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A Cross-Sectional Examination of Wrist Wrap Use Prevalence and Characterization for Ergogenic Purposes in Actively Competing Powerlifters

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ABSTRACT

Purpose: Wrist wraps are regularly incorporated by competitive powerlifters, but several product-specific variations may influence any potential ergogenic benefits. In addition, the prevalence of athletic wrist wrap use is hitherto undescribed. Methods: Seventy actively competing powerlifters (n=70; 27±6y) who competed in the last two years were randomly recruited at sanctioned meets, whereby wrist wrap use descriptive data (wrap style [F or S], wrap length, and events used), wrap tightness (assessed via pulse oximeter-detected oxygen saturation (SpO_2) and subjective discomfort [Borg CR10+]), as well as post-meet bench press one repetition maximum (1RM) were collected. Wrist wrap use prevalence data (wrap style, wrap length, and events used) were compared across TX, NC/SC, and CA regions, along with any potential correlations between both region-collapsed wrapped SpO_2 and bench press. Finally, predictors of bench press 1RM (weight [kg], age [y], stiff wrap, wrap length, wrapped discomfort [WCR10+], and $WSpO_2$) were assessed using linear regression, whereby all aforementioned statistical analyses were set at a significance level of $p<.05$. Results: Analyses failed to detect any significant regional differences in wrap style, length, or events used ($p>0.05$). Moreover, linear regression analysis revealed a significant effect ($r^2= 0.851$, $p = 0.02$) where weight solely predicted bench press 1RM ($p = 0.0433$). Conclusions: Although we failed to detect any significant wrist wrap relationships, actively competing powerlifters nonetheless prominently utilize wraps across the regions assessed. Therefore, the potential for wrist wraps to augment bench press performance warrants further elucidation in a controlled, standardized investigation.

Keywords: Resistance training; barbell bench press; barbell back squat; pulse oximetry; Borg CR10+

INTRODUCTION

Powerlifting is a strength-based competitive sport consisting of three sequential barbell events: back squat, bench press, and deadlift (15, 26). Individuals are allotted three attempts in each event to reach a maximal weight while subjected to strict judging criteria. Subsequently, the lifter's best attempts from each event are summed and then normalized to body weight using mathematical coefficients (such as the empirically validated Wilks Coefficient) to determine the strongest relative athlete (15, 39). Furthermore, powerlifting training prioritizes several barbell movements associated with benching, squatting, and overhead pressing that elicit excessive strain on the musculoskeletal system (i.e., joints) (1, 2, 9, 13, 29). Without proper support and preventive care, these strength athletes are susceptible to overuse injuries amidst the broad muscle groups responsible for performing the aforementioned and associated exercises (14). Therefore, these athletes often use supportive equipment to generally aid their training to minimize injury while potentially gaining a competitive advantage (7, 9, 12-14, 20, 25, 27, 30). Bengtsson et al. (6) reported that 18-46% of injuries in powerlifting are associated with bench press, which allows for the least amount of supportive gear. Wrist wraps are one such piece of ancillary equipment and commonly used in the raw (limited supportive gear) powerlifting division within official competitive federations (11).

Despite claims concerning injury prevention, rehabilitation, and more general performance improvements, strikingly few investigations corroborate the efficacy of wrist wrap use (4, 10, 13, 20, 25). Specifically, a single investigation by Judge et al. (20) described a significant wrist wrap-mediated improvement in throwing distance amongst Olympic male shotput athletes relative to unwrapped controls. The authors contend this performance enhancement was likely facilitated by augmenting natural passive stiffness across the wrist joint (20). Moreover, several product-specific variations like type (i.e., material and length) and tightness of wrist wraps may alter the assistance provided to the wearer (13, 20). Despite widespread wrist wrap use in both recreational and competitive powerlifters, no investigations have hitherto characterized their use amongst these athletes, nor the potentially large differences between the multiplicity of products worn. In addition, it is unknown whether any meaningful relationships exist with wrap use and successful competitive performance. Therefore, the current investigation sought to characterize the pervasiveness of wrist wrap use amongst competitive powerlifters across multiple United States regions with regard to type/material, length, and athlete-imposed tightness, as well as if these attributes or general wrist wrap use significantly predicts competitive barbell bench press performance.

MATERIALS AND METHODS

Experimental Approach to the Problem

In this cross-sectional and exploratory investigation, participants were recruited via convenience sampling at official, locally sanctioned USA Powerlifting (USAPL) and United States Powerlifting Association (USPA) meets in California (CA), Texas (TX), as well as North (NC) and South Carolina (SC) regions. All were subject to initial familiarization, which incorporated a comprehensive wrist wrap use (events [squat and/or bench press], styles [flexible (F) or stiff (S)], tightness, and lengths) questionnaire and consent form. Wrist wrap style was discerned by the ability of the material to stretch; a more detailed description can be found in Figure 1. Length was assessed by measuring the full unfurled length of the wrap and tightness was inferred using subjective discomfort, as well as finger oxygen saturation (SpO_2) via pulse oximetry. The aforementioned variables were compared across data collection regions and further assessed for their ability to predict the athletes' best achieved competition barbell bench press at that meet.

Participants

Seventy actively competing powerlifters (n = 53 males, n=17 females) between the ages of 18-48 volunteered for and completed this study, whereby individuals were randomly selected throughout the weigh-in process (i.e., equipment check, weigh-in, and obtaining rack heights) at various local meets in the aforementioned regions. Participants included individuals competing at the visited meets, as well as both their coaches and general spectators at the events. Briefly, participants were excluded if competing outside the "raw" division (classic raw, single-ply, multi-ply), as other divisions encompass additional equipment that may impact equipment preference (30). Furthermore, all

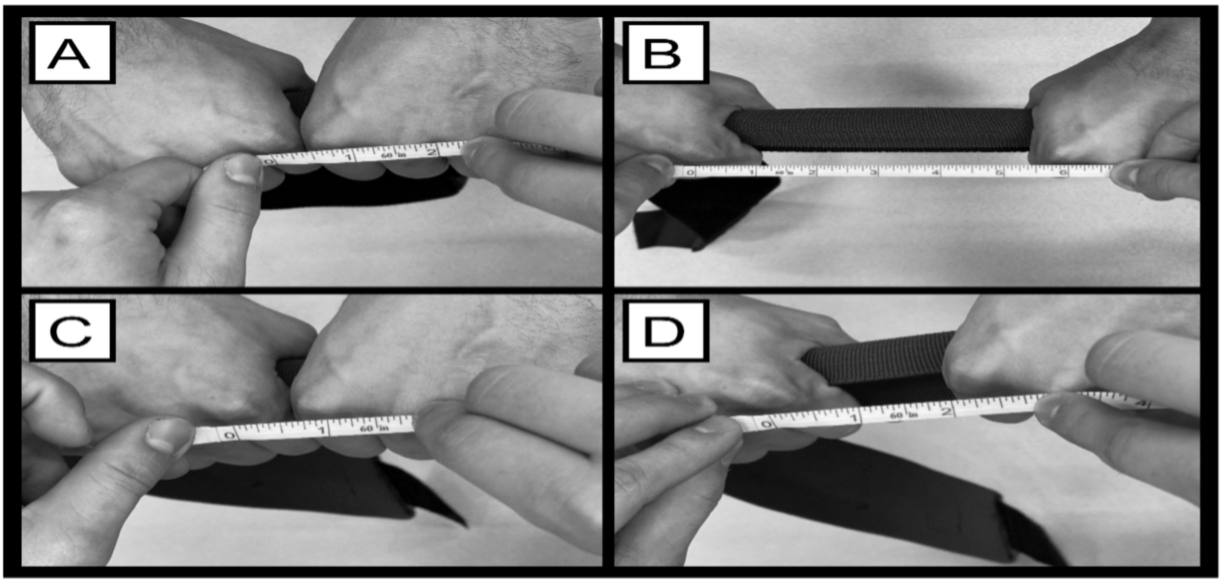

Figure 1. Visualization of wrist wrap style (F or S) assessment method. Style was determined by the capacity of the wrist wrap to stretch, whereby flexible (A, B) was indicated to have a stretch of greater than or equal to 1.5 inches and stiff (C, D) was less than 1.5 inches.

participants were considered "actively competing" by having competed at least once in the last two years and were required to have a minimum 300 Wilks coefficient (implemented in our previous investigations to preclude inexperienced athletes) obtained in the aforementioned active competition timeframe (26, 32). The aforementioned active competitive timeframe was chosen to accommodate athletes who may have been unable to participate in sanctioned meets due to limitations imposed by the ongoing SARS CoV-2/COVID-19 pandemic. Although several body weight-corrected metrics are employed by powerlifting federations to assess athlete ranking, the Wilks coefficient was chosen for the present investigation as the best supported empirically-validated figure (15, 26, 32, 39). Each participant's qualifying Wilks score was checked and verified during the screening process using data from the Open Powerlifting Project database (OpenPowerlifting.org). Furthermore, to minimize geographical sampling bias and encompass a more nationwide understanding of practical wrist wrap use in these athletes, powerlifter subjects were recruited from various locations; these regions include both USPA and USAPL meets in TX, CA, as well as NC and SC locations.

Procedures

Wrist Wrap Questionnaire

Participants were asked a series of question to assess wrist wrap habits, including which events (squat and/or bench press), styles (F or S), and lengths each employed. Specifically, style (F or S) was determined by asking participants to grip the middle of their wrap where the distance between the first index knuckles of both hands was measured. Participants were subsequently instructed to maximally stretch their wraps and the widest distance reached was measured (see Figure 1). Lastly, participants were asked to unfurl and lay their unstretched wrist wrap flat, whereby length was measured end-to-end (Velcro strap to thump loop).

Wrap Tightness Assessment

Both finger oxygen saturation (SpO_2) and Borg CR10+ subjective discomfort were utilized in an attempt to approximate a wrist wrap tightness profile as no other research has yet characterized the former. Specifically, a previously validated CMS50DL pulse oximeter (Zimmer Biomet, Warsaw, IA) was used to determine the percentage of oxygenated hemoglobin (23). This method has been employed in previous literature to accurately infer the compressive pressure required to elicit upper-body arterial occlusion pressure in blood flow restriction investigations (22, 40). The CR10+ discomfort scale was explained in detail akin to the methods described by Loenneke et al. (8, 24) as a more precise determinant relative to alternative subjective metrics (5). Participants rested in a seated position for approximately 5 minutes before collection of baseline CR10+ and SpO_2 during the initial familiarization and questionnaire period (3, 28). The research technician then placed the pulse oximeter on the right hand index finger in each instance, keeping the device slightly below heart level to remove any gravitational influence; furthermore, final measurements were only acquired after 10-15 seconds had passed to reach a stable reading (34). Once baseline parameters were established, the participant was asked to wrap their right hand as they normally would for competition, following the same steps as described previously to obtain wrapped CR10+ and SpO_2 in each instance. More specifically, the participant was asked to wrap their wrists as similarly as possible to their typical use for each event (i.e., bench press and/or squat), wherein both CR10+ and SpO_2 were obtained 15 seconds after wrists had been wrapped.

Statistical Analysis

Participant descriptive data (age [y], body mass [kg], squat 1RM [kg], bench 1RM [kg], PL total [kg], Qualifying Wilks [points]) were assessed using individual one way (region [TX, CA, and NC/SC]) ANOVA. Additionally, squat- and bench-specific Wilks coefficient were separately calculated from each participant's best most recent competition squat and bench press, wherein these figures were acquired from the OpenPowerlifting project database. Wrist wrap questionnaire assessments (events [squat and/or bench press], styles [F or S] and length) were analyzed using Pearson's chi-squared tests and the relationships between squat and bench press wrap tightness (wrapped subjective discomfort [ΔBWCR10+ and ΔSWCR10+] and SpO_2 [ΔSpO_2]), squat and bench press 1RM (acquired post-meet via OpenPowerlifting.org), and squat- and bench press-specific Wilks coefficient were assessed using individual region-collapsed Pearson's product-moment correlations. Bench wrap use, squat and bench press 1RM, and squat- and bench press-specific Wilks coefficient were analyzed using region-collapsed Welch's t-tests. Finally, the ability of squat- and bench-specific Wilks coefficient, age, wrap style, wrap length, and the change from baseline/unwrapped to wrapped discomfort and wrapped SpO_2 (ΔBWCR10+, ΔSWCR10+, $\Delta BWSpO_2$, and $\Delta SWSpO_2$, respectively) to cumulatively predict squat and bench press 1RM was assessed using multiple linear regressions. If significant interaction effects were present following ANOVA testing, pairwise comparison analyses were used with a Bonferroni adjustment for alpha inflation. All analyses were performed in R (version 4.2; R Core Team; Vienna, AT) with an alpha level of 0.05. Descriptive statistics are reported as mean ± standard deviation (SD). Confidence intervals (CI) for significant comparisons are reported as 95% CI (lower bound, upper bound).

RESULTS

Participants

A total of 70 participants volunteered for this investigation, wherein all participant descriptive data are depicted in Table 1. Analyses failed to reveal any regional differences between PL total (p = 0.595), squat one 1RM (p = 0.566), and bench press 1RM (p = 0.453). Consequently, analyses did reveal a main regional effect for age (p = 0.048), BM (p = 0.031), and Wilks coefficient (p = 0.017). While the aforementioned variables were statistically different, pairwise comparison did not reveal any further interaction effects between regions.

Wrist Wrap Questionnaire Assessment

Of the 70 participants, 71.43% employed wrist wraps for squat and 88.57% for bench press. Although wraps were adorned less frequently for squat, the flexible variation had a total reported use of 6.25% at <59 cm, 15.18% at 60-99 cm, and 13.39% at ≥100 cm. In addition, stiff products were used 0.89% at <59 cm, 7.14% at 60-99 cm, and 2.69% at ≥100 cm. Contrariwise, wrist wrap use was higher for bench

Table 1. Powerlifter descriptive data across Texas (TX), North/South Carolina (NC/SC), and California (CA) coast regions including age, BM, both post meet barbell squat and bench 1RM, powerlifting (PL) total, and qualifying Wilks coefficient. * Indicates significant main effect. All data are reported as means ± SD.

Region	n	Age (y)	BM (kg)	Squat 1RM (kg)	Bench 1RM (kg)	PL Total (kg)	Wilks (points)
TX	30	25±6	92.1±16.6	208±42	130±30	568±106	369±46
NC/SC	20	29±7	93.7±22.1	212±58	137±45	592±156	397±45
CA	20	28±5	79.5±17.4	195±55	121±45	547±149	406±46
p-value	NA	0.048	0.031	0.566	0.453	0.595	0.017*

Table 2. Region-collapsed frequency of wrist wrap use in actively competing powerlifters.

Region	Texas	North & South Carolina	California	*P*-value	n
Events					
Bench	3	6	5		
Squat & Bench	24	13	11	0.162	69
Neither	2	1	2		
Squat	NA	NA	2		
Length					
<59cm	4	3	5		
59-99cm	10	12	9	0.197	64
≥100cm	13	4	4		
Style					
Flexible	18	13	9	0.719	62
Stiff	9	6	7		

press, whereby the flexible variations had a reported use of 6.25% at <59 cm, 15.18% at 60-99 cm, and 14.29% at ≥100 cm while stiff saw use at 18.18% at <59 cm, 59.09% at 60-99 cm, and 22.72% at ≥100 cm. Frequency of wrist wrap use is displayed in Table 2; briefly, Pearson's chi-squared tests failed to reveal any significant differences in the region-collapsed frequency of wrist wraps used across events (i.e., squat and/or bench) ($X_2^6 = 9.2$, $p = 0.162$). Similarly, there were no significance differences in the event-collapsed bench press wrap length ($X_2^4 = 0.03$, $p = 0.197$) nor amongst event-and-region-collapsed style across regions ($X_2^2 = 0.659$, $p = 0.719$).

Wrap Tightness Assessment

There were no significant changes between CR10+ subjective discomfort and BWSpO2 when wrapped relative to baseline values ($p = 0.522$, $r = -0.147$, 95% CI [-0.674, 0.398]), as well as no significance between CR10+ subjective discomfort and $SWSpO_2$ relative to baseline values ($p = 0.327$, $r = 0.283$, 95% CI [-0.292, 0.707]). Although not statistically significant, there was a small negative correlation between bench press 1RM and $\Delta BWSpO_2$ ($p = 0.162$, $r = -0.267$, 95% CI [-0.577, 0.111]). Additionally, there was no significant correlation between bench press-specific Wilks coefficient and $\Delta BWSpO_2$ ($p = 0.236$, $r = -0.227$, 95% CI [-0.548, 0.152]). $\Delta SWSpO_2$ and both squat 1RM ($p = 0.828$, $r = -0.050$, 95% CI [-0.472, 0.390]) and squat-specific Wilks coefficient ($p = 0.643$, $r = 0.107$, 95% CI [-0.340, 0.515]) were similarly non-significant.

Wrist Wrap Use on Squat and Bench Press Performance Outcomes

Analyses failed to detect any significant differences in either bench press 1RM ($p = 0.584$) nor bench press-specific Wilks scores ($p = 0.747$) between those who employed wrist wraps contrasted to those who did not. Similarly, there were no significant differences in wrapped-versus-unwrapped squat 1RM ($p = 0.911$) and squat-specific Wilks coefficient ($p = 0.503$). Multiple linear regression analysis revealed a significant effect including weight, age, wrap stiffness and length, as well as BWCR10 and $BWSpO_2$ as the predictor variables for bench press 1RM ($r^2 = 0.851$, $p = 0.02$). Unsurprisingly, weight singularly significantly predicted bench press 1RM ($p = 0.043$), whereas age ($p = 0.245$), wrap stiffness ($p = 0.061$), wrap length ($p = 0.158$), BWCR10 ($p = 0.383$), and $BWSpO_2$ ($p = 0.578$) failed in this regard. For squat 1RM predictor variables, a multiple linear regression analysis revealed a significant effect including weight, age, wrap stiffness and length, along with SWCR10 and $SWSpO_2$ ($r^2 = 0.782$, $p = 0.041$). Similarly, weight eminently predicted squat 1RM ($p = 0.004$), whereby age ($p = 0.833$), wrap stiffness ($p = 0.835$), wrap length ($p = 0.980$), SWCR10 ($p = 0.950$), and $SWSpO_2$ ($p = 0.219$) did not significantly estimate within the model.

DISCUSSION

This investigation is the first to examine the prevalence of wrist wrap use in competitive powerlifters as an ergogenic aid, specifically detailing several product-specific variations and the potential for tightness-associated variables such as subjective discomfort and finger-specific oxygen saturation to predict competition bench press performance. Incidentally, we are unaware of any previous research that has examined wrist wrap use pervasiveness, whereas other investigations have assessed the effects of other compressional equipment such as knee wraps and sleeves, bench shirts, erector shirts, and deadlift suits on performance indices (13, 16, 20, 25, 30, 31, 36, 38). Nevertheless, our findings suggest that there is no universal employment of a singular wrap style or length amidst our participant pool of actively competing powerlifters.

Although not statistically significant, wrist wraps were most frequently used in the squat and bench press collectively when compared to either event alone or completely abstaining. While wrist wrap event use did not differ across TX, CA, and NC/SC regions, the 60-99 cm long flexible wraps were most commonly employed for both bench press and squat, especially when compared to the other lengths (i.e., <50 cm and > 100 cm) employed. Consequently, this may largely be due to preference of each individual as wrist wraps can be comprised of different materials that can offer a unique combination of elasticity (e.g., flexible or stiff) and support to the lifter (13). However, while stiff wraps can potentially offer more support, they were sparsely used by our subject population over the flexible variation, regardless of event or length. The athletes in the current investigation nevertheless demonstrated a clear bias towards general wrist wrap use, whereby only two participants chose not to compete with them. Although we did not record anecdotal reasons for use, this may be sourced within wrist wraps ostensible wrist stabilization; adorned to hopefully deter wrist and elbow joint injuries via restricted backward and sideways wrist movements (9, 10, 35).

Morais et al. (33) contends that powerlifters competing in the raw division readily adhere to the belief that tighter compressional equipment results in a competitive edge, which ultimately may encompass characteristics such as the style and tightness of wrist wraps worn. While the present data somewhat corroborate this notion via a clear bias towards wrist wrap use, none of the variables associated with wrap tightness yielded any significant positive relationships with strength outcomes. Specifically, subjective discomfort saw no differential changes in wrapped versus unwrapped oxygen saturation conditions; however, this may nonetheless simply illustrate that powerlifters are acclimated to the compression inherent to wrist wraps and other ancillary equipment, thus tempering any augmentations from baseline in the CR10+ metric (16, 25, 30). Despite the statistically equivocal relationships between wrap tightness and neither bench press nor squat performance variables, there may specifically be credence towards the inverse relationship observed between bench press 1RM and finger oxygen saturation with a larger sample across a wider regional recruitment area. More specifically, although squat-specific Wilks coefficient and 1RM failed to reveal any significance or correlations, when associated to bench press-specific Wilks coefficient and 1RM, SpO_2 demonstrated a small negative correlation. The latter has been indicated by numerous studies elucidating that tighter joint-based equipment augment performance, wherein this may potentially be due to the above mentioned ostensible increase in both objective and subjective stability (17, 18, 20, 21, 25, 37). Conversely, body weight was singularly the only significant predictor in estimating our participants' bench press performance. These findings are nevertheless corroborated by prior data that reported that body mass - either as total or lean body mass - is a leading factor that influences bench press strength (19).

Although the current findings provide a novel glimpse into both the prevalence of wrist wrap use and its potential relationship with competitive bench press performance, the primary limitations to the present study were its cross-sectional design and singularly bench press-specific inferences. Furthermore, participant recruitment was unequal across regions and only focused on local competitors in the United States; future research may therefore benefit from including more advanced competitors, as well as a more extensive national and international-level recruitment strategy to elucidate their potentially varying wrist wrap techniques. It is also worth noting that the COVID-19 global pandemic required us to extend our competitive criteria from one to two years, which may have increased variability in athlete performance and equipment selection associated with potentially inconsistent training regimens and powerlifting equipment trends, respectively (16). Finally, our present wrap tightness-associated data was limited by laboratory equipment accessibility, whereby Judge et al. (2015) employed a load cell to objectively assess wrist wrap tension changes across "light" and "heavy" variations. They nevertheless failed to implement this technology to quantify wrap tightness beyond describing generalized wrap material characteristics, opting to allow their shotput athlete participants to wrap until they had achieved subjectively optimal perceived support, wherein the present investigation stretching effort levels may substantially vary between individuals impacting the classification of the wrist wraps adorned. Conversely, we prioritized the implementation of the Borg CR10+ subjective discomfort scale and pulse oximetry as more readily accessible and practical technology to objectively assess wrap tightness.

In conclusion, the mechanisms that motivate continued wrist wrap use remain nebulous. While previous literature anticipates that wrist wraps may improve performance via augmenting the natural passive stiffness bestowed by the numerous muscles that cross the wrist joint, evidence substantiating their ergogenic enhancement amongst many athletic populations that voluntarily use them is hitherto unknown (13, 20). Consequently, this investigation primarily illustrated that wrist wraps are frequently used by actively competing powerlifters but failed to illustrate any significant differences in their use with respect to event, style, or lengths employed. Therefore, future research is tasked with elucidating the ergogenic viability of this tool amidst its widely varying characteristics by implementing a randomized, controlled research design.

CONCLUSION AND FUTURE RECOMMENDATIONS

The present investigation is the first study to establish the pervasiveness of wrist wrap use in actively competing powerlifters. Our data demonstrates that across TX, CA, and NC/SC regions, neither flexible nor stiff wrist wraps at varying lengths had a significantly higher reported use. Although these data failed to detect any wrist wrap relationships between style, length, events, and tightness, we further corroborate previous findings that body weight unsurprisingly significantly predicts squat and bench press 1RM. Actively competing powerlifters nonetheless demonstrated highly prominent wrist wrap use across US regions assessed and thus future research is warranted to determine their ergogenic viability amidst a plethora of varying characteristics.

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This article includes data from the OpenPowerlifting project, https://www.openpowerlifting.org. You may download a copy of the data at https://gitlab.com/openpowerlifting/opl-data

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