Journal Physical Health Recreation (JPHR)
Volume 5 Nomor 4 ; September 2025
https://jurnal.stokbinaguna.ac.id/index.php/JP
e-ISSN : 2747- 013X

SLR: Peran Strength and Conditioning Training dalam Peningkatan Performa Atlet Bola Basket

Christopher Ronggo Panuntunan Simatupan[1], Candra Brema Tarigan[2], Daniel Risky Fernando Sitinjak[3], Agus Satria Siregar[4], Rio Erlangga Simanjuntak[5]

{chrisopherronggo@gmail.com[1], candratarigan@gmail.com[2], danielsitinjak@gmail.com[3], agussiregar@gmail.com[4], riosimanjuntak@gmail.com[5]}

Sekolah Tinggi Olahraga dan Kesehatan Bina Guna, Jl. Alumunium Raya No.77, Tj. Mulia Hilir, Kec. Medan Deli, Kota Medan, Sumatera Utara 20241[1] Sekolah Tinggi Olahraga dan Kesehatan Bina Guna, Jl. Alumunium Raya No.77, Tj. Mulia Hilir, Kec. Medan Deli, Kota Medan, Sumatera Utara 20241[2], Sekolah Tinggi Olahraga dan Kesehatan Bina Guna, Jl. Alumunium Raya No.77, Tj. Mulia Hilir, Kec. Medan Deli, Kota Medan, Sumatera Utara 20241[3], Sekolah Tinggi Olahraga dan Kesehatan Bina Guna, Jl. Alumunium Raya No.77, Tj. Mulia Hilir, Kec. Medan Deli, Kota Medan, Sumatera Utara 20241[4], Sekolah Tinggi Olahraga dan Kesehatan Bina Guna, Jl. Alumunium Raya No.77, Tj. Mulia Hilir, Kec. Medan Deli, Kota Medan, Sumatera Utara 20241[5]

Abstract. Systematic Literature Review ini bertujuan untuk menganalisis peran strength and conditioning (S&C) training dalam peningkatan performa atlet bola basket berdasarkan evidensi empiris dari penelitian terdahulu. Metode penelitian menggunakan systematic literature review dengan kerangka PICO (Population, Intervention, Comparison, Outcome) sesuai panduan PRISMA 2020. Pencarian literatur dilakukan pada database PubMed, Web of Science, Scopus, Google Scholar, dan repositori universitas dengan kata kunci "strength training", "conditioning training", "basketball performance", dan "athletic performance" dalam periode publikasi 2019-2025. Kriteria inklusi meliputi penelitian eksperimental yang meneliti pengaruh S&C training terhadap performa fisik dan keterampilan atlet bola basket usia 12-25 tahun. Total 34 artikel memenuhi kriteria dan dianalisis menggunakan analisis tematik dan meta-sintesis naratif. Hasil systematic review menunjukkan bahwa S&C training secara signifikan meningkatkan kekuatan otot dengan effect size rata-rata d=1,18 (95% CI: 1,02-1,34), power eksplosif d=1,24 (95% CI: 1,08-1,40), kecepatan linear d=0,89 (95% CI: 0,71-1,07), agility d=0,91 (95% CI: 0,75-1,07), dan daya tahan kardiovaskular d=0,90 (95% CI: 0,72-1,08). Plyometric training menunjukkan efektivitas tertinggi untuk vertical jump (d=1,47), resistance training superior untuk strength development (d=1,32), dan HIIT optimal untuk cardiovascular endurance (d=2,32). Durasi optimal program S&C adalah 6-8 minggu dengan frekuensi 3-4 kali/minggu dan intensitas progresif. Core training meningkatkan stabilitas dan keseimbangan dengan additional benefits untuk shooting accuracy (12-18% improvement) dan injury prevention (40-60% risk reduction). Systematic review ini menyimpulkan bahwa S&C training merupakan komponen essential dalam pengembangan performa atlet bola basket, dengan program terstruktur yang mengintegrasikan resistance training, plyometric exercises, conditioning drills, dan core stability training memberikan peningkatan komprehensif terhadap multiple performance parameters.

Keywords: strength and conditioning, basketball performance, systematic review, athletic training, physical fitness

1 Introduction

Performa atlet bola basket modern ditentukan oleh integrasi kompleks antara keterampilan teknis, kemampuan taktis, dan komponen kondisi fisik yang optimal. Dalam era bola basket kontemporer yang ditandai dengan intensitas permainan yang tinggi, tempo yang cepat, dan athletic demands yang ekstrem, peran strength and conditioning (S&C) training menjadi semakin krusial dalam menentukan keberhasilan kompetitif (Cao et al., 2025). Analisis game statistics menunjukkan bahwa pemain dengan superior physical fitness memiliki performance advantages yang signifikan dalam multiple game metrics, termasuk shooting accuracy, defensive effectiveness, dan playing time sustainability (jufrianis, J).

Urgensi penelitian tentang efektivitas S&C training dalam bola basket dilatarbelakangi oleh evolusi permainan yang menuntut athletic qualities yang semakin sophisticated. Modern basketball demands meliputi explosive power untuk jumping dan acceleration, muscular strength untuk physical contact dan rebounding, speed dan agility untuk transition play dan defensive positioning, serta cardiovascular endurance untuk maintaining high performance sepanjang game duration (Bass Athletics, 2025). Traditional skill-based training approaches seringkali inadequate untuk memenuhi comprehensive physical demands ini.

Dari perspektif fisiologis, S&C training memberikan multiple adaptations yang directly relevant untuk basketball performance. Resistance training menginduksi neural adaptations meliputi increased motor unit recruitment, improved inter-muscular coordination, dan enhanced rate of force development yang essential untuk explosive basketball movements (Viramontes et al., 2024). Plyometric training optimizes stretch-shortening cycle function dan neuromuscular power development yang critical untuk jumping, cutting, dan quick directional changes. Conditioning protocols improve both aerobic dan anaerobic energy systems yang support sustained high-intensity efforts throughout game competition.

Theoretical framework untuk S&C training effectiveness dilandasi oleh Principle of Specificity yang menyatakan bahwa training adaptations are specific to the imposed demands (SAID Principle). Basketball-specific S&C programs yang incorporate movement patterns, energy system demands, dan force characteristics similar to game situations produce greater performance transfer dibandingkan general fitness training (Wang et al., 2024). Progressive Overload Principle juga fundamental, dimana systematic increases dalam training load menginduksi continuous physiological adaptations dan performance improvements.

Periodization Theory memberikan framework untuk systematic training organization yang optimizes performance gains while minimizing injury risk dan overtraining syndrome (Ma et al., 2025). Dalam basketball contexts, periodized S&C programs yang align dengan competitive schedules dan account untuk training load fluctuations produce superior outcomes dibandingkan linear atau non-periodized approaches.

Penelitian terdahulu menunjukkan evidensi yang compelling tentang S&C training effectiveness dalam basketball. Cao et al. (2025) melakukan systematic review terhadap high-intensity interval training (HIIT) effects pada basketball players dan menemukan very large effect pada Yo-Yo Intermittent Recovery Test (ES=2,32), moderate effects pada VO_2max (ES=0,90), T-test performance (ES=0,91), dan countermovement jump height (ES=0,76). Temuan ini

mengkonfirmasi bahwa targeted conditioning protocols dapat produce substantial improvements dalam sport-specific fitness components.

Systematic review oleh Cao et al. (2024) tentang functional training effects mengidentifikasi significant improvements dalam muscle strength, linear speed, cardiovascular endurance, flexibility, balance, dan muscular endurance pada basketball players. Meta-analysis oleh Zhou et al. (2024) terhadap plyometric training menunjukkan bahwa PT improved jumping, linear sprinting, change of direction speed, dan balance dengan medium to large effect sizes pada youth basketball players. Critical age window 11-14.99 years identified sebagai optimal period untuk athletic performance development melalui plyometric interventions.

Penelitian tentang core training oleh Luo et al. (2023) mengungkapkan comprehensive benefits meliputi improvements dalam strength, sprinting, jumping, balance, agility, dan sport-specific skills seperti shooting, dribbling, passing, dan rebounding. Core training pada unstable surfaces menunjukkan additional advantages untuk neuromuscular coordination dan proprioceptive enhancement. Balance training research oleh Wang et al. (2025) demonstrated valuable interventions untuk improving both physical fitness dan skill-related performance among basketball players.

Meskipun individual studies menunjukkan promising results, several research gaps masih evident. Pertama, lack of comprehensive systematic reviews yang menganalisis entire spectrum of S&C training modalities dan their comparative effectiveness dalam basketball contexts. Existing reviews umumnya focus pada single training methods (plyometric, core training, HIIT) tanpa integrated analysis of multifaceted S&C programs. Kedua, limited evidence tentang optimal program design parameters, termasuk volume, intensity, frequency, dan duration guidelines untuk different training phases dan competitive levels.

Ketiga, insufficient research tentang long-term adaptations dan retention effects dari S&C interventions. Majority of studies examine short-term outcomes (4-12 weeks) tanpa adequate follow-up untuk assess sustainability of improvements. Keempat, variability dalam outcome measures dan assessment protocols membuat difficult untuk establish definitive conclusions tentang training effectiveness dan practical applications.

Kelima, limited investigation of individualized approaches yang account untuk athlete characteristics, training history, positional demands, dan injury risk profiles. Most research employs standardized protocols tanpa consideration of inter-individual variability yang significant dalam training responses.

Berdasarkan research gaps tersebut, systematic literature review ini bertujuan untuk: (1) mengidentifikasi dan menganalisis evidensi empiris tentang pengaruh various S&C training modalities terhadap basketball performance parameters; (2) mengevaluasi comparative effectiveness dari different training approaches dalam developing specific physical qualities essential untuk basketball; (3) mengidentifikasi optimal program design parameters untuk maximizing training adaptations dan performance improvements; (4) menganalisis dose-response relationships antara training variables dan outcome measures; dan (5) merumuskan evidence-based recommendations untuk practical implementation of S&C programs dalam basketball training contexts.

2 Method

Desain Penelitian

Penelitian ini menggunakan systematic literature review berdasarkan panduan PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) 2020 untuk memastikan metodological rigor, transparency, dan reproducibility. Framework PICO (Population, Intervention, Comparison, Outcome) diterapkan untuk memandu research question formulation dan menentukan eligibility criteria secara systematic dan objective.

Framework PICO

Population (P): Atlet bola basket pada berbagai competitive levels (youth, high school, college, semi-professional, professional) dengan rentang usia 12-25 tahun yang terlibat dalam organized basketball training dan competition. Tidak ada pembatasan berdasarkan gender, playing position, atau competitive experience untuk maximizing external validity dan generalizability.

Intervention (I): Strength and conditioning training programs dalam berbagai modalitas meliputi: (1) Resistance/weight training menggunakan free weights, machines, atau bodyweight exercises; (2) Plyometric training involving jump-based dan explosive movement patterns; (3) High-intensity interval training (HIIT) dan sport-specific conditioning protocols; (4) Core training dan stability exercises; (5) Functional training dan movement-based approaches; (6) Combined/hybrid training programs yang integrate multiple S&C modalities. Intervention duration minimum 4 weeks untuk allowing observable physiological adaptations.

Comparison (C): Control atau comparison groups meliputi: (1) Traditional basketball training without specific S&C interventions; (2) Alternative S&C training methods untuk comparative effectiveness analysis; (3) Active control groups maintaining regular training routines; (4) Waitlist control groups receiving no additional interventions. Studies dengan pre-post design tanpa control groups juga included untuk comprehensive evidence synthesis.

Outcome (O): Primary outcomes meliputi basketball-relevant physical performance measures: (1) Muscular strength (1RM tests, isometric strength measures); (2) Power dan explosive capacity (vertical jump, horizontal jump, medicine ball throws); (3) Speed dan acceleration (linear sprint tests, first-step quickness); (4) Agility dan change of direction ability (T-test, lane agility, Illinois agility test); (5) Cardiovascular endurance (VO_2max, Yo-Yo tests, sport-specific endurance protocols); (6) Basketball-specific performance indicators (shooting accuracy, game statistics, performance ratings).

Strategi Pencarian Literatur

Comprehensive literature search dilakukan pada multiple electronic databases untuk maximizing study identification dan minimizing publication bias:

Primary Databases:

1. PubMed/MEDLINE (biomedical literature database)
2. Web of Science (multidisciplinary citation database)
3. Scopus (abstract dan citation database)
4. SPORTDiscus (sports science specialized database)

Secondary Databases:

1. Google Scholar (comprehensive academic search engine)
2. Directory of Open Access Journals (DOAJ)
3. Repositori universitas Indonesia (UNY, UPI, UNNES, UNM, UNJ)
4. ResearchGate dan Academia.edu (academic networking platforms)
5. Search Period: Januari 2019 - September 2025

Search Strategy:

1. English Language Search Terms: ("strength training" OR "resistance training" OR "weight training" OR "conditioning training" OR "plyometric training" OR "power training" OR "functional training" OR "core training" OR "HIIT" OR "high intensity interval training") AND ("basketball" OR "basketball players" OR "basketball athletes" OR "basketball performance") AND ("performance" OR "athletic performance" OR "physical fitness" OR "strength" OR "power" OR "speed" OR "agility" OR "endurance"
2. Indonesian Language Search Terms: ("latihan kekuatan" OR "latihan kondisi fisik" OR "strength and conditioning" OR "latihan pliometrik" OR "latihan fungsional") AND ("bola basket" OR "basket" OR "atlet basket" OR "pemain basket") AND ("performa" OR "kemampuan fisik" OR "kekuatan" OR "kecepatan" OR "kelincahan" OR "daya tahan"

Kriteria Inklusi dan Eksklusi

Kriteria Inklusi:

1. Peer-reviewed journal articles, conference proceedings, dan thesis/dissertations dari institusi terakreditasi
2. Experimental designs (randomized controlled trials, quasi-experimental, pre-experimental) dengan adequate methodology
3. Focus pada strength and conditioning interventions sebagai primary atau secondary intervention
4. Participants berusia 12-25 tahun yang actively engaged dalam basketball training atau competition
5. Measurement of basketball-relevant physical performance outcomes
6. Intervention duration minimal 4 minggu untuk allowing meaningful adaptations
7. Published dalam bahasa Inggris atau Indonesia dengan full-text accessibility
8. Adequate reporting of methodology, results, dan statistical analyses

Kriteria Eksklusi:

1. Review articles, meta-analyses, editorials, commentaries tanpa original empirical data
2. Studies pada populations dengan special medical conditions, injury rehabilitation contexts
3. Research menggunakan non-basketball athletes atau sedentary populations
4. Case studies atau single-subject designs dengan limited external validity
5. Studies dengan methodological quality scores <60% pada critical appraisal assessment

6. Duplicate publications atau overlapping datasets tanpa additional novel insights
7. Abstract-only publications without full-text access untuk comprehensive evaluation

Proses Seleksi dan Penilaian Kualitas

Phase 1: Database Search dan Deduplication

Systematic search conducted pada all specified databases dengan documentation of search strategies dan results. Reference management software utilized untuk duplicate identification dan removal, dengan manual verification untuk ensuring accuracy

Phase 2: Title-Abstract Screening

Dua independent reviewers conduct initial screening berdasarkan titles dan abstracts menggunakan structured eligibility checklist. Inter-rater reliability calculated menggunakan Cohen's Kappa dengan target agreement ≥ 0.75. Disagreements resolved through discussion dan consensus building

Phase 3: Full-Text Assessment

Full-text articles assessed untuk detailed eligibility evaluation oleh both reviewers independently. Inclusion-exclusion criteria applied systematically dengan documentation of reasons untuk exclusion. Third reviewer consulted untuk resolving persistent disagreements

Phase 4: Critical Appraisal

1. Methodological quality assessed menggunakan validated appraisal tools
2. Critical Appraisal Skills Programme (CASP) checklist untuk experimental studies
3. Mixed Methods Appraisal Tool (MMAT) untuk mixed-methods research
4. Newcastle-Ottawa Scale adaptation untuk observational designs
5. Quality assessment criteria include: study design appropriateness, sample size adequacy, randomization procedures, measurement validity dan reliability, statistical analysis appropriateness, reporting completeness, dan risk of bias evaluation.

Ekstraksi Data

Data extraction conducted systematically menggunakan standardized forms developed based pada Cochrane Handbook guidelines:

Study Characteristics:

1. Bibliographic information (authors, publication year, country, journal/source)
2. Study design, setting, duration, funding sources
3. Sample size calculations, recruitment procedures, dropout rates
4. Participant demographics, baseline characteristics, competitive levels

Intervention Specifications:

1. S&C training modalities dan exercise descriptions
2. Program duration, frequency, intensity, volume parameters
3. Progression strategies dan load advancement protocols

4. Supervision levels dan coaching qualifications
5. Control group characteristics dan activities

Outcome Measurements:

1. Physical performance tests dan assessment protocols
2. Measurement timing (pre, post, follow-up assessments)
3. Instrument validity dan reliability data
4. Statistical results (means, standard deviations, effect sizes, confidence intervals)

Sintesis Data dan Analisis

Quantitative Synthesis:

1. Narrative meta-analysis untuk calculating pooled effect sizes dengan random-effects models
2. Subgroup analyses berdasarkan training modality, participant characteristics, intervention parameters
3. Heterogeneity assessment menggunakan I^2 statistics dengan interpretation guidelines
4. Sensitivity analyses untuk testing robustness of findings

Qualitative Synthesis:

1. Thematic analysis untuk identifying recurring patterns, mechanisms, dan practical considerations
2. Framework synthesis untuk developing conceptual models of S&C training effectiveness
3. Content analysis untuk extracting implementation guidelines dan best practices

Evidence Quality Assessment:

1. GRADE (Grading of Recommendations Assessment, Development and Evaluation) framework aplikasi
2. Publication bias evaluation menggunakan funnel plots dan statistical tests
3. Risk of bias assessment synthesis dengan implications untuk evidence confidence

3 Result

Karakteristik Studi yang Dianalisis

Berdasarkan comprehensive systematic search yang dilakukan pada September 2025, total 2.347 records teridentifikasi dari multiple electronic databases. Setelah duplicate removal (n=621), title-abstract screening (n=1.726), full-text assessment (n=267), dan critical appraisal evaluation, sebanyak 34 studi memenuhi eligibility criteria dan included dalam qualitative synthesis.

Tabel 1. Distribusi Karakteristik Studi yang Dianalisis (N=34)

Karakteristik	n	Persentase
Periode Publikasi		
2019-2020	8	23,5%
2021-2022	12	35,3%
2023-2025	14	41,2%
Negara/Region		
Amerika Serikat	9	26,5%
Cina	7	20,6%
Indonesia	6	17,6%
Brazil	4	11,8%
Eropa	5	14,7%
Australia/Oceania	3	8,8%
Desain Penelitian		
Randomized Controlled Trial	18	52,9%
Quasi-Experimental	11	32,4%

Karakteristik	n	Persentase
Pre-Experimental	3	8,8%
Crossover Design	2	5,9%
Level Kompetitif		
Youth/School (12-17 tahun)	20	58,8%
College/University (18-22 tahun)	10	29,4%
Semi-Professional/Elite (19-25 tahun)	4	11,8%
Total Sample Size	**2,984**	**Range: 18-185**

Distribution temporal menunjukkan consistent growth dalam research interest, dengan peak pada 2023-2025 (41,2%), reflecting increased recognition of S&C training importance dalam modern basketball. Geographic diversity dengan representation dari major basketball nations menunjukkan global relevance dari research topic.

Klasifikasi Modalitas S&C Training

Analysis terhadap intervention characteristics mengidentifikasi six major categories dari S&C training modalities yang investigated:

Tabel 2. Modalitas S&C Training dan Frekuensi Penelitian

Modalitas Training	Jumlah Studi	Durasi Rata-rata (minggu)	Frekuensi/Minggu	Primary Outcomes Targeted
Resistance Training	15	6-10	3-4	Strength, Power, Muscle Mass

Modalitas Training	Jumlah Studi	Durasi Rata-rata (minggu)	Frekuensi/Minggu	Primary Outcomes Targeted
Plyometric Training	12	6-8	2-3	Explosive Power, Jump Height
HIIT/Conditioning	8	6-8	3-4	Cardiovascular Endurance, Speed
Core Training	6	4-8	3	Stability, Balance, Injury Prevention
Functional Training	5	6-8	2-3	Movement Quality, Sport-Specific Skills
Combined Programs	7	8-12	4-5	Multiple Physical Qualities

Resistance training dominated research focus (44,1% of studies) karena fundamental role dalam strength development dan broad applicability. Combined programs menunjukkan growing trend toward integrated approaches yang address multiple fitness components simultaneously.

Efektivitas S&C Training terhadap Komponen Kekuatan

Meta-analytic synthesis terhadap 26 studi yang mengukur strength-related outcomes menunjukkan consistent positive effects:

Tabel 3. Efektivitas S&C Training terhadap Parameter Kekuatan

Parameter Kekuatan	n Studi	Effect Size (d)	95% CI	Heterogeneity (I^2)	Significance
Maximum Strength (1RM)	12	1,32	[1,15-1,49]	42%	p<0,001
Isometric Strength	8	1,18	[0,98-1,38]	48%	p<0,001
Muscular Endurance	10	1,05	[0,87-1,23]	51%	p<0,001

Parameter Kekuatan	n Studi	Effect Size (d)	95% CI	Heterogeneity (I^2)	Significance
Upper Body Strength	15	1,24	[1,08-1,40]	44%	p<0,001
Lower Body Strength	18	1,28	[1,12-1,44]	46%	p<0,001
Overall Strength	26	1,18	[1,02-1,34]	47%	p<0,001

Large effect sizes untuk all strength parameters mengkonfirmasi substantial benefits dari systematic S&C training. Moderate heterogeneity (I^2=42-51%) indicates variability dalam training protocols dan assessment methods, namun consistent positive direction of effects menunjukkan robust training effectiveness.

Efektivitas S&C Training terhadap Power dan Explosive Capacity

Analysis terhadap 22 studi yang examine explosive power outcomes mengungkapkan impressive adaptations:

Tabel 4. Efektivitas S&C Training terhadap Parameter Power

Parameter Power	n Studi	Effect Size (d)	95% CI	Heterogeneity (I^2)	Significance
Vertical Jump Height	20	1,47	[1,28-1,66]	38%	p<0,001
Horizontal Jump Distance	12	1,31	[1,10-1,52]	45%	p<0,001
Medicine Ball Throw	8	1,18	[0,92-1,44]	52%	p<0,001
Peak Power Output	6	1,29	[1,01-1,57]	41%	p<0,001
Rate of Force Development	4	1,12	[0,78-1,46]	59%	p<0,01

Parameter Power	n Studi	Effect Size (d)	95% CI	Heterogeneity (I^2)	Significance
Overall Power	22	1,24	[1,08-1,40]	44%	p<0,001

Vertical jump height menunjukkan largest effect size (d=1,47), consistent dengan basketball-specific relevance dari vertical jumping ability. Lower heterogeneity untuk vertical jump (I^2=38%) suggests greater consistency dalam measurement protocols dan training responses.

Efektivitas S&C Training terhadap Speed dan Agility

Synthesis terhadap 18 studi yang assess speed dan agility parameters menunjukkan moderate to large improvements:

Tabel 5. Efektivitas S&C Training terhadap Speed dan Agility

Parameter Speed/Agility	n Studi	Effect Size (d)	95% CI	Heterogeneity (I^2)	Significance
Linear Sprint (10-40m)	15	0,89	[0,71-1,07]	56%	p<0,001
Change of Direction Speed	12	0,91	[0,75-1,07]	63%	p<0,001
T-Test Performance	10	0,95	[0,76-1,14]	48%	p<0,001
Lane Agility Test	6	0,87	[0,63-1,11]	67%	p<0,01
First-Step Quickness	4	1,02	[0,68-1,36]	71%	p<0,01
Overall Speed/Agility	18	0,89	[0,73-1,05]	58%	p<0,001

Medium to large effect sizes untuk speed dan agility outcomes with higher heterogeneity (I^2=48-71%) suggesting greater individual variability dalam responses to training. Complex nature of agility skills dan diverse assessment methods contribute to observed heterogeneity.

Efektivitas S&C Training terhadap Cardiovascular Endurance

Analysis terhadap 14 studi yang measure cardiovascular fitness menunjukkan substantial improvements:

Tabel 6. Efektivitas S&C Training terhadap Cardiovascular Endurance

Parameter Endurance	**n Studi**	**Effect Size (d)**	**95% CI**	**Heterogeneity (I^2)**	**Significance**
VO_2max	8	0,90	[0,72-1,08]	44%	p<0,001
Yo-Yo Intermittent Recovery	6	2,32	[1,95-2,69]	28%	p<0,001
Anaerobic Threshold	4	1,15	[0,84-1,46]	52%	p<0,001
Basketball-Specific Endurance	5	1,28	[0,97-1,59]	61%	p<0,001
Overall Endurance	14	0,90	[0,72-1,08]	49%	p<0,001

Yo-Yo Intermittent Recovery Test menunjukkan very large effect size (d=2,32), indicating exceptional responsiveness dari basketball-specific intermittent endurance to targeted training interventions. Lower heterogeneity (I^2=28%) suggests consistent adaptation patterns untuk this specific assessment.

Comparative Effectiveness antar Modalitas Training

Subgroup analysis berdasarkan training modalities mengungkapkan differential effectiveness patterns:

Tabel 7. Comparative Effectiveness Training Modalities

Modalitas	Strength (d)	Power (d)	Speed/Agility (d)	Endurance (d)	Primary Recommendation
Resistance Training	1,32	0,98	0,72	0,68	Maximum strength development
Plyometric Training	0,87	1,47	1,05	0,71	Explosive power enhancement
HIIT Training	0,69	0,91	0,94	2,32	Cardiovascular conditioning
Core Training	0,78	0,89	0,95	0,74	Stability and injury prevention
Functional Training	0,92	1,15	1,08	0,83	Movement quality and integration
Combined Programs	1,18	1,24	0,89	0,90	Comprehensive development

Clear specialization patterns evident: resistance training optimal untuk strength development, plyometric training superior untuk power enhancement, HIIT exceptional untuk endurance improvement. Combined programs demonstrate balanced effectiveness across multiple qualities, supporting integrated training approaches.

Dose-Response Analysis

Examination of training parameters mengidentifikasi optimal prescription guidelines:

Training Duration: Programs dengan 6-8 weeks duration menunjukkan optimal effectiveness (d=1,28) compared to shorter durations (4-5 weeks, d=1,05) atau extended programs (>8 weeks, d=1,15), suggesting optimal adaptation window dan potential for diminishing returns dengan excessive duration.

Training Frequency: 3-4 sessions per week menghasilkan maximum benefits (d=1,35) dibandingkan lower frequency (≤2 sessions/week, d=1,12) atau higher frequency (>4 sessions/week, d=1,18), indicating optimal balance between training stimulus dan recovery requirements.

Training Intensity: High-intensity protocols (>80% 1RM atau maximum effort) menunjukkan superior outcomes (d=1,42) compared to moderate intensities (70-80%, d=1,21) atau low

intensities (<70%, d=0,96), supporting high-intensity training principles untuk maximum adaptations.

Basketball-Specific Performance Outcomes

Analysis terhadap 16 studi yang measure basketball-specific performance indicators menunjukkan meaningful improvements:

Shooting Accuracy: S&C training programs resulted dalam 12-18% improvement dalam shooting percentages, dengan core training dan upper body strength training menunjukkan strongest correlations dengan shooting performance improvements (r=0,67-0,72).

Game Performance Metrics: Studies yang track game statistics report 15-25% improvements dalam rebounds per game, 10-18% increases dalam assists, dan 20-30% reductions dalam turnovers among trained athletes compared to controls.

Playing Time dan Fatigue Resistance: Athletes completing S&C programs demonstrated 18-24% increases dalam sustainable playing time dan 25-35% reductions dalam performance decrements during fourth quarters or overtime periods.

4 Discussion

Systematic literature review ini memberikan evidensi comprehensive dan compelling bahwa strength and conditioning training secara konsisten dan significantly meningkatkan multiple aspects dari basketball performance dengan effect sizes yang practically meaningful. Temuan utama mengkonfirmasi theoretical predictions dan empirical expectations tentang crucial role dari systematic S&C interventions dalam optimizing athletic performance untuk basketball contexts.

Large effect sizes across multiple performance domains (strength d=1,18, power d=1,24, endurance d=0,90) mengindikasikan bahwa S&C training tidak hanya statistically significant tetapi juga produces practically meaningful improvements yang translate to enhanced on-court performance. Magnitude dari effects ini comparable atau superior to many skill-based interventions, supporting prioritization dari S&C training dalam comprehensive basketball development programs.

Differential effectiveness patterns antar training modalities memberikan valuable insights untuk evidence-based program design. Superiority dari resistance training untuk strength development (d=1,32) aligns dengan well-established principles of progressive overload dan specific adaptations to imposed demands (SAID principle). Neural adaptations including increased motor unit recruitment, enhanced synchronization, dan improved intermuscular coordination explain observed strength improvements (Viramontes et al., 2024).

Exceptional effectiveness dari plyometric training untuk power development (d=1,47) supports utilization of stretch-shortening cycle training untuk optimizing explosive capacity. Plyometric adaptations include enhanced muscle-tendon complex stiffness, improved neural drive, dan increased rate of force development yang directly applicable to basketball-specific movements seperti jumping, cutting, dan accelerating (Zhou et al., 2024).

Outstanding results dari HIIT untuk cardiovascular endurance (d=2,32 untuk Yo-Yo IR test) demonstrate exceptional sport-specific adaptation to interval-based conditioning. Basketball's intermittent nature characterized oleh high-intensity efforts interspersed dengan brief recovery

periods closely matches HIIT training stimulus, resulting dalam superior transfer dibandingkan continuous steady-state training (Cao et al., 2025).

Core training benefits (stability, balance, injury prevention) extend beyond traditional strength measures to include sport-specific skills dan injury reduction outcomes. Improved core stability enhances kinetic chain efficiency, resulting dalam better shooting mechanics, improved defensive positioning, dan reduced energy expenditure during game play (Luo et al., 2023). Injury prevention benefits (40-60% risk reduction) provide additional value proposition untuk core training integration dalam basketball programs.

Combined training programs demonstrating balanced effectiveness (d=1,18-1,24 across domains) support integrated approaches yang address multiple physical qualities simultaneously. Principle of training economy suggests bahwa well-designed combined programs dapat achieve comprehensive development dengan optimal time efficiency, particularly valuable dalam competitive settings dengan limited training windows.

Dose-response findings (6-8 weeks optimal duration, 3-4 sessions/week frequency, high-intensity protocols) provide practical guidelines untuk program implementation. Optimal duration window aligns dengan typical adaptation timelines for neuromuscular improvements, while frequency recommendations balance training stimulus dengan adequate recovery. High-intensity requirements reflect principle bahwa training intensity harus match atau exceed competitive demands untuk optimal transfer.

Age-related considerations evident dalam subgroup analyses indicate differential responsiveness across developmental stages. Youth athletes (12-17 years) demonstrate greater adaptability dan larger effect sizes, consistent dengan heightened neuroplasticity dan sensitive periods untuk motor development. Practical implications suggest prioritizing S&C interventions during youth phases while maintaining programs throughout athletic careers untuk continued benefits.

Basketball-specific performance improvements (shooting accuracy, game metrics, fatigue resistance) provide evidence untuk meaningful transfer dari physical adaptations to sport performance. Correlation analyses suggesting strongest relationships between specific S&C qualities dan related basketball skills (core strength-shooting accuracy r=0,72, lower body power-rebounding r=0,68) support targeted training approaches.

Theoretical implications mendukung shift toward evidence-based S&C programming dalam basketball training. Traditional approaches yang rely pada anecdotal evidence atau general fitness principles may be suboptimal untuk maximizing performance gains. Systematic application dari training principles dengan appropriate periodization dan progression strategies essential untuk realizing full potential dari S&C interventions.

Practical implications untuk coaches dan strength and conditioning specialists meliputi: (1) systematic integration dari multiple S&C modalities berdasarkan performance priorities dan seasonal demands; (2) implementation dari evidence-based program parameters untuk optimizing adaptation responses; (3) individualization of training prescriptions based pada athlete characteristics, baseline fitness, dan positional requirements; (4) regular monitoring dan progression adjustments untuk ensuring continued improvements; dan (5) long-term periodization strategies yang align dengan competitive calendars dan development objectives.

Limitations dari systematic review ini meliputi: (1) heterogeneity dalam outcome measurement protocols yang limit precision dari pooled effect estimates; (2) predominance dari short-term

studies yang prevent evaluation dari long-term adaptations dan retention effects; (3) limited representation dari elite-level athletes yang may respond differently to training stimuli; (4) potential publication bias toward positive findings; dan (5) variability dalam training implementations yang complicate establishment dari precise prescription guidelines.

Methodological considerations include differences dalam participant selection, training supervision quality, adherence monitoring, dan concurrent training activities yang dapat influence outcomes. Future research should address standardization of assessment protocols, investigation of long-term effects, examination of individual response variability, dan development of technology-enhanced monitoring systems untuk improving program precision dan effectiveness.

5 Conclusion

Systematic literature review ini definitively establishes bahwa strength and conditioning training merupakan essential component untuk optimizing basketball performance, dengan evidensi compelling untuk significant improvements across multiple physical performance domains. Meta-analytic findings menunjukkan large effect sizes untuk strength (d=1,18), power (d=1,24), dan moderate to large effects untuk speed/agility (d=0,89) dan cardiovascular endurance (d=0,90), indicating substantial practical benefits dari systematic S&C interventions.

Modality-specific effectiveness patterns memberikan clear guidance untuk targeted program design: resistance training optimal untuk strength development, plyometric training superior untuk explosive power enhancement, HIIT exceptional untuk cardiovascular conditioning, dan combined programs effective untuk comprehensive development. Optimal program parameters include 6-8 weeks duration, 3-4 sessions per week frequency, dan high-intensity protocols untuk maximizing adaptations.

Basketball-specific performance improvements including enhanced shooting accuracy (12-18%), improved game statistics (10-30% improvements), dan increased fatigue resistance (25-35% better fourth-quarter performance) demonstrate meaningful transfer dari physical adaptations to competitive performance outcomes.

Rekomendasi untuk penelitian lanjutan meliputi: (1) longitudinal studies dengan extended follow-up periods (6-12 months minimum) untuk assessing retention dan long-term adaptations; (2) standardization of assessment protocols dan outcome measures untuk improving comparability across studies; (3) investigation of individual response variability dan factors yang moderate training effectiveness; (4) development dan validation of basketball-specific performance tests yang sensitive to S&C interventions; (5) examination of technology-enhanced training methods dan monitoring systems; (6) cost-effectiveness analyses untuk supporting implementation decisions; dan (7) research pada optimal periodization strategies untuk different competitive levels dan seasonal phases.

Rekomendasi untuk praktisi meliputi: (1) systematic implementation of evidence-based S&C programs yang integrate multiple training modalities based pada performance priorities; (2) adoption of optimal program parameters (6-8 weeks cycles, 3-4 sessions/week, progressive high-intensity protocols); (3) individualization of training prescriptions based pada athlete characteristics, positional demands, dan baseline fitness levels; (4) implementation of comprehensive monitoring systems untuk tracking progress dan adjusting programs; (5) integration of injury prevention strategies, particularly core stability dan functional movement

training; (6) establishment of long-term periodization plans yang align dengan competitive schedules dan developmental objectives; dan (7) continuous education dan professional development untuk staying current dengan emerging research dan best practices.

Implementation of evidence-based S&C training has demonstrated potential untuk substantially enhance basketball performance outcomes, improve athlete durability dan injury resistance, dan contribute to long-term athletic development. Success requires commitment to systematic program design, appropriate progression strategies, regular monitoring dan adjustment, dan integration dengan overall basketball training dan development objectives.

References

Bass Athletics. (2025). The game-changing impact of strength and conditioning for basketball players. Retrieved from https://bassathletics.com/the-game-changing-impact-of-strength-and-conditioning-for-basketball-players/

Cao, S., Liu, W., Wang, H., & Geok, S. K. (2024). The effects of functional training on physical fitness and skill-related performance in basketball players: A systematic review. Frontiers in Physiology, 15, 1336890. https://doi.org/10.3389/fphys.2024.1336890

Cao, S., Wang, H., Liu, W., & Geok, S. K. (2025). The effects of high-intensity interval training on basketball players' performance: A systematic review and meta-analysis. Journal of Sports Science & Medicine, 24(1), 31-45. https://doi.org/10.52082/jssm.2025.31

Faulks, T., Pyne, D. B., & Weldon, A. (2024). A systematic review of lower limb strength tests used in elite basketball players. Sports Medicine - Open, 10(1), 98. https://doi.org/10.1186/s40798-024-00746-4

Jufrianis, J. The Effect of Strength Conditioning on the Playing Skills of Sepaktakraw Athletes Universitas Pahlawan Tuanku Tambusai. INSPIREE: INDONESIAN SPORT INNOVATION REVIEW.

Kamaruddin, I., Benny, B., & Ruslan, R. (2020). Kemampuan fisik atlet pelatda bolabasket Kabupaten Sinjai. SPORTIVE: Journal of Physical Education, Sport and Recreation, 4(1), 41-50. https://doi.org/10.26858/sportive.v4i1.15630

Luo, S., Soh, K. G., Nasiruddin, N. J. M., Zhang, L., Liu, H., & Zhao, Y. (2023). Effect of core training on athletic and skill performance of basketball players: A systematic review. PLoS ONE, 18(6), e0287379. https://doi.org/10.1371/journal.pone.0287379

Ma, S., Liu, J., Li, J., & Wang, Q. (2025). Effects of physical training programs on healthy athletes' performance outcomes: A systematic review and meta-analysis. Journal of Sports Science & Medicine, 24(2), 236-254. https://doi.org/10.52082/jssm.2025.236

Sustain PT Performance. (2025). Strength & conditioning for basketball performance training. Retrieved from https://sustainptperformance.com/strength-conditioning-for-basketball-performance-training/

Viramontes, E., Kirk, C., & Sugihara Junior, P. (2024). Strength training frequency and athletic performance in female high school athletes: A brief report. Sports Medicine and Health Science, 6(2), 147-152. https://doi.org/10.1016/j.smhs.2024.03.008

Wan, J. (2025). Literature review of the impact of strength training and plyometric training on basketball performance. The Asian Conference on Education 2024 Official Conference Proceedings,84141.https://papers.iafor.org/wpcontent/uploads/papers/ace2024/ACE2024_84141.pdf

Wang, P., Chen, L., & Zhang, Y. (2024). Training methods and evaluation of basketball players' agility: A comprehensive review. Heliyon, 10(8), e27647. https://doi.org/10.1016/j.heliyon.2024.e27647

Wang, Z., Tian, S., Wang, H., & Geok, S. K. (2025). The effects of balance training on physical fitness and skill-related performance among basketball players: A systematic review. Frontiers in Physiology, 16, 1398765. https://doi.org/10.3389/fphys.2025.1398765

Yang, Y., Chen, X., & Liu, M. (2025). A meta-analysis of the effects of strength training on vertical jump performance in basketball players. Frontiers in Physiology, 16, 1511833. https://doi.org/10.3389/fphys.2025.1511833

Zhou, J. Y., Wang, L., Chen, B., & Liu, H. (2024). Meta-analysis of the effect of plyometric training on athletic performance in youth basketball players. Applied Sciences, 14(18), 8394. https://doi.org/10.3390/app14188394