the least comfortable in terms of physiological responses and comfort perceptions. This is expected as additional clothing layers increases thermal insulation leading to decreased heat transfer from the body to the external environment, creating a warmer clothing microclimate. This in turn leads to lower comfort perception levels and a faster rise in core temperature, skin temperature, and sweat rate (Havenith, 1999, 2002).

Conclusions: The objective of this research was to determine whether compression girdles have the physiological benefits claimed by manufacturers and athletics professionals within the industry. Under the specific ambient conditions, physiological protocol, and garment ensembles tested in this study, an increase in SBF was found for compression girdles which may lead to more efficient muscle recovery. However, results also show that an additional or thicker base layer such as a padded compression girdle, comes at the cost of decreased physiological comfort as increases in THY, SWA, and TSK were found along with lower comfort perceptions.

Limitations of this study include the inability to isolate and analyze lower body SBF, SWA, THY, and TSK measurements. Future research should continue to evaluate compression garments and their effects on athletes to further the development of products to decrease injuries in sports.

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