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REVIEW ARTICLE

Resistance training status detection via local muscular endurance adaptation maximum repetition strategy: Brief review

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ABSTRACT

Aim: The strength-endurance maximum repetition strategy is local muscular endurance development via unprompted fatigue to voluntary contraction adaptation. Brief review aimed to maximum repetition developing on exercise selection and maximal repetition strategy of resistance training constant set workload. Multiple set and endurance maximum repetition strategy must be planned according to purposing resistance training science. Methods: The local muscular endurance periodic session and periodization detected to strength-endurance maximum repetition strategy including loading change and constant repetition set set-ups respectively, 102.3%, 90%, 85%, 80%, 75%, 70%, 65%, 60%, 55%, 50%, 45%, 40% and 30%1RM. The population of resistance training formed on local muscular endurance adaptation to date below of 2023 yr. to trained or untrained resistance individuals obtained from PubMed and Web of Science databases, specifically in S&C Journal investigation. Results: Primarily analysis of LME strategy used to absolute endurance and relative endurance performance uncommon without this critical literature search. Again, strength-endurance loading resistance session have been performed to develop absolute endurance provided high load low repetition strategy commonly used to performance detection and relative endurance detected low load high repetition strategy detected to neurofatigue detection using strength-endurance maximum repetition periodization in researches. Conclusion: Resistance training population may be detecting time-dependent strength and endurance maximum repetition periodic periodization session local muscular endurance adaptation to develop neuromuscular adaptation and strength gain. In conclusion, actual exercise and resistance training can be dependent to LME strategy.
Keywords: LME strategy, Resistance training, Absolute endurance, Relative endurance.

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INTRODUCTION

One of resistance training is local muscular endurance via strength-endurance maximum repetition strategy in dynamic strength and effective speed gain to enhance neuromuscular adaptation and strength gain, however, resistance training process from past to present to local muscular endurance adaptation uncommon popular resistance training periodization.

Endurance resistance sessions are developed maximize strength based repetition maximum set-up (Bastos-Silva et al., 2019; Iglesias et al., 2010; Pryor et al., 2011). In this case, general endurance training principle has been explained gradually maximal strength loading increase and equated volume change to reach repetition maximum strategy (Cesar et al., 20099. However, local muscular endurance adaptation is linear progression to each resistance training periodization specifically to provide loading and volume increase performing single or multiple set session (Conrado de Freitas et al., 2018; Mann et al., 2015).

The currently loading intensity change or repetition increase and decrease plan show maximum repetition (Rodriguez-Rosell et al., 2020; Shimano et al., 2006). Current review approach is that resistance training periodization should be perform on strength and endurance maximum repetition strategy to determine exercise and training condition (Clarke et al., 2015; Hirsch and Frost, 2021; Terzis et al., 2008).

Maximum repetition for example local muscular endurance adaptation planned on reverse loading periodization with 5-10% intensity change to provide absolute and relative endurance loading determination undetermined resistance training condition (Stone and Coulter, 1994; Rodriguez-Rosell et al., 2020). The local muscular endurance adaptation previously performed on constant 1 set and high fatigue 5 set and +-15RM into linear, reverse, and undulation model periodic resistance training periodization (Teodoro et al., 2019; Brigatto et al., 2019). In contrast, periodic strength and endurance session unexplained to conduct local muscular endurance adaptation is repetition maximum set-up, however local muscular endurance adaptation provided inconstant maximal load-time curve to training load determination on the performance changes (Radaelli et al., 2015; Gomes et al., 2010).

Linear long term periodization noted that reverse loading may be low and high load volume local muscular endurance strategy on periodic sets produce neuromuscular and strength gain (Stone and Coulter, 1994). However, highly local muscular endurance adaptation strategies have been reported on low load 70%-1RM - ≥15RM based maximum repetition to training fatigue determination (Conrado de Freitas et al., 2018). Furthermore, these strategies unelaborated on strength and endurance maximum repetition, respectively, absolute and relative endurance loading to detect training neuromuscular level (Shimano et al., 2006; Baker et al., 2016).

General report determined long time periodization on resistance training formed absolute local muscular endurance at 15-20RM moderate repetition to high strength gain and relative local muscular endurance at 30-40RM high repetition to low strength gain were known (Radaelli et al., 2015; Hirsch and Frost, 2021; Stone and Coulter, 1994). In this case, review will report to low load strength training and periodic session provided on maximal repetition change to relative endurance increase as exercise condition, again absolute endurance resulted on moderate load accomplishment to detect constant endurance performance level. For this reason, strength and endurance maximum repetition strategy related local muscular endurance adaptation uncleared in resistance training population. Thus, review aimed to define neuromuscular performance evolution using local muscular endurance adaptation is critical resistance session and training strategy in resistance trained population.

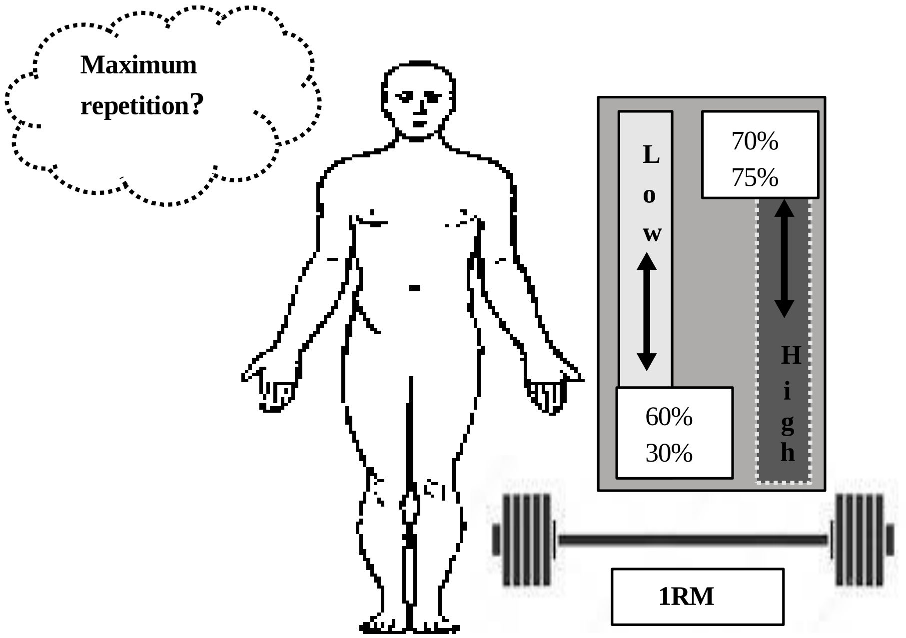

Figure 1. Local muscular endurance.

Table 1. Strength-endurance maximum repetition.

%1RM (one repetition maximum)	Repetition range (RM)
100	1
95	2
93	3
90	4
87	5
85	6
83	7
80	8
77	9
Strength/endurance (75)	10
70	11
67	12
Absolute endurance (65)	15
60	20
57	23
55	25
53	27
50	30
47	33
45	35
43	37
Relative endurance (30)	40

METHODS

The review study resulted to local muscular endurance adaptation evaluate quantitative model researches. Inclusion criteria described absolute and relative endurance resistance training periodization and periodic session databases to detect proverbial neuromuscular adaptation, endurance and strength gain. Research approach have been proven to critical results. Researches below 2023 yr. investigated in PubMed, Web of Science and S&C journal databases without local muscular endurance review. Keywords of research detected initially local muscular endurance and maximal number of repetition or number of maximum repetition and absolute endurance and relative endurance. Evaluating local endurance adaptation strategies used descriptive outcomes.

RESULTS

Provable outcomes of absolute and relative endurance localization session and periodic resistance plan resulted on local muscular endurance adaptation discussion of absolute strategies (Table 2) and relative strategies (Table 3). In this common approach reported separately different resistance loading change both absolute and relative ranges to provide local muscular endurance adaptation may be use on strength-endurance resistance training periodization. Absolute endurance strategies reported tremendous high load variability compared to relative endurance provided low load diversity in current studies limited.

Table 2. Absolute endurance outcomes.

Author	Population	Strategy	Result	Outcomes
Baker et al (2016)	Unresistance healthy men: (n=9), age (54.8 y)	Leg press, chest press 3 set – 70%1RM, 1 min interval	Leg press: -18% rep Chest press: -8%	Maximum set and repetition ineffective neuromuscular adaptation
Bastos-Silva et al (2019)	Unresistance males: (n=12), age (22.08 y)	Leg press, bench press 1 set (2s ecc vs 2s con) – 80%1RM	Leg press: 13.5 rep Bench press: 8.2	Bench press detection
Bertolaccini et al (2019)	Strength-trained men: (n=18), age (19-40 y)	Knee extension 3 set -70%1RM, 90 s interval	Knee extension: +%6 rep	Increased maximum repetition
Conrado de Freitas et al (2018)	Resistance-trained men: (n=10), age (22.7 y)	Squat 4 set – 70%1RM, 90 s interval	Squat: +%10 rep	Maximum repetition produced fatigue responses
Cesar et al (2009)	Untrained women: (n=19), age (18-26 y)	Bench press, latissimus pull down, military press, lying barbell extension, standing barbell curl, leg press, knee extension, hamstring curl 3 set – 15RM, 1 min interval	Bench press: +%8 1RM Latissimus pull down: +7% Military press: +4% Lying barbell extension: +3% Standing barbell curl: +4% Leg press: +53% Knee extension: +8% Hamstring curl: +7%	Strength-endurance strategy provided totally muscle strength gain
Davies et al (2022)	Recreationally trained: (n=12 men and n=9 women), age (26.10 y)	Bench press 1 set – 70%1RM	Bench press: +1.3% rep	Increased maximum repetition
Gomes et al (2010)	Untrained men: (n=15), age (23.9 y)	Knee extension, bench press 1 set – 80%1RM	Knee extension: +3% rep Bench press: +1.7%	Increased maximum repetition

Iglesias et al (2010)	Untrained men: (n=13), age (26.85 y)	Bench press, biceps curl 1 set- 90%1RM 1 set- 70%1RM	Bench press (90%) – 22 rep Biceps curl (90%) – 19 Bench press (70%) – 16 Biceps curl (70%) – 8	Bench press compared Biceps curl (*p* = .001)
Mann et al (2015)	Football players: (n=203), age (19.6 y)	Bench press 1 set – 102.3 kg	Bench press: +1%	Unincreased maximum repetition
Pryor et al (2011)	Collage-aged men: (n=24), age (20.7 y)	Bench press 1 set- 80%1RM	Bench press: 8.5 rep	Bench press detection
Rodriquez-Rosell et al (2020)	Untrained young men: (n=20), age (25 y)	Bench press, squat 2 set – 70%1RM 2 set – 80%1RM	Bench press (70%): 12.3 rep Squat (70%): 9.6 Bench press (80%): 7.7 Squat (80%): 6.0	Muscle neurofatigue showed both strategies to constant repetition maximum determination
Rossi et al (2016)	Untrained men: (n=8), age (24.6 y)	Squat, bench press 2 set – 70%1RM, 30 s interval 2 set – 70%1RM, 90 s interval	Squat (30s): 45.1 rep Squat (90s): 62.4 Bench press (30s): 23.4 Bench press (90s): 33.2	Moderate intervals increased maximum repetition
Simao et al (2020)	Trained men: (n=33), age (21.4 y)	Chest press, latpull down, shoulder press, seated row 3 set -75%1RM	Chest press: 26.1 rep Latpull down: 30.1 Shoulder press: 24.0 Seated row: 26.3	Self-selective intervals determine high repetition maximum
Shimano et al (2006)	Trained men: (n=8), age (25.3 y)	Back squat, bench press, arm curl 1 set – 80%1RM 1 set – 90%1RM	Back squat (80% - 90%): 11.8 – 6.5 rep Bench press (80% - 90%): 9.1 – 6.0 Arm curl (80% -90%): 8.9 – 3.9	Total body strength-endurance detection
Teodoro et al (2019)	Resistance trained men: (n=10), age (19-33 y)	Knee flexion 4 set – 70%1RM	Knee flexion total work: 2.500 (t)	Total volume based loading increase via maximum repetition strategy
Terzis et al (2008)	Untrained men: (n=12), age (22.1 y)	Leg press 2 set – 85%1RM 2 set – 70%1RM	Leg press (85%): 10 rep Leg press (70%): 22	Muscle neurofatigue showed both strategies to constant repetition maximum determination

Table 3. Relative endurance outcomes.

Author	Population	Strategy	Result	Outcomes
Brigatto et al (2019)	Untrained young men: (n=20), age (27.1 y)	Bench press, squat 1 set – 60%1RM	Hypertrophic groups (8-12RM): A= +2% bench press, +1% squat B= +2% bench press, +3% squat	Increased maximum repetition
Clarke et al (2015)	Resistance trained men: (n=15), age (19-26 y)	Bench press 1 set – 60%1RM	Bench press: 22 rep	Bench press detection
Hirsch and Frost (2021)	Powerlifters men: (n=15), age (26.8 y)	Bench press 1 set- 45%1RM	Bench press: 9.5 rep	Bench press detection
Radaelli et al (2015)	Untrained men: (n=48), age (24.4 y)	Bench press, leg press 5 set – 20RM	Bench press: +20% Leg press: +34%	Increased maximum repetition
Rodriguez-Rosell et al (2020)	Untrained young men: (n=20), age (25 y)	Bench press, squat 2 set – 60%1RM 2 set – 50%1RM	Bench press (60%): 19.3 rep Squat (60%): 16.2 Bench press (50%): 22.5 Squat (50%): 23.4	Muscle neurofatigue showed both strategies to constant repetition maximum determination
Shimano et al (2006)	Trained men: (n=8), age (25.3 y)	Back squat, bench press, arm curl 1 set – 60%1RM	Back squat: 35.9 rep Bench press: 21.6 Arm curl: 17.2	Total body endurance detection
Stone and Coulter (1994)	Collage-age women: (n=50), age (23.1 y)	Bench press, squat 1 set – 45%1RM 1 set – 55%1RM	Bench press (45%): High regime: +12% Medium regime: +21% Low regime: +8% Bench press (55%): High regime: -3% Medium regime: +5% Low regime: +3.8% Squat (45%): High regime: +23% Medium regime: +30% Low regime: +27% Squat (55%): High regime: +11%, Medium regime: +7% Low regime: +10%	Strength-endurance strategy provided totally muscle strength gain

DISCUSSION

Strength-endurance resistance training performs normally on timed speed performance to movement failure analysed absolute endurance (i.e., 70% 1RM -repmax) (Rossi et al., 2016). Constantly, submaximal at 80% 1RM strength-endurance performance performing cadences to detect maximum repetition strategy, however timed speed ecc vs. con interval contraction connected importantly neurofatigue (Pryor et al., 2011). Additionally, speed loss monitoring indicates to each exercise objectively qualitative and quantitative endurance effort, neuromuscular adaptation and muscle weakness during resistance training properly load and intensity detection (Rodriguez-Rosell et al., 2020). In this reason, rapid immunometabolic responses on different intervals show glucose and growth factor detection increase related local muscular endurance adaptation unaffected on metabolic factor action, actually acute responses provide fatigue responses and prominent interval condition. In this case, absolute endurance produces metabolic adaptation threshold to detect growth neuromuscular conformity enhancement with constant non-linear strength-endurance resistance periodization (Rossi et al., 2016). In other study reported self-selected intervals observed on strength gain to neurofatigue adaptation preferred on constant set non-linear strength-endurance resistance at 75%1RM micro training periodization.

The absolute endurance regime additionally demonstrated in moderate intervals suggested to long term unfatigue training adaptation (Simao et al., 2020). Repeated neurofatigue increases reduce adenosinetripposphata contribute determining fibril force generation has been yielded this to constant. Both each constant set and timed speed provide better control to tested movement failure determining exercise regimes (de Freitas et al., 2018). Various exercise condition studies have been used to perform endurance development, however local muscular endurance adaptation in generally absolute high load at 80% 1RM one of resistance performance constant has been considered strength and endurance performance determinant (Gomes et al., 2010). Moreover, maximal repetition strategies popularly contribute to cluster set and traditional resistance training, after high intensity showed on 90% 1RM to cluster set and potential fatigue exercise performed 70% 1RM to traditional resistance training explained on local muscular endurance one of exercise factor (Iglesias et al., 2010). Previously, positive strength-endurance performance assessed training routine to examine repetition failure biased constant set at 70%v1RM currently is local muscular endurance adaptation explain one repetition endurance training loading range (Bertolaccini et al., 2019). However, heavy load performance without moderate strength-endurance performance in generally between fatigue and volume potential determine to neuromuscular response after local muscular endurance adaptation in normal speed (de Freitas et al., 2018).

Improving performance specifically session using on detect training plateau generated high load at 80% 1RM absolute local endurance may be important movement speed control (Bastos-Silva et al., 2019). Similarly, preexercise strength and muscle mass independently training session during muscle performance detection controlled fatigue at 70% 1RM unproduced important movement speed and local muscular endurance adaptation (Baker et al., 2016). In contrast, long term high load equated volume on both cluster set and traditional resistance training manipulation favoured repetition failure at 70% 1RM greater observed local muscular endurance detection (Davies et al., 2022).

Excessive local muscular endurance adaptation determining strength-endurance resistance performance estimated to 102.3 kg maximum repetition test unprofitable to resistance trained population as general work capacity (Mann et al., 2015). In currently using to resistance training periodization used hypertrophy and strength gain adapt endurance adaptation fatigue intolerance related (1-4 set at 70%1RM) absolute endurance (Teodoro et al., 2019). Indeed, strength-endurance resistance training related in muscle strength, hypertrophy and endurance regarding have been selected submaximal load on 70-85% 1RM (Terzis et al., 2008). Active resistance training to fixing high load and high repetition used local muscular endurance ranges on 75-85% (Desgorces et al., 2010). In this direction, localized endurance strategies change musculature performance in regional composition resistance exercises on high repetition load and 80-90% 1RM performing limited uninterval to continuous training regimes (Simao et al., 2006). Inverse, absolute combine resistance training effort preferred to increasing muscle endurance, however strength-endurance combination training regimes actually no used to local muscular endurance development (Rossi et al., 2016; Iglesias et al., 2010). Other study reported that absolute local endurance training on strength gain performed to trained resistance population except maximal strength training (Cesar et al., 2009).

Strength-endurance loading range resistance training regime performed to detect relative endurance test (i.e.., 60%1RM - repmax) indeed endurance performance test (Brigatto et al., 2019). If exercise condition is low and high load determine relative endurance strategy to high training adaptation (Gomes et al., 2010). The training loading range to performed speed opportunity between 30% and 40%1RM high repetition set and non-linear local endurance have been obtained targeting velocity and as fast as possible may be attain strategy of different speed (Hirsch and Frost, 2021).

Speed loss and reserve training correction aimed to maximal repetition on high quality effort (Rodriguez-Rosell et al., 2020). Unlike, performance observation to investigate muscular endurance and strength indeed acute exercise and ergogenic caffeine use on time-dependent neurofatigue responses recorded unimportant (Clarke et al., 2015). In contrast, high repetition loading intensities relative local endurance tests at 20RM used to dose-response 1, 3, 5RM set performance may be gain strength and endurance to determine the correct threshold performance (Radaelli et al., 2015). Indeed, long training adaptation described to neuromuscular performance of equating local endurance maximum repetition strategy on weekly hypertrophy training regime basis to perform response of general strength-endurance at 60%1RM relative local endurance (Brigatto et al., 2019). Therefore, resistance training prescription unevaluated repetition maximum poorly studied to relative exercise intensity (Shimano et al., 2006). Actual submaximal and maximal predictive strength detection use 45% and 55%1RM maximal repetition prescription linked to increase low repetition and low intensity performance (Stone and Coulter, 1994). Other approach, lowering loading to all total resistance intensities and local endurance show to performing of unapplied procedures of potential repetition quality correlated muscle fatigue adaptation (Rodriguez-Rosell et al., 2020). However, relative endurance poorly understood at 45% and 55%1RM to perform local endurance resistance training regimes, indeed high resistance-low repetition, low resistance-high repetition and medium resistance-medium repetition training regimes yielded strength-endurance combination imposed maximal, absolute and relative strength gain (Stone and Coulter, 1994).

CONCLUSION

This research concluded that local endurance is a resistance strategy that has not yet gained popularity in the literature. Local endurance should not only be a part of strength-endurance resistance training, but also a measurement strategy used to determine the gains of resistance training based on the relationship between load and intensity in determining resistance load. However, our review tells us that these results are critical. It is hoped that future research will include both absolute and relative endurance strategies in popular resistance training and programs.

AUTHOR CONTRIBUTIONS

Authors YK and İV design, hypothesis, discussion, result and training experience were applied to this study.

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DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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