Exercise Physiology

Study about the measurement of weekly strength training volume divided by muscle groups in athletes. Wellness vs. women's physique

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Abstract - Aim: The objective of this study was to quantify the weekly training volume of competitive female physique athletes, identify potential differences between competitive categories Wellness (WL) and Women's Physique (WP) across various muscle groups, and compare the findings with current literature recommendations. **Methods:** A total of 9 athletes from various federations were assessed through structured questionnaires containing detailed information about their training practices. **Results:** WP showed volume increases (sets=st) from off-season to pre-contest for quadriceps (17 → 30 st; +76.47%), hamstrings (11 → 24 st; +118.18%), glutes (11 → 18 st; +63.64%), triceps surae (9.5 → 14 st; +47.37%), chest (2 → 4 st; +100%), latissimus dorsi (17 → 30 st; +76.47%), shoulders (20 → 36 st; +80%), biceps (11 → 18 st; +47.37%), triceps (11 → 18 st; +47.37%), abdominals (2 → 8 st; +300%), and paravertebrals (2 → 4 st; +100%). WL athletes maintained stable volumes, particularly for: quadriceps (28 → 28 st) and glutes (24 → 24 st), with small changes across other muscle groups. WP markedly increased total weekly training volume during pre-contest, while WL showed a more stable profile. These differences highlight distinct periodization models aligned with aesthetic and functional requirements of each competitive category. **Conclusion:** These findings align with current literature regarding training periodization in physique sports. Nonetheless, further research is warranted to elucidate the specific training approaches employed by athletes in different categories, thereby enabling more precise and evidence-based recommendations.

Keywords: weight lifting, resistance exercise, resistance training.

Introduction

Strength training (ST) is a well-established intervention for promoting increases in muscle mass and strenght [1]. In trained women, training volume and frequency have evolved significantly over the past decades, requiring more individualized approaches for hypertrophy[2]. To maximize hypertrophic adaptations, it has been proposed that the strategic manipulation of ST variables is essential[3]. Among these variables, training volume - commonly defined as the number of sets performed per muscle group per week - has been identified as one of the most influential factors. Consequently, numerous systematic reviews, meta-analyses, and position stands established evidence-based guidelines on the optimal training volume for maximizing muscle hypertrophy across various populations[4-8].

Despite these efforts, the current literature remains somewhat inconclusive regarding the ideal weekly training volume per muscle group to maximize hypertrophy[9]. Some guidelines recommend that natural bodybuilders perform approximately 40-70 repetitions per session, at least twice per week, suggesting that higher volumes may be more appropriate for advanced individuals. Additionally, a meta-analysis reported that performing at least 10 sets per muscle group per week produced superior hypertrophic outcomes compared to lower volumes[6]. However, the available data were insufficient to determine whether training volumes above this threshold yield further benefits. More recent evidence has suggested limiting weekly volume to fewer than 15 sets per muscle group due to concerns that excessive volume may impair recovery and ultimately compromise muscle growth[10].

Although these recommendations provide a valuable framework for hypertrophy-oriented training, no studies to date have investigated whether these guidelines reflect the actual training practices of competitive physique athletes, whose primary goal is to maximize muscular development. Therefore, the aim of this study was to quantify the weekly training volume of competitive physique athletes, assess potential differences by sex and competitive division across various muscle groups, and compare these findings with current evidence-based recommendations regarding strength training volume.

Materials and methods

Study design

A cross-sectional online survey was conducted between April and December 2020. The study employed self-administered questionnaires (via Google Forms) in two languages (English and Portuguese), distributed through social media platforms as well as the authors' professional and personal networks. The inclusion criteria were as follows: (1) competitive athletes from any federation or affiliation; (2) participation in at least one competition within the past two years; (3) individuals of any sex; (4) athletes from any competitive category or division; and (5) participants engaged in a consistent training routine.

To enhance transparency, a mock version of the online questionnaire was made available to allow readers to review the structure and phrasing of the survey items (link available in the Internet Resources section). Each participant completed two questionnaires: one reflecting their practices during the off-season and another for the pre-contest period. The survey addressed the following topics:

Participants, sampling, and population

A total of 9 competitive female physique athletes consented to the analysis of their current ST programs during both off-season and pre-contest periods. Participants were actively competing across various federations and affiliations, including:

- International Federation of Bodybuilding and Fitness - São Paulo (IFBB SP): 2 athletes
- São Paulo Fisiculturismo e Fitness (SPFF): 2 athletes
- National Physique Committee PRO LEAGUE (NPC): 5 athletes

All participants signed informed consent forms authorizing the analysis of their training programs. The study complied with all ethical standards for research involving human participants, in accordance with the Declaration of Helsinki, and was approved by the Research Ethics Committee of São Judas Tadeu University (CAAE: 66523917.1.0000.0089; approval number: 2.022.898).

Weekly set volume by muscle group

The weekly training volume (TV) per muscle group was calculated based on established methodologies from previous studies[11,12].

$$TV = Ne * Ns * Nt$$

where Ne = Number of exercises per muscle group per training session, Ns = number of sets per exercise in each training section, and Nt = weekly training frequency per muscle group.

Muscle groups and exercise selection

This study analyzed the primary muscle groups most frequently targeted in hypertrophy-oriented training programs: pectoralis major, latissimus dorsi, deltoids, biceps brachii, triceps brachii, gluteal muscles, quadriceps, hamstrings, triceps surae, and abdominal muscles. For each muscle group, commonly performed exercises (e.g., French press for triceps brachii) were considered. All exercise variations were included, regardless of the modality employed (free weights, machines, cable systems, or bodyweight exercises).

Data analysis

Descriptive data were presented as mean ± standard deviation (SD), median (Med), minimum (Min), and maximum (Max) values. The Shapiro-Wilk test indicated that the data did not follow a normal distribution. Therefore, The Wilcoxon was applied using individual paired data (off-season vs pre-contest) at the athlete level. Median (min-max) values are presented for descriptive purposes only. In cases where the test could not be computed due to ties or insufficient variability, p-values are reported as NA. Given the exploratory nature of the study and the limited number of Women's Physique athletes available, no formal a priori sample size calculation for paired nonparametric comparisons was performed. Therefore, results should be interpreted as exploratory, with emphasis on descriptive statistics and within-category changes. Significance at $p < 0.05$ was stablished.

Results

The aim of this study was to quantify weekly training volume among competitive female physique athletes, assess differences between categories Wellness and Women's Physique across various muscle groups, and compare the results to current strength training (ST) guidelines Table 1.

Discussion

This study quantified weekly strength training volume in competitive female physique athletes and compared periodization patterns between the Wellness and

Table 1 - Comparison (P-value) of weekly sets volume performed to upper body per week in Off-season and Pre-contest in categories.

		Period			
Group muscle	**Categories**	**Off-season**	**Pre context**	**Δ%**	**Wilcoxon's Test**
Pectoral	Wellness	1.00 (0.00-16.00)	1.50 (0.00-16.00)	50	p-value = 0.20
	Women's Physique	2.00 (0.00-4.00)	4.00 (0.00-20.00)	100	p-value = NA
Latissimus dorsi					
	Wellness	16.00 (0.00-32.00)	16.00 (0.00-36.00)	0	p-value = 0.68
	Women's Physique	17.00 (4.00-30.00)	30.00 (4.00-48.00)	76.47	p-value = NA
Deltoid					
	Wellness	18.00 (0.00-50.00)	17.00 (0.00-50.00)	-5.56	p-value = 0.31
	Women's Physique	20.00 (4.00-36.00)	36.00 (4.00-40.00)	80	p-value = NA
Biceps Brachii					
	Wellness	8.00 (0.00-24.00)	7.00 (0.00-24.00)	-12.05	p-value = 0.32
	Women's Physique	11.00 (4.00-18.00)	18.00 (4.00-36.00)	63.64	p-value = NA
Triceps Brachii					
	Wellness	10.00 (0.00-26.00)	8.50 (0.00-26.00)	-15	p-value = 0.23
	Women's Physique	11.00 (4.00-18.00)	18.00 (4.00-36.00)	63.64	p-value = NA

Women's Physique categories across off-season and pre-contest phases. The main finding was the clear divergence in volume-management strategies between categories. While Wellness athletes maintained relatively stable weekly training volumes across most muscle groups, Women's Physique athletes demonstrated marked increases in training volume during the pre-contest phase, affecting both upper and lower body musculature Table 2.

In the Wellness category, lower-body muscle groups weekly training volumes, particularly quadriceps and gluteal muscles, remained largely unchanged between phases. This stability suggests a maintenance-oriented strategy, likely reflecting the aesthetic demands of the division, which emphasize lower-body development achieved earlier in the season rather than aggressive volume escalation during contest preparation. Minor fluctuations observed in upper-body muscle groups did not indicate a systematic increase in overall training load. In contrast, Women's Physique athletes exhibited substantial increases in weekly training volume from off-season to pre-contest across multiple muscle groups, including quadriceps, hamstrings, gluteals, latissimus dorsi, deltoids, arms, abdominal muscles, and paravertebral musculature. The most pronounced relative changes were observed in core-related muscle groups, such as abdominals and lower back, which may reflect a strategic emphasis on muscular definition, density, and trunk stability during the pre-contest phase. These findings highlight a distinct periodization approach characterized by progressive volume escalation rather than volume maintenance.

These category-specific strategies align with current evidence indicating that training volume is a primary driver of hypertrophic adaptations, particularly in trained individuals. Meta-analytic data suggest that performing at least 10 sets per muscle group per week is associated with superior hypertrophy compared with lower volumes, while the benefits of substantially higher volumes remain less clear and may be constrained by recovery capacity[6]. In the present study, both categories frequently exceeded this minimum threshold, especially during the pre-contest phase in Women's Physique athletes, underscoring the high-volume nature of competitive physique training. However, excessive volume may impair recovery and compromise muscle growth when not properly managed[13].

The stable volume profile observed in Wellness athletes may therefore represent a strategy aimed at preserving muscle mass while minimizing accumulated fatigue as competition approaches. Conversely, the aggressive volume increases observed in Women's Physique athletes suggest a deliberate trade-off between stimulus magnitude and recovery, possibly supported by concurrent adjustments in nutrition, rest, and increase cardiovascular training, as described in previous contest preparation studies[14-23]. Regarding cardiovascular training, Wellness athletes demonstrated a significant increase in cardio duration per session during the pre-contest phase, while frequency remained relatively stable. This pattern suggests a preference for extending session duration rather than increasing weekly frequency, potentially to enhance fat loss while minimizing interference with resistance training adaptations Table 3. Concurrent endurance and resistance training has been shown to influence metabolic rate and body composition, particularly during energy-restricted

Table 2 - Comparison (P-value) of weekly sets volume performed to lower body and CORE per week in Off-season and Pre-contest in categories.

		Period			
Group muscle	**Categories**	**Off-season**	**Pre-context**	**Δ%**	**Wilcoxon's Test**
Quadriceps					
	Wellness	28.00 (1.00-60.00)	28.00 (2.00-50.00)	0	p-value = 0.75
	Woman's Physique	17.00 (4.00-30.00)	30.00 (8.00-36.00)	76.47	p-value = 0.32
Hamstrings					
	Wellness	24.00 (1.00-40.00)	25.50 (1.00-40.00)	6.25	p-value = 0.41
	Woman's Physique	11.00 (4.00-18.00)	24.00 (8.00-36.00)	118.18	p-value = 0.18
Gluteal					
	Wellness	24.00 (3.00-90.00)	24.00 (1.00-90.00)	0	p-value = 0.71
	Woman's Physique	11.00 (4.00-18.00)	18.00 (4.00-24.00)	63.64	p-value = 0.31
Triceps surae					
	Wellness	12.00 (0.00-36.00)	13.00 (0.00-36.00)	8.33	p-value = 0.31
	Woman's Physique	9.50 (5.00-14.00)	14.00 (4.00-40.00)	47.37	p-value = 0.32
Abdominals					
	Wellness	12.00 (0.00-44.00)	13.50 (0.00-44.00)	12.5	p-value = 0.78
	Woman's Physique	2.00 (0.00-4.00)	8.00 (5.00-20.00)	300	p-value = 0.18
Lower back					
	Wellness	1.00 (0.00-18.00)	1.00 (0.00-18.00)	0	p-value = 0.28
	Woman's Physique	2.00 (0.00-4.00)	4.00 (0.00-20.00)	100	p-value = NA

Table 3 - Cardio work training off-season and pre-contest.

		Weekly frequency		
Categories	**Off-season**	**Pre-contest**	**Δ%**	**Wilcoxon's Test**
Wellness	6.00 (0.00-7.00)	6.50 (0.00-7.00)	8.33	p-value = 0.25
Woman's Physique	1.50 (0.00-3.00)	1.50 (0.00-3.00)	0	p-value = NA
		During the session-min		
Categories	Off-season	Pre-contest		Wilcoxon's Test
Wellness	40.00 (0.00-65.00)	40.00 (0.00-125.00)	0	p-value = 0.03*
Woman's Physique	15.00 (0.00-30.00)	30.00 (0.00-40.00)	100	p-value = NA

phases[24,25]. In Women's Physique athletes, although median increases in cardio duration were observed, statistical inference was limited by sample size, and these results should be interpreted descriptively.

Collectively, these findings support the notion that competitive physique categories adopt distinct training periodization models aligned with their specific aesthetic and functional requirements. The divergence observed between Wellness and Women's Physique athletes emphasizes the need for category-specific training recommendations rather than generalized prescriptions derived from non-competitive or mixed athletic populations. Current guidelines provided by organizations such as the American College of Sports Medicine and the National Strength and Conditioning Association[7,26] offer valuable frameworks for general populations, but may not fully capture the demands of highly trained physique athletes.

Limitations must be acknowledged, as small sample size, particularly within the Women's Physique category, limits statistical power and generalizability, reinforcing the exploratory nature of the study. Additionally, training data were self-reported, which may introduce recall bias; however, the objective and structured nature of the questionnaire likely mitigated this limitation. Despite these constraints, this study provides novel insights into real-world training practices among competitive female physique athletes. A limitation of the study was the absence of a pilot test or evaluator training; however, this was justified given the objective nature of the questions, which reflected actual training routines. Questionnaires were completed autonomously, minimizing researcher influence.

Conclusion

This study did not analyze total training load based on lifted weight, but rather total weekly volume, representing a limitation. Future research should incorporate total workload analysis to better inform training strategies for female physique athletes. For now, we recommend increased cardiovascular training during the pre-contest period and reduced total training volume - an approach supported by current evidence.

Wellness and Women's Physique athletes apply distinct training volume strategies across off-season and pre-contest phases. Wellness athletes generally maintain stable weekly volumes, particularly for lower-body muscle groups, whereas Women's Physique athletes tend to increase total weekly volume during the pre-contest phase across lower-body, upper-body, and core musculature. From an applied perspective, coaches are advised to maintain training volume in muscle groups that already meet category-specific aesthetic standards, selectively increase weekly sets for target muscles that require greater definition or density during pre-contest, and avoid global volume escalation. Volume adjustments should be implemented gradually and accompanied by close monitoring of recovery, fatigue, and performance markers to preserve training quality throughout contest preparation. This study provides a novel contribution by systematically analyzing training volume in competitive female physique athletes, offering a foundation for future research and evidence-based coaching.

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Internet Resources

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