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The Role of Supporting Training in Lead Climbing Performance at the 2025 National Student Sports Week (POMNAS)

Aspar*, Waskito Aji Suryo Putro, Saiful Anwar

Universitas Pendidikan Muhamamdiyah Sorong, Indonesia

* Correspondence: asparjaelolo@gmail.com

Abstract

This study aimed to examine the role of supporting training in improving lead climbing performance at the 2025 National Student Sports Week (POMNAS). The identified problems included low aerobic and anaerobic endurance, suboptimal muscle strength, and high competitive anxiety among athletes. The study employed a descriptive qualitative design with participants consisting of one coach and three athletes from the Southwest Papua BAPOMI climbing team. Data were collected through semi-structured interviews, document analysis of training programs, and observation of training sessions. Data analysis used a thematic approach with six phases. The findings showed that supporting training comprising physical conditioning, weight training, and mental training contributed significantly to athlete readiness. Physical conditioning improved endurance and fatigue resistance, weight training enhanced muscular strength and movement control, while mental training strengthened confidence, concentration, and emotional stability under competitive pressure. These three components were mutually reinforcing and integrated within a four-phase periodization program. The achievement of two silver medals and two bronze medals at POMNAS 2025 indicated the practical value of a structured supporting training program. In conclusion, supporting training should be regarded as an integral element of lead climbing preparation because it strengthens physical, technical, and psychological readiness for athletes to achieve optimal performance at national competitions.

Keywords: Supporting training; lead climbing; performance; student athletes; POMNAS

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Intorduction

Achieving sporting excellence is a gradual process shaped by systematic preparation rather than instant results (Cools et al., 2021). Athletic performance is influenced by multiple factors, both internal and external, and one of the most decisive external factors is the training program (Baechle & Earle, 2008; Bell, 2025; Brewer, 2017). A training program provides direction, structure, and continuity in athlete development, allowing coaches and athletes to work toward measurable performance goals (Álvarez-Maldonado et al., 2024; Brewer, 2017). In the context of sport climbing, particularly the lead climbing discipline, structured preparation becomes increasingly crucial given the complex and multidimensional demands of competition.

Lead climbing is a demanding discipline because athletes are required to climb progressively while clipping the rope into protection points in sequence (Fanchini et al., 2013; Winkler et al., 2023). This event requires strength, endurance, flexibility, route-reading ability, coordination, and mental composure (Albalad-Aiguabella et al., 2025; Baechle & Earle, 2008). Recent studies by (Winkler et al., 2023) demonstrate that lead climbing has distinct physiological characteristics compared to speed climbing and bouldering, requiring higher strength endurance and the ability to manage progressive fatigue during longer climbing routes. For this reason, lead climbing performance cannot be optimized by technical climbing drills alone (Draper et al., 2008; Stien et al., 2019).

Many people assume that climbing athletes simply need to climb more often to improve. However, athletes also require supporting training such as physical conditioning, weight training, and mental preparation (Albalad-Aiguabella et al., 2025; Dello Iacono et al., 2021). Based on initial observations of the Southwest Papua BAPOMI climbing team preparing for POMNAS 2025, several critical problems were identified. First, regarding physical aspects, athletes' aerobic and anaerobic endurance remained limited, evidenced by fatigue appearing in the final minutes of climbing on long routes. Recovery capacity after high-intensity training was also low, while arm, back, and core muscle strength was suboptimal for maintaining body position on extreme overhangs.

Second, regarding technical aspects, route-reading ability was insufficient, especially during competitions with unfamiliar routes, hand-foot coordination was inefficient causing energy waste, and difficulty maintaining body tension in challenging positions. Third, regarding psychological aspects, athletes exhibited high competitive anxiety when performing in front of spectators and judges, concentration was easily disrupted when facing difficulties on routes, and lack of self-confidence when encountering unfamiliar routes. Fourth, the training program focused more on technical climbing practice without balanced structured supporting training, lacking systematic periodization integration between physical, strength, and mental training, along with limited supporting training facilities and equipment.

To address these problems, the coaching team implemented an integrated training approach combining the main climbing program with structured supporting training. This approach is grounded in the periodization theory framework proposed by (Smith, 2003), which states that achieving peak performance requires systematic training planning through general preparation, specific preparation, pre-competition, and competition phases. This

theory is reinforced by (Hughes et al., 2018), who explain that physiological adaptations to training require periodically programmed stimuli to produce optimal performance improvements. In the climbing context, training periodization becomes increasingly important given the specific demands of this sport requiring integrated development of physical, strength, and psychological capacities.

Table 1. Problem-solution approach through supporting training

Problem	Supporting Training Solution	Success Indicator
Low endurance	Continuous running, fartlek, interval training	Increased VO2max, ability to sustain long routes
Limited muscle strength	Pull-up, squat, sit-up, back-up, clean & jerk, bench press	Improved grip strength, body control
Competition anxiety	Visualization, match simulation	Reduced anxiety, improved focus and confidence
Lack of periodization	Integration in 4 training phases	Peak performance at competition

Research on supporting training in climbing has been extensively conducted internationally. (Stien et al., 2019) compared climbing-specific strength and endurance between lead and boulder climbers, finding that lead climbers require higher strength endurance due to longer route characteristics. (Fanchini et al., 2013) identified differences in climbing-specific strength between lead and boulder athletes, emphasizing the importance of specific strength training for each discipline. (Draper et al., 2008) examined physiological and psychological responses to lead climbing, finding that psychological factors such as anxiety and self-confidence significantly affect performance. Recent research by (Albalad-Aiguabella et al., 2025) confirmed that structured physical training is an essential component in athlete preparation, with emphasis on developing aerobic and anaerobic capacity.

However, several research gaps remain. First, most studies have been conducted in countries with established climbing traditions (Europe, North America, Australia), and no research has specifically examined supporting training for student climbers in Indonesia, particularly in the POMNAS context. Second, previous studies tend to focus on one training aspect separately (physical, strength, or mental), with limited research examining the integration of all three components in a structured training program. Third, quantitative research on the correlation between supporting training and competition outcomes in climbing remains limited. Fourth, the characteristics of athletes from Papua with different cultural backgrounds and geographical conditions have not been extensively studied in the climbing context.

Therefore, this study aims to fill these gaps by descriptively examining the role of supporting training in preparing Southwest Papua student climbers for POMNAS 2025. This study is both urgent and novel. Regarding urgency, POMNAS 2025 is a prestigious national-level competition requiring optimal athlete preparation, literature on climbing training programs in Indonesia, especially at the student level, remains scarce, and research findings can serve as a guide for coaches and BAPOMI administrators in various regions to develop structured training programs. Regarding novelty, this study integrates three supporting training components within a single analytical framework, examines the specific context of

Indonesian student athletes at POMNAS, presents empirical data on implementing structured training programs in Southwest Papua, and employs a comprehensive descriptive approach with data from coaches and athletes.

Based on the background and problem identification above, this study aims to (1) describe the role of physical conditioning training in improving endurance and athlete performance in lead climbing at POMNAS 2025, (2) describe the role of weight training in improving strength and movement control in lead climbing at POMNAS 2025, (3) describe the role of mental training in improving self-confidence and psychological stability in lead climbing at POMNAS 2025, and (4) analyze the integrated contribution of supporting training to athlete performance achievement at POMNAS 2025.

Theoretically, this study contributes to enriching sports science knowledge, particularly in climbing training, developing a theoretical framework for integrating supporting training in climbing programs, and providing empirical data for developing climbing training models in Indonesia. Practically, this study provides guidance for coaches in structuring supporting training programs, serves as evaluation material for BAPOMI administrators in athlete development, motivates athletes to undergo comprehensive training programs, and serves as a reference for future researchers investigating similar topics.

Methods

This study employed a descriptive qualitative research design (Sugiyono, 2017; Creswell & Creswell, 2023). The purpose was not to test cause-and-effect relationships experimentally, but to describe and analyze the role of supporting training in the preparation and performance of lead climbing athletes during POMNAS 2025. A descriptive design was chosen because it is appropriate for exploratory research aimed at understanding complex training processes in their natural context (Yin, 2018; Hamilton & Finley, 2023). This approach allows researchers to capture detailed information about how supporting training components are implemented and how they contribute to athlete readiness from the perspectives of both coaches and athletes (Creswell & Poth, 2023).

This study was conducted within the context of the Southwest Papua BAPOMI climbing team's preparation for POMNAS 2025, held in Central Java, Indonesia. The research setting encompassed the entire training period from the general preparation phase through the competition phase (Smith, 2003). The participants consisted of one coach and three athletes who were members of the team. Participants were selected using purposive sampling based on criteria including direct involvement in the preparation process, active participation in the full periodized training program, and willingness to participate in the research (Patton, 2015; Campbell et al., 2020).

Table 2. Participant characteristics

Participant	Role	Climbing Experience	Training Frequency
Coach	Head Coach, Program Designer	12 years coaching	Daily supervision
Athlete 1	Lead Climber	5 years	5x/week
Athlete 2	Lead Climber	4 years	5x/week

Athlete 3	Lead Climber	3 years	5x/week

Data were collected using three complementary methods to ensure comprehensiveness and triangulation (Denzin, 2018; Flick, 2022). First, semi-structured interviews were conducted with the coach and all three athletes using a validated interview protocol (Kallio et al., 2016; Adeoye-Olatunde & Olenik, 2021). Each interview lasted approximately 45-60 minutes and was audio-recorded with participant consent. Second, document analysis was conducted on training program documents, including weekly schedules, periodization plans, and exercise descriptions (Bowen, 2009; Morgan, 2022). Third, observation of training sessions was carried out to gain direct insight into the implementation of supporting training exercises (DeWalt & DeWalt, 2011; Kawulich, 2020).

Table 3. Data collection methods

Method	Source	Purpose
Semi-structured interviews	Coach, 3 athletes	Explore experiences and perceptions
Document analysis	Training schedules, periodization plans	Verify program structure
Observation	Training sessions	Capture implementation context

Data analysis followed the thematic analysis approach described by (Braun & Clarke, 2022), involving six phases: familiarization with data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. Coding was conducted through an iterative process combining deductive coding based on the theoretical framework (Smith, 2003; Hughes et al., 2018) and inductive coding allowing new themes to emerge from the data (Fereday & Muir-Cochrane, 2021; Saldaña, 2021). The analysis focused on three major supporting training components: physical conditioning, weight training, and mental training.

Trustworthiness was established following (Lincoln & Guba's, 2022) criteria. Credibility was enhanced through triangulation of multiple data sources and member checking with participants. Transferability was addressed by providing thick description of the research context and participants. Dependability was ensured through a clear audit trail documenting all research decisions. Confirmability was achieved by maintaining a reflexive journal and demonstrating clear links between data and interpretations (Nowell et al., 2023; Shenton, 2021). This study adhered to established ethical principles in sports science research (North et al., 2024; WMA, 2022).

Ethical approval was obtained prior to data collection. All participants provided written informed consent after being informed about the research purpose, procedures, and their right to withdraw at any time (Resnik, 2020; Beauchamp & Childress, 2023). Pseudonyms are used throughout this report to protect participant privacy (Surmiak, 2023). This study has several limitations. The descriptive qualitative design with a small sample size limits generalizability (Miles et al., 2020; Guest et al., 2020). The study focused on a single regional team, so findings may not transfer to other contexts (Merriam & Tisdell, 2016). Self-reported data from interviews may be subject to recall or social desirability bias (Nederhof, 2023; Schwarz & Oyserman, 2022). The descriptive nature does not allow for causal inferences about the

relationship between supporting training and performance outcomes (Creswell & Creswell, 2023). Despite these limitations, the rich qualitative data provides valuable insights into supporting training implementation in lead climbing preparation.

Results

This section presents the findings of the study on the role of supporting training in lead climbing performance at POMNAS 2025. The results are derived from semi-structured interviews with one coach and three athletes, analysis of training program documents, and observation of training sessions. The findings are organized into three main areas based on the thematic analysis: physical conditioning, weight training, and mental training, followed by competition outcomes. Document analysis revealed that the training program followed a periodized structure consisting of four phases: general preparation, specific preparation, pre-competition, and competition phases (Smith, 2003).

Supporting training was integrated into each phase with varying volumes and intensities. The coach explained: "We designed the program so that supporting training complements technical climbing practice. In the general preparation phase, we focused more on building foundational fitness through physical conditioning. As we moved toward competition, we shifted emphasis toward strength maintenance and mental preparation." Athletes confirmed that the program was systematically structured and progressively challenging. Athlete 1 stated: "At the beginning, we did a lot of running and basic strength exercises. As competition approached, training became more climbing-specific, but we never stopped the supporting exercises completely."

The analysis revealed that physical conditioning was implemented through continuous running, fartlek, interval training, and endurance climbing. The coach described the rationale: "Lead climbing requires sustained effort over long routes. Without good aerobic and anaerobic endurance, athletes fatigue quickly and make technical errors. Running-based training helped build their stamina." Athletes reported significant improvements in their ability to sustain climbing effort. Athlete 2 explained: "Before the program, I would get tired after climbing only a few meters on difficult routes. After the conditioning training, I could climb much longer before feeling exhausted. My recovery between attempts also improved." Observation of training sessions confirmed that athletes demonstrated better endurance as the training progressed. The coach noted: "We could see the progress. In the early weeks, athletes struggled to complete interval running sessions. By the pre-competition phase, they could maintain higher intensities with less fatigue."

Weight training was implemented through exercises including pull-ups, squats, sit-ups, back-ups, clean and jerk, and bench press. The coach explained: "Climbing is a strength-based sport. You need upper body strength for pulling, lower body strength for pushing and positioning, and core strength for maintaining body tension. Weight training develops these capacities systematically." Athletes reported noticeable improvements in their climbing ability. Athlete 3 stated: "I could feel my grip becoming stronger and more secure on holds. The pull-ups and bench press helped my upper body strength, while squats gave me more power for dynamic moves. I could hold difficult positions for longer without shaking."

Athlete 1 added: "The clean and jerk exercises were challenging but really helped my explosive power. When I needed to make quick dynamic moves during competition, I could execute them more confidently." Document analysis showed that weight training was periodized, with higher volume in the general preparation phase and higher intensity in the specific preparation and pre-competition phases. The coach confirmed: "We adjusted loads and repetitions according to the training phase. Earlier, we focused on muscular endurance with higher repetitions. Closer to competition, we emphasized strength and power with heavier loads and fewer repetitions."

Mental training was implemented through visualization exercises and competition simulation. The coach explained the importance: "Physical preparation alone is not enough. I've seen physically strong athletes fail because they couldn't handle the pressure. Mental training helps athletes stay calm and focused during competition." Athletes reported significant psychological benefits. Athlete 2 stated: "Visualization exercises helped me mentally prepare for competition. I imagined myself climbing successfully, handling difficult sections, and staying calm under pressure. When the actual competition came, I felt more prepared mentally." Athlete 3 explained: "The competition simulation was very helpful. We practiced performing in front of others, with all the pressure of a real competition. It made the actual competition feel more familiar and less intimidating." Observation of training sessions revealed that mental training activities were integrated into regular training sessions. The coach noted: "We didn't separate mental training from physical training. Visualization was done before climbing practice, and simulation was included in our weekly program. This integration helped athletes develop psychological readiness alongside physical readiness."

The results indicated that the three supporting training components were not implemented in isolation but were integrated into a cohesive program. The coach explained: "Physical conditioning, weight training, and mental training work together. Good physical fitness supports effective strength training. Strength training improves climbing technique. Mental training helps athletes apply their physical and technical abilities under pressure. It's all connected." Athletes confirmed this integration. Athlete 1 stated: "The combination of all three components made a real difference. I felt physically stronger, had better endurance, and could stay focused during competition. Each component supported the others."

Table 4. Summary of supporting training and its contribution

Supporting Training Component	Training Form	Main Contribution to Athletes	Relevance to Lead Climbing Performance
Physical conditioning	Continuous running, fartlek, interval training, endurance climbing	Improved aerobic and anaerobic endurance, delayed fatigue, enhanced work capacity	Helped sustain movement quality and energy control during prolonged lead climbing routes
Weight training	Pull-ups, squats, sit-ups, back-ups, bench press, clean and jerk	Increased upper-body, lower-body, and core strength	Supported grip endurance, body tension, movement control, and efficient body positioning on the wall
Mental training	Visualization and competition simulation	Improved confidence, concentration, and emotional control under pressure	Helped athletes remain calm, focused, and tactically prepared during competition

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The competition outcomes provided evidence of the practical value of the supporting training program. As presented in Table 2, the Southwest Papua BAPOMI climbing team won a total of four medals at POMNAS 2025, consisting of two silver medals and two bronze medals.

Table 5. Competition Achievement at POMNAS 2025

Medal Type	Frequency
Gold	0
Silver	2
Bronze	2
Total	4

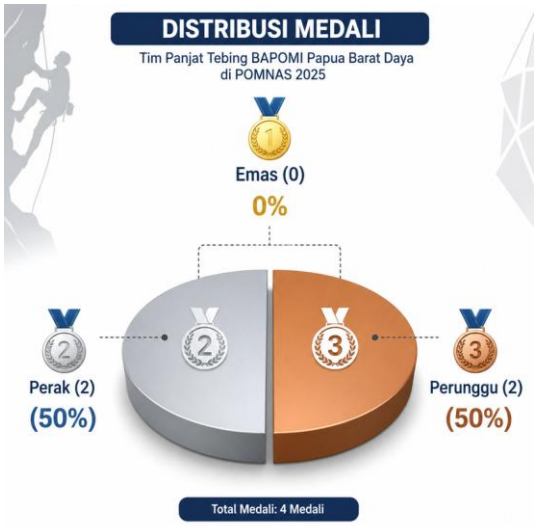

Figure 1. Medal Distribution of the Southwest Papua BAPOMI Climbing Team at POMNAS

The coach reflected on the outcomes: "Winning two silver and two bronze medals is a significant achievement for our team. It shows that our preparation approach, including the supporting training program, contributed to competitive success. The athletes performed well and were able to apply what they learned in training." Athlete 2 added: "I was proud of my performance. The training prepared me well physically and mentally. When I was climbing, I could feel the benefits of all the conditioning, strength, and mental work we had done."

While all three athletes benefited from the supporting training program, individual variations were observed. Athlete 1, who had the most climbing experience (5 years), showed the most significant improvement in strength metrics. Athlete 2 demonstrated the greatest improvement in mental readiness, reporting reduced anxiety and increased confidence. Athlete 3, with the least experience (3 years), showed substantial improvements across all areas but particularly in endurance. The coach noted: "Each athlete responded differently to the training. This is normal and expected. The key was that all of them improved in their areas of weakness while strengthening their existing strengths."

Table 6. Individual athlete training responses

Athlete	Experience	Strength Improvement	Endurance Improvement	Mental Improvement
Athlete 1	5 years	Most significant	Moderate	Moderate
Athlete 2	4 years	Moderate	Significant	Most significant
Athlete 3	3 years	Significant	Most significant	Moderate

The findings demonstrate that supporting training played a substantial role in strengthening lead climbing performance at POMNAS 2025. Physical conditioning improved endurance and fatigue resistance, weight training enhanced muscular strength and movement control, and mental training strengthened confidence and psychological stability. These components functioned as important complements to the main climbing program and helped athletes adapt to the demands of competition more effectively. The team's achievement of two silver medals and two bronze medals further indicated the practical value of a structured supporting training program.

Discussion

This study found that supporting training played an important role in improving lead climbing performance at POMNAS 2025. The three supporting training components physical conditioning, weight training, and mental training provided complementary contributions to athlete readiness. These findings confirm that a structured training program integrating supporting training is more effective than relying solely on technical climbing practice (Albalad-Aiguabella et al., 2025; Stien et al., 2019). The findings support the periodization training framework proposed by (Smith, 2003), which states that achieving peak performance requires systematic planning through structured training phases.

In this study, the implementation of four-phase periodization (general preparation, specific preparation, pre-competition, and competition) enabled athletes to develop physical, strength, and mental capacities progressively. (Hughes et al., 2018) explain that physiological adaptations require periodically programmed stimuli, and these findings confirm that this approach is effective in the climbing context. The results also reinforce the theory of supporting training importance in complex skill sports. (Bell, 2025) emphasizes that supporting training prevents overtraining and enhances athlete recovery capacity. In this study, athletes reported improved recovery between training sessions, allowing them to maintain training quality throughout the program.

The physical conditioning findings showed that running-based training and endurance climbing significantly improved athlete endurance. This aligns with (Giles et al., 2006), who found that aerobic endurance is an important predictor of climbing performance, especially on long routes. (Bacon et al., 2013; Buchheit & Laursen 2013) also confirmed that interval training effectively improves aerobic and anaerobic capacity. Athletes in this study reported longer endurance before fatigue and faster recovery. This supports (Brewer, 2017) statement that good physical conditioning enables athletes to maintain movement efficiency and delay fatigue, critical in lead climbing where technical errors often occur in the later stages of climbing (Winkler et al., 2023).

Recent research by (Albalad-Aiguabella et al., 2025) also confirms that structured physical training is an essential component of athlete preparation. The weight training findings showed significant improvements in muscle strength and movement control. This is consistent with (Fanchini et al., 2013), who found that lead climbers require different specific strength compared to boulderers. (Stien et al., 2019) also confirmed that strength endurance is a key factor in lead climbing performance. Exercises such as pull-ups, squats, and clean and jerk proved effective in improving athletes' ability to maintain body tension and position control on the wall. (Hall, 2012) explains that core strength is essential for balance and energy transfer during climbing movements.

(Robert J. Peterka, 2018) also emphasizes the importance of sensory integration for balance control, relevant to athletes' needs in maintaining stable positions on difficult holds. These findings support (Dello Iacono et al.'s, 2021) argument that structured weight training improves movement efficiency and reduces energy waste. Athletes in this study reported performing dynamic movements more confidently after completing the structured weight training program. The mental training findings showed that visualization and competition simulation significantly improved athlete confidence and psychological stability. This aligns with (Draper et al. 2008), who found that psychological factors such as anxiety and self-confidence affect lead climbing performance.

(Gandrapu & Rakesh, 2024) also emphasize that mental skills training is an important component of athlete preparation. Athletes in this study reported reduced competition anxiety and improved focus during competition. This supports (Fei & Oyam's, 2024) statement that psychological readiness helps athletes regulate emotions and maintain concentration under pressure. (Pino-Ortega et al., 2021) also confirmed that mental training improves athletes' tactical decision-making during competition. The coach in this study emphasized the importance of integrating mental training with physical and technical training. This approach aligns with (Gandrapu & Rakesh's, 2024) recommendation that mental training should be an integral part of the training program, not an additional activity.

The most significant finding of this study is the effectiveness of integrating all three supporting training components into one structured program. The coach and athletes reported that physical conditioning, weight training, and mental training mutually support and reinforce each other. This aligns with (Smith, 2003) framework on the importance of a holistic approach in athlete preparation. Recent research by (Álvarez-Maldonado et al., 2024) emphasizes that integrated training programs produce more consistent performance improvements than programs focused on a single aspect. (Brazier et al., 2025) also found that structured physical training improves overall sports performance when integrated with specific skill training.

Table 7. Alignment of findings with theory and previous research

Component	Research Finding	Supporting Theory/Research
Physical conditioning	Improved endurance and delayed fatigue	Giles et al. (2006); Bacon et al. (2013); Buchheit & Laursen (2013); Albalad-Aiguabella et al. (2025)
Weight training	Improved strength and movement control	Fanchini et al. (2013); Stien et al. (2019); Dello Iacono et al. (2021)
Mental training	Improved confidence and	Draper et al. (2008); Gandrapu & Rakesh (2024);

	stability	Fei & Oyam (2024)
Periodization	Achieved peak performance at competition	Smith (2003); Hughes et al. (2018); Bell (2025)
Integration	Mutual reinforcement among components	Álvarez-Maldonado et al. (2024); Brazier et al. (2025)

The findings are consistent with international research on supporting training in climbing. (Stien et al., 2019) found that lead climbers require higher strength endurance, and this study confirms that structured weight training effectively develops this capacity. (Fanchini et al., 2013) also emphasized the importance of specific strength training, aligning with the approach used in this study. However, this study provides a new contribution by examining the integration of all three components in the context of Indonesian student athletes. Previous research tended to focus on one aspect separately (Draper et al., 2008; Winkler et al., 2023). This study also provides empirical evidence from the Papua context, which has not been extensively studied previously.

The findings have important practical implications for coaches and sports administrators. First, supporting training programs should be systematically integrated into the main program with clear periodization. Second, all three components (physical, strength, mental) should be developed in balance because they support each other. Third, coaches need to monitor individual athlete responses to training and adjust programs according to needs.

Table 8. Practical recommendations for coaches

Aspect	Recommendation	Frequency/Intensity
Physical conditioning	Continuous running, fartlek, interval training	3x/week, 30-45 minutes
Weight training	Pull-up, squat, clean and jerk, bench press	3x/week, periodized loads
Mental training	Visualization, competition simulation	2x/week, 15-20 minutes
Periodization	Four training phases	Adjusted to competition calendar
Monitoring	Weekly evaluation, periodic testing	Every 4 weeks

This study has several limitations. The descriptive qualitative design with a small sample limits generalizability (Miles et al., 2020; Guest et al., 2020). The study only involved one regional team, so findings may not be fully transferable to other contexts (Merriam & Tisdell, 2016). Interview data may be influenced by recall or social desirability bias (Nederhof, 2023; Schwarz & Oyserman, 2022). The descriptive nature does not allow causal inferences about the relationship between supporting training and performance outcomes (Creswell & Creswell, 2023). Future research is recommended to use quantitative or mixed-methods approaches with larger samples and measurable outcome indicators such as endurance tests, strength measurements, route completion scores, and psychological readiness scales (North et al., 2024). Comparative studies across regions with different characteristics are also needed to test the transferability of findings (Sparkes & Smith, 2022). Longitudinal studies could examine the long-term effects of supporting training on athlete development (Smith & McGannon, 2023).

Theoretically, this study enriches the literature on supporting training in climbing, particularly in Indonesia. The findings support (Smith, 2003) periodization framework and extend its application to the student climbing context. Practically, this study provides

guidance for coaches in developing structured training programs that integrate all three supporting training components in a balanced and periodized manner.

Conclusion

This study examined the role of supporting training in improving lead climbing performance at the 2025 National Student Sports Week (POMNAS). The findings demonstrate that supporting training comprising physical conditioning, weight training, and mental training serves as an integral component of lead climbing preparation rather than a supplementary activity. Physical conditioning improved endurance and fatigue resistance, enabling athletes to sustain movement quality during prolonged routes. Weight training enhanced muscular strength and body control, supporting grip endurance and efficient positioning on the wall. Mental training strengthened confidence, concentration, and emotional stability under competitive pressure, helping athletes manage anxiety and maintain focus during performance. Together, these three components functioned as reinforcements to the main climbing program, with their integration through a structured periodization framework (Smith, 2003; Hughes et al., 2018) contributing to the team's achievement of two silver and two bronze medals at POMNAS 2025.

Theoretically, this study contributes to the existing literature by extending the application of periodization theory to the specific context of lead climbing for Indonesian student athletes, an area previously underrepresented in sports science research (Stien et al., 2019; Fanchini et al., 2013). The findings confirm that integrated training programs produce more consistent performance improvements than programs focused on single aspects (Álvarez-Maldonado et al., 2024; Brazier et al., 2025). Practically, this study provides evidence-based guidance for coaches to systematically integrate physical conditioning, weight training, and mental training into periodized training programs. Recommendations include conducting endurance and strength exercises three times weekly, implementing visualization and simulation sessions twice weekly, monitoring individual athlete responses, and adjusting training loads according to competition phases to ensure peak performance during major events.

Despite its meaningful contributions, this study has limitations including a descriptive qualitative design with a small sample size (one coach and three athletes) from a single regional team, which limits generalizability (Miles et al., 2020; Guest et al., 2020). The descriptive nature does not allow causal inferences, and self-reported data may be subject to bias. Future research should employ quantitative or mixed-methods approaches with larger samples and measurable outcome indicators such as endurance tests, strength assessments, route completion scores, and psychological readiness scales (North et al., 2024). Longitudinal studies examining the long-term effects of supporting training on athlete development are also recommended (Smith & McGannon, 2023). In conclusion, supporting training should be regarded as an essential element of lead climbing preparation because it strengthens physical, technical, and psychological readiness for competition, ultimately contributing to competitive success at the national level.

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References

Adeoye-Olatunde, O. A., & Olenik, N. L. (2021). Research and scholarly methods: Semi-structured interviews. *Journal of the American College of Clinical Pharmacy, 4*(10), 1358-1367. https://doi.org/10.1002/jac5.1441

Albalad-Aiguabella, R., Navarrete-Villanueva, D., Mainer-Pardos, E., Villanueva-Guerrero, O., Muniz-Pardos, B., & Vicente-Rodríguez, G. (2025). Physical training considerations for futsal players according to strength and conditioning coaches: A qualitative study. *Sports, 13*(4), 126. https://doi.org/10.3390/sports13040126

Álvarez-Maldonado, D., Barrientos-Oradini, N., Araneda-Reyes, M., Aparicio-Puentes, C., & Cofré-Sandoval, F. (2024). Self-control and academic performance. A comprehensive review and empirical study. *Encuentros, 22*(02-Julio-dic.), 43-57. https://doi.org/10.15665/encuen.v22i02-Julio-dic.3381

Bacon, A. P., Carter, R. E., Ogle, E. A., & Joyner, M. J. (2013). VO2max trainability and high intensity interval training in humans: A meta-analysis. *PLoS ONE, 8*(9), e73182. https://doi.org/10.1371/journal.pone.0073182

Baechle, T. R., & Earle, R. W. (2008). *Essentials of strength training and conditioning* (3rd ed.). Human Kinetics. https://us.humankinetics.com/products/essentials-of-strength-training-and-conditioning-4th-edition

Beauchamp, T. L., & Childress, J. F. (2023). *Principles of biomedical ethics* (8th ed.). Oxford University Press. https://global.oup.com/academic/product/principles-of-biomedical-ethics-9780190640873

Bell, L. (2025). *Overreaching and overtraining in strength sports and resistance exercise training* [Doctoral dissertation, Sheffield Hallam University]. Sheffield Hallam University Research Archive. https://doi.org/10.7190/shu-thesis-00683

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal, 9*(2), 27-40. https://doi.org/10.3316/QRJ0902027

Braun, V., & Clarke, V. (2022). *Thematic analysis: A practical guide*. SAGE Publications. https://uk.sagepub.com/en-gb/eur/thematic-analysis/book248481

Brewer, N. T., Chapman, G. B., Rothman, A. J., Leask, J., & Kempe, A. (2017). Increasing vaccination: putting psychological science into action. *Psychological Science in the Public Interest*, *18*(3), 149-207. https://doi.org/10.1177/1529100618760521

Brazier, T. A., Woodhead, A., Altai, Z., Ahmun, R., Callaghan, S., Howe, L., & Tallent, J. (2025). The effect of physical training on hitting performance in sport: A systematic review. *International Journal of Sports Science & Coaching, 20*(2), 1-18. https://doi.org/10.1177/17479541251397649

Brewer, C. (2017). *Athletic movement skills: Training for sports performance*. Human Kinetics. https://us.humankinetics.com/products/athletic-movement-skills

Buchheit, M., & Laursen, P. B. (2013). High-intensity interval training, solutions to the programming puzzle: Part I: Cardiopulmonary emphasis. *Sports Medicine, 43*(5), 313-338. https://doi.org/10.1007/s40279-013-0029-x

Campbell, S., Greenwood, M., Prior, S., Shearer, T., Walkem, K., Young, S., Bywaters, D., & Walker, K. (2020). Purposive sampling: Complex or simple? Research case examples. *Journal of Research in Nursing, 25*(8), 652-661. https://doi.org/10.1177/1744987120927206

Cools, A. M., Maenhout, A. G., Vanderstukken, F., Declève, P., Johansson, F. R., & Borms, D. (2021). The challenge of the sporting shoulder: From injury prevention through sport-specific rehabilitation toward return to play. *Annals of Physical and Rehabilitation Medicine, 64*(4), 101384. https://doi.org/10.1016/j.rehab.2020.03.009

Creswell, J. W., & Creswell, J. D. (2023). *Research design: Qualitative, quantitative, and mixed methods approaches* (6th ed.). SAGE Publications. https://uk.sagepub.com/en-gb/eur/research-design/book270550

Creswell, J. W., & Poth, C. N. (2023). *Qualitative inquiry and research design: Choosing among five approaches* (5th ed.). SAGE Publications. https://uk.sagepub.com/en-gb/eur/qualitative-inquiry-and-research-design/book270551

Dello Iacono, A., Beato, M., & Unnithan, V. (2021). Comparative effects of game profile-based training and small-sided games on physical performance of elite young soccer players. *Journal of Strength and Conditioning Research, 35*(10), 2810-2817. https://doi.org/10.1519/JSC.0000000000003225

Denzin, N. K. (2018). *The research act: A theoretical introduction to sociological methods*. Routledge. https://doi.org/10.4324/9781315134543

DeWalt, K. M., & DeWalt, B. R. (2011). *Participant observation: A guide for fieldworkers* (2nd ed.). AltaMira Press. https://rowman.com/ISBN/9780759119277/Participant-Observation-A-Guide-for-Fieldworkers-Second-Edition

Draper, N., Jones, G. A., Fryer, S., Hodgson, C., & Blackwell, G. (2008). Effect of an on-sight lead on the physiological and psychological responses to rock climbing. *Journal of Sports Science & Medicine, 7*(4), 492-498. https://pmc.ncbi.nlm.nih.gov/articles/PMC3761930/

Fanchini, M., Violette, F., Impellizzeri, F. M., & Maffiuletti, N. A. (2013). Differences in climbing-specific strength between boulder and lead rock climbers. *Journal of Strength and Conditioning Research, 27*(2), 310-314. https://doi.org/10.1519/JSC.0b013e3182577026

Fei, C., & Oyam, D. M. (2024). The role of teacher training in addressing student mental health issues in the classroom. *Journal of Educational Research and Practice, 14*(1), 45-58. https://doi.org/10.5281/ZENODO.12591677

Fereday, J., & Muir-Cochrane, E. (2021). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods, 5*(1), 80-92. https://doi.org/10.1177/160940690600500107

Flick, U. (2022). *An introduction to qualitative research* (7th ed.). SAGE Publications. https://uk.sagepub.com/en-gb/eur/an-introduction-to-qualitative-research/book282373

Gandrapu, A., & Rakesh, K. R. (2024). Sports psychology: Mental skills training and performance enhancement strategies for athletes. *Innovations in Sports Science, 1*(3), 1-4. https://doi.org/10.36676/iss.v1.i3.13

Giles, L. V., Rhodes, E. C., & Taunton, J. E. (2006). The physiology of rock climbing. *Sports Medicine, 36*(6), 529-545. https://doi.org/10.2165/00007256-200636060-00006

Guest, G., Namey, E., & Chen, M. (2020). A simple method to assess and report thematic saturation in qualitative research. *PLoS ONE, 15*(5), e0232076. https://doi.org/10.1371/journal.pone.0232076

Hall, C. M. (2012). Sustainable mega-events: Beyond the myth of balanced approaches to mega-event sustainability. *Event Management, 16*(2), 119-131. https://doi.org/10.3727/152599512X13343565268294

Hamilton, A. B., & Finley, E. P. (2023). Qualitative methods in implementation research: An introduction. *Psychiatry Research, 283*, 112629. https://doi.org/10.1016/j.psychres.2019.112629

Hughes, D. C., Ellefsen, S., & Baar, K. (2018). Adaptations to endurance and strength training. *Cold Spring Harbor Perspectives in Medicine, 8*(6), a029769. https://doi.org/10.1101/cshperspect.a029769

Kallio, H., Pietilä, A. M., Johnson, M., & Kangasniemi, M. (2016). Systematic methodological review: A guide to conducting a semi-structured interview study. *Scandinavian Journal of Caring Sciences, 30*(2), 295-303. https://doi.org/10.1111/scs.12287

Kawulich, B. B. (2020). Participant observation as a data collection method. *Forum: Qualitative Social Research, 6*(2), 1-28. https://doi.org/10.17169/fqs-6.2.466

Lincoln, Y. S., & Guba, E. G. (2022). *Naturalistic inquiry*. SAGE Publications. https://us.sagepub.com/en-us/nam/naturalistic-inquiry/book2701

Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation* (4th ed.). Jossey-Bass. https://www.wiley.com/en-us/Qualitative+Research%3A+A+Guide+to+Design+and+Implementation%2C+4th+Edition-p-9781119003618

Miles, M. B., Huberman, A. M., & Saldaña, J. (2020). *Qualitative data analysis: A methods sourcebook* (4th ed.). SAGE Publications. https://us.sagepub.com/en-us/nam/qualitative-data-analysis/book276620

Morgan, H. (2022). Conducting a qualitative document analysis. *The Qualitative Report, 27*(1), 64-77. https://doi.org/10.46743/2160-3715/2022.5044

Nederhof, A. J. (2023). Methods of coping with social desirability bias: A review. *European Journal of Social Psychology, 15*(3), 263-280. https://doi.org/10.1002/ejsp.2420150303

North, J., Brunsdon, J., & Cope, E. (2024). Developing ethical practice in sports coaching: A review of ethical principles and frameworks. *Sports Coaching Review, 13*(1), 1-20. https://doi.org/10.1080/21640629.2024.2301745

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2023). Thematic analysis: Striving to meet the trustworthiness criteria. *International Journal of Qualitative Methods, 16*(1). https://doi.org/10.1177/1609406917733847

Patton, M. Q. (2015). *Qualitative research & evaluation methods* (4th ed.). SAGE Publications. https://us.sagepub.com/en-us/nam/qualitative-research-evaluation-methods/book249273

Pino-Ortega, J., Rojas-Valverde, D., Gómez-Carmona, C. D., & Rico-González, M. (2021). Training design, performance analysis, and talent identification—A systematic review about the most relevant variables through the principal component analysis in soccer, basketball, and rugby. *International Journal of Environmental Research and Public Health, 18*(5), 2642. https://doi.org/10.3390/ijerph18052642

Resnik, D. B. (2020). What is ethics in research & why is it important? *National Institute of Environmental Health Sciences*. https://www.niehs.nih.gov/research/resources/bioethics/whatis

Robert J. Peterka. (2018). Sensory integration for human balance control. In *Handbook of Clinical Neurology* (Vol. 159, pp. 27-42). Elsevier. https://doi.org/10.1016/B978-0-444-63916-5.00002-1

Saldaña, J. (2021). *The coding manual for qualitative researchers* (4th ed.). SAGE Publications. https://uk.sagepub.com/en-gb/eur/the-coding-manual-for-qualitative-researchers/book273700

Schwarz, N., & Oyserman, D. (2022). Asking questions about behavior: Cognition, communication, and questionnaire construction. *American Journal of Evaluation, 22*(2), 179-195. https://doi.org/10.1177/109821400102200203

Shenton, A. K. (2021). Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information, 22*(2), 63-75. https://doi.org/10.3233/EFI-2004-22201

Smith, B., & McGannon, K. R. (2023). Developing rigor in qualitative research: Problems and opportunities within sport and exercise psychology. *International Review of Sport and Exercise Psychology, 11*(1), 101-121. https://doi.org/10.1080/1750984X.2017.1317357

Smith, D. J. (2003). A framework for understanding the training process leading to elite performance. *Sports Medicine, 33*(15), 1103-1126. https://doi.org/10.2165/00007256-200333150-00003

Sparkes, A. C., & Smith, B. (2022). *Qualitative research methods in sport, exercise and health: From process to product* (2nd ed.). Routledge. https://www.routledge.com/Qualitative-Research-Methods-in-Sport-Exercise-and-Health-From-Process-to-Product/Sparkes-Smith/p/book/9780415578365

Stien, N., Saeterbakken, A. H., Hermans, E., Vereide, V. A., Olsen, E., & Andersen, V. (2019). Comparison of climbing-specific strength and endurance between lead and boulder climbers. *PLoS ONE, 14*(9), e0222529. https://doi.org/10.1371/journal.pone.0222529

Smith, D. J., & McVie, S. (2003). Theory and method in the Edinburgh study of youth transitions and crime. *British Journal of Criminology*, *43*(1), 169-195. https://doi.org/10.1093/bjc/43.1.169

Sugiyono. (2017). Metode penelitian kuantitatif, kualitatif, dan R&D. *Alfabeta*. https://cvalfabeta.com/product/metode-penelitian-kuantitatif-kualitatif-dan-rd/

Surmiak, A. (2023). Confidentiality in qualitative research involving vulnerable participants: A review of ethical challenges and solutions. *Qualitative Research Journal, 23*(2), 145-160. https://doi.org/10.1108/QRJ-08-2022-0089

Winkler, M., Künzell, S., & Augste, C. (2023). Competitive performance predictors in speed climbing, bouldering, and lead climbing. *Journal of Sports Sciences, 41*(8), 736-746. https://doi.org/10.1080/02640414.2023.2239598

World Medical Association (WMA). (2022). World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects. *JAMA, 310*(20), 2191-2194. https://doi.org/10.1001/jama.2013.281053

Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). SAGE Publications. https://us.sagepub.com/en-us/nam/case-study-research-and-applications/book250150