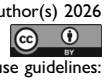
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Representativeness of training activities in competitive sports: A systematic review

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Abstract

This study aimed to systematically review the scientific literature evaluating the representativeness of training activities in sports. A systematic search of electronic databases was conducted in September 2024 and May 2026, with keywords relating to representative learning design, training activities and sport coaching. Studies which quantified the representativeness of a training activity, within any sport, involving participants of any age, gender, and playing experience were included. Nineteen studies met the eligibility criteria to be included. Small-sided games ($n = 13$; 68%) and match simulations ($n = 11$; 58%) were the most investigated training activities, whilst the influence of task constraints on representativeness of training activities has received limited investigation ($n = 3$; 16%). Studies evaluated representativeness using technical ($n = 12$; 63%), physical ($n = 10$; 53%), and tactical (n = 5; 26%) variables, with no study using psychological variables. Furthermore, the majority of studies investigated the representativeness of Australian rules football ($n = 8$; 42%) and included predominantly male ($n = 12$; 63%) and national-level ($n = 10$; 53%) participants. Overall, training activities, including match simulations, often failed to replicate competition demands. Coaches and coach education can use these findings to inform design, delivery and reflection of representative practices; however, results should be interpreted cautiously due to methodological limitations. Future research should quantify tactical variables, adopt multi-team, longitudinal designs and manipulate task constraints in isolation to identify causal drivers of representativeness. This will provide better support for coaches aligning practice with competition demands.

Keywords

Action fidelity, ecological dynamics, match simulation, planning, practice design, reflection

Reviewer: David Broadbent (Deakin University, Australia)

Introduction

Sport coaching is inherently complex, shaped by the dynamic, unpredictable, and context-specific nature of the individuals involved and environment in which it occurs.[1–3] Consequently, coaches must be adaptable in their decision-making, drawing on a range of knowledge sources (i.e., professional, inter and intra)[4] to respond effectively to the unique demands of their coaching context. To do so, coaches are required to systematically plan, implement and evaluate their coaching practices.[5,6]

For planning to be effective, coaches must create goals, design activities and formulate strategies to achieve them.[7] Coaching sessions should support athletes' skill development and decision-making, while providing a level of challenge comparable to competition.[8] Therefore, how coaches devise these goals and structure their practices depends on access to relevant knowledge (e.g., understanding of the sport) and what information is readily available to them (e.g., physical, technical, or tactical analysis and insights).[9] Planning is a continuous, cyclical and adaptive process. Coaches need to regularly revisit and revise their intentions based on new insights gained through experience and analysis.[10] Therefore, effective planning is grounded in

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evidence-based decision-making (i.e., the integration of evidence from sources such as, research, practitioner expertise, and context specific information).[11] Ultimately, the effectiveness of planning depends on the quality of information available to support it.

Many coaches engage in reflection through conversations with peers, athletes, and coach developers, which can provide valuable insight into coaching practice.[3] However, obtaining access to information about how hard players worked, the complexity of decisions made, or how closely the training mirrors competitive conditions is problematic. Dialogue with peers and coach developers can facilitate coaches to explore ideas, test assumptions, and make sense of their experiences.[12] Importantly, such information should not be treated as inherently objective or neutral, as decisions about what is measured, how variables are operationalised, and how data are interpreted are shaped by theoretical, methodological, and contextual assumptions. As with planning, reflection is only as good as the quality of information that supports it.[13] Therefore, rather than privileging numerical data over dialogue, reflective practice may be strengthened when coaches integrate multiple sources of evidence, including coach observation, athlete feedback, peer dialogue, and systematically collected quantitative and qualitative information. In this sense, the quality of information supporting planning and reflection depends not only on its measurement properties, but also on its relevance, interpretation, and use within the coaching context.

Without tangible data to guide coaches' thinking, the processes of planning and reflection becomes difficult. Whilst objective and quantifiable measures are often prioritised, it is also important to look more broadly to include the perceptual, action and contextual information that shapes athlete-environment interactions. For coaches, this involves drawing on multiple information sources,[14] which is challenging when acknowledging the limited available empirical evidence. One approach used to evaluate training is Representative Learning Design (RLD). Grounded in Brunswik's theory of representative design,[15] RLD emphasises the importance of preserving key perceptual and movement demands within training to ensure effective skill transfer to competition. RLD is also underpinned by ecological dynamics, which views skilled behaviour as emerging through the continuous interaction between the performer, task and environment. From this perspective, representative practice should preserve the key informational variables and perception–action couplings that shape behaviour in competition. The framework comprises two core components: functionality, which reflects how well a task replicates the perceptual-cognitive demands of the game; and action fidelity, which concerns the extent to which behaviours in training mirror those in competition. Kinetic, kinematic and technical variables are typically analysed to assess representativeness,[16,17] although physiological (e.g., heart rate, RPE) and psychological variables (e.g., mental effort, confidence, anxiety, motivation) should also be considered, as they impose important context-specific constraints within competitive environments. Pinder et al. (2011) emphasised that RLD requires practitioners to create dynamic interventions to account for 'interacting constraints on movement behaviours, (…) informational variables from the specific performance environments, and (…) functional coupling between perception and action processes' (p. 151).[18] Despite the theoretical value of representative training, its application in the scientific literature (most commonly within the scope of RLD) remains inconsistent. Recommendations for the application of representative training are often presented as hypothetical or anecdotal examples without underpinning data,[19–21] or in ways that are not easily digestible or practical for coaches.[20,22] For example, studies may assess either training or competition environments in isolation,[23–26] relying on indirect comparisons with previously published data rather than direct assessments of representativeness. Consequently, it is difficult to understand the current state and extent of the scientific literature which has attempted to evaluate the representativeness of training activities. Therefore, this review aims to 1) systematically review the scientific literature evaluating the representativeness of training activities in sports, 2) identify the methods used to assess representativeness, and 3) summarise how training activities can be designed to more (or less) closely mirror the demands of competition.

Methods

Design and search strategy

This systematic review was completed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).[27] A systematic search of electronic databases (APA PsycInfo, CINAHL, MEDLINE, PubMed, Scopus and SPORTDiscus) was conducted on 2nd September 2024, with no date restrictions. An updated search was conducted on 18th May 2026, to identify any additional studies published since the original search. The search strategy included terms for representative learning design ('representative learning' OR 'representativeness' OR 'learning design' OR 'ecological dynamics') AND training activities ('training' OR 'practice' OR 'activit*') AND sport coaching ('sport*' OR 'coach*'). The reference list of included studies were manually reviewed against the eligibility criteria for potentially eligible studies. A review protocol was not registered.

Eligibility criteria

Included studies quantified the representativeness of a training activity, within any sport, and involving participants

(athletes and coaches) of any age, gender, playing standard and playing (or coaching) experience. Only peer-reviewed, full-text journal articles were included, with abstracts, conference proceedings, book chapters, review studies, and student theses excluded. Studies could be written in any language. Studies quantifying; performance during training and competition but not evaluating representativeness (i.e., comparison of variables between environments; descriptive, statistical significance, relationships),[25,28] representativeness of a whole training session (i.e., not an individual training activity),[29] or only analysing training activities (i.e., no quantification of performance during competition)[26] were excluded.

Study selection

Duplicate studies were identified and removed prior to screening. A two-stage screening process was conducted, with two researchers (CF, AHA) independently reviewing studies against the eligibility criteria. Initial screening (first-stage) involved reviewing the title, abstract, and keywords, with remaining studies included for full-text screening (second-stage). Disagreements following initial or full-text screening, were resolved through discussion with a third researcher (EC). Studies remaining following full-text screening were included within this review.

Methodological quality

The methodological quality of included studies were reviewed against a modified version of the Downs and Black checklist (Supplemental Table 1).[30] The modified checklist excluded irrelevant criteria for the methodological approaches adopted by studies within the current review (e.g., criteria only relevant for intervention studies: reporting (Q4, 8, 9), external validity (Q12, 13), internal validity (Q14, 15, 16, 17, 19, 21 22, 23, 24)). Subsequently, a study could attain a maximum score of 12 from 11 criteria. The methodological quality was independently reviewed by two researchers (CF, SQ), with any disagreements resolved by discussion with a third researcher (EC).

Data extraction

Data were extracted by CF and reviewed by AHA. Data relating to study characteristics (e.g., year of publication, country, year of data collection), participant characteristics (e.g., sex, age group, playing standard), methods of data collection and analysis (e.g., number of competition observations, number of training observations, inclusion criteria), and representativeness of training activities (i.e., physical, technical, tactical or psychological variables) were extracted. The categorisation of physical, technical, tactical and psychological variables for variables quantifying representativeness of training activities is aligned to wider sport science and coaching literature investigating performance during competition and training.[31] Physical variables described the internal or external demands (e.g., heart rate (HR), distance covered, accelerations), technical variables described the action of discrete, sport-specific skills (e.g., passes, shots, disposals), tactical variables described the team, unit or individual-specific behaviours related to position, space or co-ordination (e.g., team length, interpersonal distance, team surface area), and psychological variables described the psychological characteristics or skills (e.g., mental effort, confidence, cognitive anxiety). Where data were presented as figures, WebPlotDigitizer v5.2[32] was used to extract data. If studies presented irrelevant data alongside comparisons between training and competition, only relevant data were extracted. If data were not distinguishable (e.g., number of training sessions, activities, or individual observations), data were reported as ND (not distinguishable). These datapoints were acknowledged but excluded from format-specific analyses due to their lack of separation. Irrelevant data included (but was not limited to); data only presented in one environment (i.e., only quantified during competition),[33] when data was not distinguishable,[34] or fixtures were not competitive.[34] To facilitate comparisons, all data were reported in standard units (e.g., distance covered (m)), with data converted if required and denoted if not possible.

Statistical analysis

Due to the range of study aims (e.g., developing a drill classification system,[35] or to investigate gender differences[33]), different methods of data collection and varied statistical analysis approaches (e.g., Cluster analysis,[35] association rules algorithm[36]) adopted across studies, a meta-analysis was not conducted. Data were presented as mean ± SD unless otherwise stated.

Results

Study selection

The study selection process is presented in Figure 1. Searching electronic databases identified 1688 studies. The screening process eliminated 1679 studies, whilst 10 studies were retrieved from manually reviewing the reference lists from included studies,[34,35,37–44] resulting in 19 studies included in this review.[33–51]

Methodological quality of studies

The methodological quality of included studies are presented in Table 1. The quality of studies ranged between 7 and 12 (mean = 9.4 ± 1.3). Overall, the methodological quality was high, with all studies, excluding one,[43] receiving a score of ≥8. All studies received a maximum score

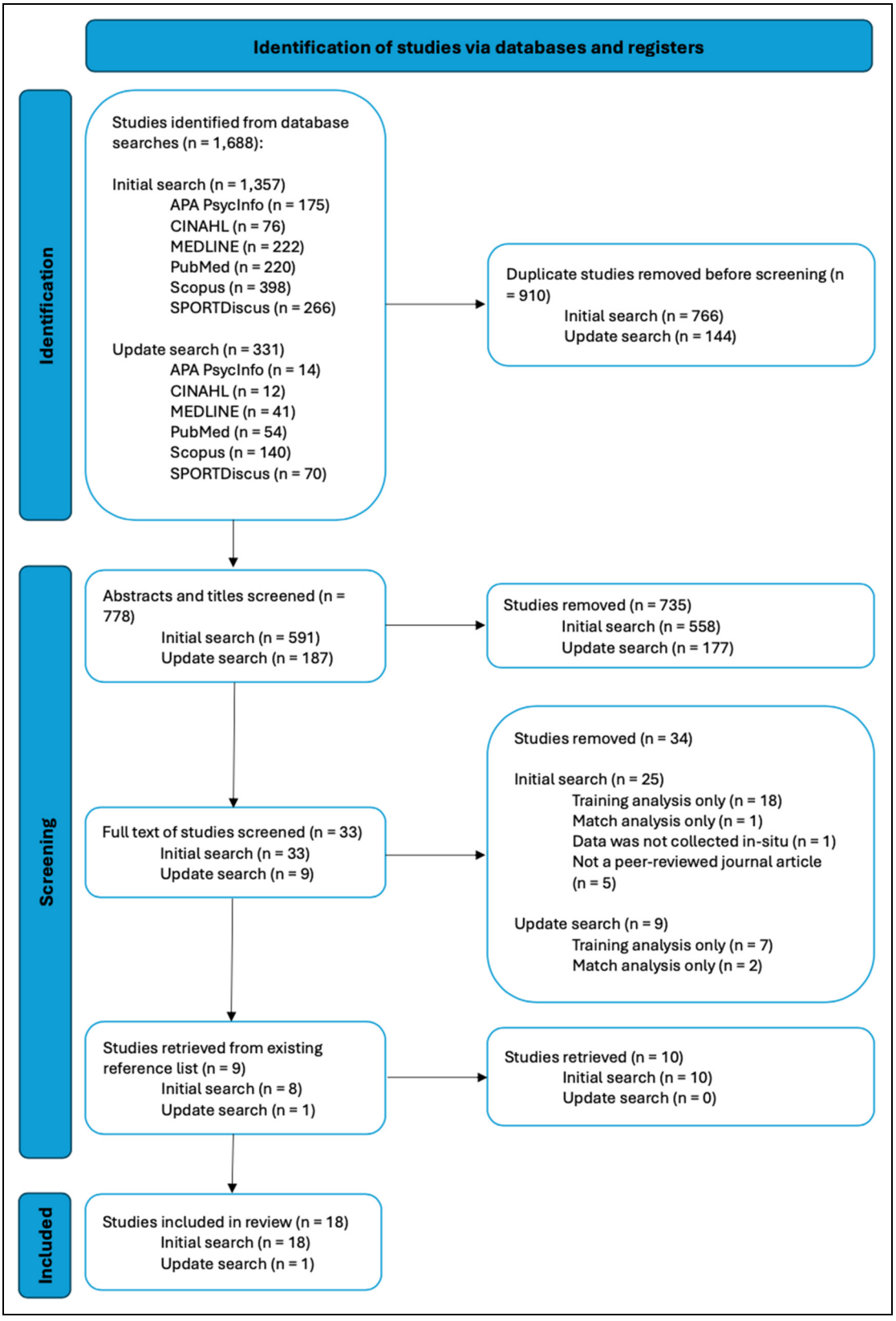


Figure 1. Flow chart of the study selection process for studies included in this review.

Table 1. Methodological quality of included studies.

Study	Criteria											Total
	1	2	3	5	6	7	10	11	18	20	25	
Bonney et al. (2020)[41]	1	1	1	2	1	1	1	1	1	1	0	11
Boyd et al. (2013)[43]	1	1	1	0	1	1	0	0	1	1	0	7
Browne et al. (2020)[36]	1	1	1	2	1	0	0	0	1	1	1	9
Casamichana et al. (2012)[38]	1	1	1	0	1	1	0	1	1	1	0	8
Corbett et al. (2018)[35]	1	1	1	2	1	0	0	0	1	1	0	8
Couto et al. (2024)[45]	1	1	1	2	1	0	1	0	1	1	1	10
Djaoui et al. (2017)[40]	1	1	1	1	1	1	0	1	1	1	1	10
Fernández-Fernández et al. (2015)[39]	1	1	1	2	1	1	1	0	1	1	1	11
Gabbett et al. (2008)[34]	1	1	1	2	1	1	0	0	1	1	1	10
Green et al. (2025)[51]	1	1	1	0	1	1	1	0	1	1	0	8
Ireland et al. (2019)[37]	1	1	1	2	1	1	1	1	1	1	1	12
Krause et al. (2019)[33]	1	1	1	2	1	1	0	1	1	1	0	10
Maloney et al. (2018)[46]	1	1	1	1	1	1	0	1	1	1	0	9
Montgomery et al. (2010)[44]	1	1	1	2	1	1	0	1	0	0	1	9
Olthof et al. (2019a)[47]	1	1	1	1	1	1	0	1	1	1	0	9
Olthof et al. (2019b)[48]	1	1	1	2	1	1	0	1	1	1	0	10
Svilar et al. (2019)[42]	1	1	1	2	1	1	0	1	1	1	0	10
Tribolet et al. (2022)[49]	1	1	1	0	1	1	0	1	1	1	1	9
Wallace et al. (2024)[50]	1	1	1	0	1	1	0	1	1	1	0	8
Total	18	18	18	25	18	15	4	12	17	17	8	9.4

on criteria 1 (i.e., clearly stating hypotheses), 2 (i.e., clearly outlining the main outcomes measured), 3 (i.e., reporting participant characteristics), and 6 (i.e., describing main findings). The criterion with the lowest score ($n = 5$; 26%)[37,39,41,45] was question 10 (i.e., reporting style of p-values). Ireland et al.[37] received the maximum score ($n = 12$), whilst Boyd et al.[43] achieved the lowest score ($n = 7$).

Study and participant characteristics

Study and participant characteristics of included studies are presented in Table 2. The earliest study was published in 2008,[34] with the greatest number of studies published in 2019 ($n = 5$; 26%).[33,37,42,47,48] Of the 12 studies (63%)[33,35–38,42,43,47–51] reporting year(s) of data collection, data were collected between 2003 and 2022, with most studies ($n = 10$; 83%)[33,36,37,42,47–51] collecting data from 2015 onwards. Country of data collection included; Australia ($n = 12$; 63%),[33–37,41,43,44,46,49–51] Netherlands ($n = 2$; 11%),[47,48] Spain ($n = 2$; 11%),[38,42] Brazil ($n = 1$; 5%),[45] and France ($n = 1$; 5%),[40] with one study (5%)[39] not reporting this information. All studies were published in English.

Studies predominantly ($n = 16$; 84%) investigated the representativeness of training activities of team sports; Australian rules football ($n = 8$; 42%),[35,37,41,43,49–51] football ($n = 6$; 32%),[34,38,40,45,47,48] and basketball ($n = 2$; 11%).[42,44] Only three studies (16%) involved individual sports; tennis ($n = 2$; 11%),[33,39] and taekwondo ($n = 1$; 5%).[46] Participants were predominantly male athletes ($n = 12$; 63%),[35–38,42–44,47–50] with two studies (11%)[34,39] involving female athletes, two studies (11%)[33,46] including a mixed-sex sample, and three studies (16%)[40,41,51] not reporting participants' sex. The majority of studies ($n = 12$; 63%)[34–38,40,42,43,46,49–51] involved senior athletes, with only seven studies (37%)[33,39,41,44,45,47,48] involving youth athletes (U13s–U20s). Seventeen studies (89%) reported playing standard, with participants competing in international ($n = 2$; 11%),[34,46] inter-national (i.e., individuals that do not represent their country, however, play in competition against opponents (i.e., individuals/clubs) from other countries (e.g., Champions League in football); $n = 1$; 5%),[33] national (n=10; 53%),[35–37,40,45,47–51] and regional ($n = 1$; 5%)[38] competitions. Three studies (16%) involved multiple levels of playing standard (national and regional,[43] national and inter-national,[42] national and international).[39] Only three studies (16%) used a multi-team/club sample, all of which investigated representativeness within football populations (2 clubs,[40] 3 clubs[47,48]). Considering only studies that investigated team sports (n=16; 84%), the number of participants ranged from 11 to 280 (mean = 55.4 ± 69.8). When excluding the two studies with the largest number of participants ($n = 280$[47]; $n = 143$[48]), the number of participants ranged from 11 to 62 (mean = 31.4 ± 14.6). Participant numbers in studies which investigated individual sports ($n = 3$; 16%), ranged between 10 and 38 (mean = 20 ± 16).

Evaluating representativeness of training activities

The methods for data collection and analysis used to evaluate representativeness of training activities within different

Table 2. Study and participant characteristics of studies evaluating representativeness of training activities.

Study	Year(s) of data collection	Country	Sport	Sex	Age-Group	Playing standard	Teams (n)	Participants (n)	Participant characteristics (age, height, body mass)
Bonney et al. (2020)[41]	NS	Australia	Australian Rules Football	NS	Youth	NS	1	22*	16.5 ± 1.0 yrs 179.1 ± 8.0 cm 69.5 ± 9.5 kg
Boyd et al. (2013)[43]	2008–2009	Australia	Australian Rules Football	M	Senior	NAT	1	19	25.2 ± 3.8 yrs 187.0 ± 6.0 cm 87.9 ± 8.6 kg
						REG		21	21.3 ± 2.4 yrs 185.3 ± 17.2 cm 87.7 ± 18.4 kg
Browne et al. (2010)[36]	2018–2019	Australia	Australian Rules Football	M	Senior	NAT	1	NS	NS
Casamichana et al. (2012)[38]	2010–2011	Spain	Football	M	Senior	REG	1	27	22.8 ± 4.5 yrs 177.0 ± 5.3 cm 74.4 ± 4.8 kg
Corbett et al. (2018)[35]	2014–2015	Australia	Australian Rules Football	M	Senior	NAT	1	40	23 ± 4 yrs 187 ± 8 cm 86 ± 9 kg
Couto et al. (2024)[45]	NS	Brazil	Football	M	U20	NAT	1	24	19.8 ± 0.9 yrs 177 ± 6 cm 72.0 ± 7.8 kg
Djaoui et al. (2017)[40]	NS	France	Football	NS	Senior	NAT	2	Training elite n = 24	24.3 ± 2.6 yrs 180.1 ± 4.1 cm 75.0 ± 5.3 kg
								Training sub elite n = 24	20.9 ± 2.9 yrs 177.2 ± 3.7 cm 72.8 kg ± 4.4 kg
								Competition group n = 14	23.1 ± 4.0 yrs 178.4 ± 5.7 cm 73.7 ± 5.1 kg
Fernández-Fernández et al. (2015)[39]	NS	NS	Tennis	F	U14	NAT/INT	NS	12	13.0 ± 0.3 yrs 168 ± 3.3 cm 51.4 ± 1.2 kg
Gabbett et al. (2008)[34]	NS	Australia	Football	F	Senior	INT	1	13	21 ± 2 yrs
Green et al. (2025)[51]	2022	Australia	Australian Rules Football	NS	Senior	NAT	1	36	23.5 ± 3.9 yrs
Ireland et al. (2019)[37]	2017	Australia	Australian Rules Football	M	Senior	NAT	1	33	26.2 ± 3.8 yrs 188.5 ± 6.9 cm 90.3 ± 7.9 kg

(continued)

Table 2. Continued.

Study	Year(s) of data collection	Country	Sport	Sex	Age-Group	Playing standard	Teams (n)	Participants (n)	Participant characteristics (age, height, body mass)
Krause et al. (2019)[33]	2012–2018	Australia	Tennis	F & M	Youth	INT-NAT	NS	Competition F n = 10	16.7 ± 2.2 yrs
								M n = 16	17.5 ± 0.5 yrs
								Training F n = 2	17.1 ± 2.3 yrs
								M n = 10	17.5 ± 0.5 yrs
Maloney et al. (2018)[46]	NS	Australia	Taekwondo	F & M	Senior	INT	1	10 (F n = 3, M n = 7)	23 ± 5 yrs
Montgomery et al. (2010)[44]	NS	Australia	Basketball	M	Youth	NS	NS	11	19.1 ± 2.1 yrs 191 ± 9 cm 87.9 ± 15.1 kg
Olthof et al. (2019a)[47]	2015–2016	Netherlands	Football	M	U13s	NAT	U13s n = 3	n = 57	12.7 ± 0.4 yrs
					U15s		U15s n = 3	n = 74	14.2 ± 0.6 yrs
					U17s		U17s n = 3	n = 73	16.3 ± 2.1 yrs
					U19s		U19s n = 3	n = 76	18.3 ± 2.5 yrs
Olthof et al. (2019b)[48]	2015–2016	Netherlands	Football	M	U17s, U19s	NAT	3	143	U17s 16.1 ± 1.4 yrs U19s 18.1 ± 1.2 yrs
Svilar et al. (2019)[42]	2017–2018	Spain	Basketball	M	Senior	NAT/ INT-NAT	1	16	NS
Tribolet et al. (2022)[49]	2019	Australia	Australian Rules Football	M	Senior	NAT	1	48	23.3 ± 4.4 yrs
Wallace et al. (2024)[50]	2019	Australia	Australian Rules Football	M	Senior	NAT	1	35	26.2 ± 3.7 yrs

NS = not stated. Sex: F = female, M = male. Age-group: U = Under. Playing standard: INT = International. INT-NAT = Inter-national NAT = National. REG = Regional. *Only 16 participants were included in statistical analyses due to equipment error.

Table 3. Methods used to evaluate representativeness of training activities.

		Competition sample			Training sample						Variables			Analyses	
Study	Aim	Competition Observations (n)	Individual Competition Observations (n)	Inclusion Criteria	Activity	Training Sessions (n)	Activity Observations (n)	Individual Activity Observations (n)	Inclusion Criteria	Data collection	Physical	Tactical	Technical	Differences	Relationships
Australian rules football (n=7)															
Bonney at al. (2020)[41]	Compare the technical and physical demands of a SSG to match-play	1	NS	NS	SSG	1	2	NS	Y	GPS (NS). Video recording; SportsCode (v10.3.25)	Y	-	Y	Y	-
Boyd et al. (2013)[43]	Describe and compare external load during training activities and matches	Elite n = 24 Sub elite n = 29	ND ND	NS	Closed skills Open Skills Tactical SSG Match simulation	ND ND ND ND ND	NS NS NS NS NS	412 256 184 193 312	Y	100Hz accelerometer (MinimaxX 2.0, Catapult)	Y	-	-	Y	-
Browne et al. (2020)[36]	Compare constraint interactions and frequency within match simulations, SSG and matches	22	NS	NS	Match simulations SSGs (varied)	NS NS	13 24	NS NS	NS	Commercial data provider (Champion Data), video recording; SportsCode (v11.2.3, HUDL)	-	-	Y	-	-
Corbett et al. (2017)[35]	Determine the extent to which training activities reproduce physical and technical demands of competition	22	NS	Y	Conditioning activities Match simulation SSG	ND ND ND	ND ND ND	NS NS NS	NS	10Hz GPS (Optimeye S5, Catapult). Video recording; SportsCode (v10.3.3, SportsTec)	Y	-	Y	-	Y
Green et al. (2025)[51]	Determine the extent to which a SSG replicates high pressure phases of matches	11	ND (6.9 ± 3.7 per match)	Y	SSG	11	11	ND (5.3 ± 2.4 per player)	Y	Video recording; notational analysis (NS)	-	-	Y	Y	-
Ireland et al. (2019)[37]	Examine task-constraints between match simulations and competitive matches	16	NS	Y	Match simulations	NS	12	NS	Y	Commercial data provider (Champion Data), video recording; SportsCode (v11.1.3, HUDL)	-	-	Y	Y	-
Tribolet et al. (2022)[49]	Compare task-constraints and tactical behaviours between match simulation and matches	22	NS	Y	Match simulations	NS	21	NS	-	Commercial data provider (Champion Data), video recording; SportsCode (v9.4.1, SportTec)	-	Y	Y	Y	-
Wallace et al. (2024)[50]	Determine the extent to which game-based training replicated match-play for Inside-50 entries	22	ND	Y	Match simulations SSG	ND ND	ND ND	ND ND	Y	Video recording; SportsCode (v.11.2.14, SportsTec)	-	-	Y	Y	Y
Football (n=6)															
	Compare physical	7	27	Y	SSGs (varied)	9		217	NS	10Hz GPS &	Y	-	-	Y	-

(continued)

Table 3. Continued.

Study	Aim	Competition sample			Training sample					Data collection	Variables			Analyses	
		Competition Observations (n)	Individual Competition Observations (n)	Inclusion Criteria	Activity	Training Sessions (n)	Activity Observations (n)	Individual Activity Observations (n)	Inclusion Criteria		Physical	Tactical	Technical	Differences	Relationships
Casamichana et al. (2012)[38]	demands between SSGs and matches						27 (8.0 ± 1.9 per SSG)			100Hz accelerometer (MinimaxX S4, Catapult)					
Couto et al. (2024)[45]	Compare positional dynamics between SSG and matches	18	NS	Y	SSG (5v5; L 40m x W 26m)	6	36	NS	NS	10Hz GPS & 200Hz accelerometer (Polar Team Pro, Polar)	-	Y	-	Y	-
					SSG (5v5; L 26m x W 40m)	6	36	NS							
Djaoui et al. (2017)[40]	Comparing maximum velocity achieved in SSGs with differing task-constraints to matches	6	NS	Y	Match simulation (11v11 + GK, 102×66m, 306m2 per player)	ND	ND	NS	NS	15Hz GPS (SPI Elite, GPSports)	Y	-	-	Y	Y
					SSGs x 14, each with different task constraints (*players*: 5v5–10v10; *rules*: with GK, scoring in mini-goals or possession; *dimensions*: L = 34–70m x W = 30–60m; *playing area*: 92–212m2 per player)	ND	ND	NS							
Gabbett et al. (2008)[34]	Compare physical demands of SSGs to national and international matches	NAT n = 10	NS	NS	SSGs (3v3, ~50×50m pitch)	ND	NS	NS	Y	Video recording; time-motion analysis	Y	-	Y	Y	-
		INT n = 12			SSG (varied task-constraints; ~50×50m)	ND	NS	NS							
Olthof et al. (2019a)[47]	Determine the relationship in tactical behaviours between SSGs and matches	U13s n = 5	NS	Y	SSG (4v4 + GK (68×47m))	NS	10	NS	NS	34–91Hz LPS (Inmotio), video recording; Noldus The Observer XT (Noldus Information Technology)	-	Y	Y	Y	Y
					SSG (6v6 + GK (80×56m))	NS	5	NS							
					SSG (8v8 + GK (91×63m))	NS	3	NS							
		U15s n = 6	NS		SSG (4v4 + GK (68×47m))	NS	15	NS							
					SSG (6v6 + GK (80×56m))	NS	15	NS							
					SSG (8v8 + GK (91×63m))	NS	9	NS							
		U17s n = 10	NS		SSG (4v4 + GK (68×47m))	NS	10	NS							
					SSG (6v6 + GK (80×56m))	NS	10	NS							
					SSG (8v8 + GK (91×63m))	NS	3	NS							
		U19s n = 4	NS		SSG (4v4 + GK (68×47m))	NS	10	NS							
					SSG (6v6 + GK (80×56m))	NS	11	NS							
					SSG (8v8 + GK (91×63m))	NS	6	NS							
Olthof et al. (2019b)[48]	Compare physical,	U17s n = 3*	NS	Y	Match simulations	1	6	NS	NS	34 – 91Hz LPS	Y	Y	Y	Y	Y

(continued)

Table 3. Continued.

Study	Aim	Competition sample			Training sample					Data collection	Variables			Analyses	
		Competition Observations (n)	Individual Competition Observations (n)	Inclusion Criteria	Activity	Training Sessions (n)	Activity Observations (n)	Individual Activity Observations (n)	Inclusion Criteria		Physical	Tactical	Technical	Differences	Relationships
	technical, and tactical demands between match simulations and matches	U19s n = 2*	NS		Match simulations	1	9	NS		(Inmotio), video recording; Noldus The Observer XT (Noldus Information Technology)					
Basketball (n=2)															
Montgomery et al. (2010)[44]	Compare physical and physiological demands between training activities and matches	3	128	NS	SSG Offensive activities Defensive activities	ND ND ND	48 57 190	NS NS NS	NS	HR monitor (Suunto Pro Team, Vantaa), 100Hz accelerometer (MinimaxX, Catapult)	Y	-	-	Y	-
Svilar et al. (2019)[42]	Comparing physical demands between drills intended to replicate or overload match demands	5	177	Y	Match simulation SSG (removal of stoppages)	ND ND	7 5	174 34	Y	LPS & 100Hz accelerometer (T6, Catapult)	Y	-	-	Y	-
Tennis (n=2)															
Fernández-Fernández et al. (2015)[39]	Compare physiological stress response between training and competition	NS	NS	NS	Match simulation	NS	NS	NS	NS	0.2Hz HR monitor** (S610, Polar), RPE scale (15-category Borg scale)	Y	-	-	Y	Y
Krause et al. (2019)[33]	Determine representativeness of serve and return training activities	15	30	Y	Technical: Serves and returns	ND	ND	ND	Y	Commercial data provider (Hawkeye), video recording; SportsCode	-	Y	-	Y	-
Taekwondo (n=1)															
Maloney et al. (2018)[46]	Determine whether match simulation represented demands of competition	NS	NS	NS	Match simulation Typical training fight***	NS NS	NS NS	NS NS	NS	Video recording; Kinovea (v0.8.25)	Y	-	Y	Y	Y

NS = not stated. ND = not distinguishable. Y = yes. Competition sample: NAT = national, INT = international, U = under. Training sample: SSG = small-sided game, L = length, W = width, GK = goalkeeper. Data collection: GPS = global positioning system, LPS = local positioning system, HR = heart rate, RPE = rate of perceived exertion. * All but one U17 match was played between academies within the studies. This may make them less competitive than in a formal league or cup structure. **Converted to SI units ***A typical training fight would include coach instruction administered throughout the whole activity (not just in rest periods between rounds).

sports are presented in Table 3. Seventeen studies (89%)[33–38,40–45,47–51] reported the number of competition observations (i.e., the number of matches within the analyses), which ranged between 1 and 53 (mean = 16.2 ± 12.4). The two studies[39,46] which did not outline competition observations, were both individual sports. Only four studies (21%)[33,38,42,44] explicitly reported the number of individual competition observations (i.e., the number of individual player/athlete observations during matches within the analyses), which ranged between 27 and 177 (mean = 90.5 ± 74.3). Ten studies (53%) detailed inclusion criteria for competition observations; minimum number of observations ($n = 1$[35,50]; $n = 2$[37]), excluding stoppages in play,[42,47,48] contested phases of play data only ($n = 1$),[51] and minimum/maximum competition observation duration (15 min,[38] ≥45 min,[40] ≤45 min[45]).

A variety of training activities were explored, including; small-sided games (SSGs) (n=13; 68%),[34–36,38,40–45,47,50] match simulations ($n = 11$; 58%),[35–37,39,40,42,43,46,48–50] technical ($n = 2$; 11%),[33,46] conditioning ($n = 1$; 5%)[35] and tactical activities ($n = 1$; 5%).[43] Twenty-six unique variations of SSGs were investigated, involving different task-constraints; number of players/opponents,[34,36,38,40,41,47,50,51] playing dimensions,[40,41,44,45,47,50,51] duration,[47] and rule variations (i.e., smaller goals,[38,40] ball-conservation,[40] inclusion of goalkeepers,[38,40,47] removal of stoppages,[42,51] and minimum kick number[41]). Of the thirteen studies investigating representativeness of SSGs, four analysed a single SSG activity,[41,42,44,51] two analysed three SSG activities,[38,47] and one study analysed two SSG activities.[45] In contrast, five studies[34–36,43,50] grouped all SSG variations together without clearly detailing the task-constraints. One study analysed 14 different types of SSGs (with variations to number of players, playing dimensions and task constraints).[40]

Five studies (26%)[38,41,45,48,51] reported the number of training sessions (i.e., the number of training sessions within the analyses) observed according to each training activity, whilst the number of observations were indistinguishable for eight studies (42%),[33–35,40,42–44,51] and were not reported for six studies (32%).[36,37,39,46,47,49] The number of training sessions observed in studies ranged between 1 and 12 (mean = 7.0 ± 5.1). Eleven studies (58%)[36–38,41,42,44,45,47–49] reported the number of training activities (i.e., the number of training activities within the analyses) observed, however, the number of training activities observed could not be identified for four studies (21%),[33,35,40,50] and was not reported for four studies (21%).[34,39,43,46] The number of training activities observed ranged between 2 and 295 (mean = 51.1 ± 82.6). When removing the study with the most training activity observations ($n = 295$),[44] the range was 2 to 107 (mean = 28.9 ± 31.7). Three studies (16%)[38,42,43] reported the number of individual observations per training activity (i.e., the number of individual player/athlete observations during the training activities within the analyses), whilst this number was indistinguishable in three studies (16%)[33,50,51] or not reported in the majority of studies ($n = 13$; 68%).[34–37,39–41,44–49] Where stated, the number of individual observations per training activity ranged between 34 and 412 (mean = 210.0 ± 112.7). Seven studies (37%) detailed inclusion criteria for training activity observations; specific task constraints ($n = 3$; >2 kicks before shot attempt,[41] serve and return activities only,[33] ≥6v6 player discrepancy),[50] ball-in play data only ($n = 2$),[41,42] contested phases of play data only ($n = 1$),[51] playing position ($n = 1$),[34] and analysis of specific data collection groups (n=1; 1st team only).[49]

Representativeness of training activities were determined using technical (n=12; 63%),[33–37,41,46–51] physical ($n = 10$; 53%),[34,35,38–44,48] and tactical ($n = 5$; 26%)[45–49] variables, with no study quantifying psychological variables. Most studies ($n = 12$; 63%)[33,36–40,42–45,50,51] quantified either technical, physical or tactical variables, followed by a combination of variables across two groupings ($n = 6$; 32%[34,35,41,46,47,49]; technical, physical, or tactical), whilst only one study (5%)[48] investigated all three variable types.

All studies provided descriptive statistics (e.g., frequencies, effectiveness/success) to evaluate representativeness. Only one study evaluated representativeness of training activities using solely descriptive statistics.[36] Studies predominantly ($n = 17$; 89%)[33,34,37,38,41–45,49,51] evaluated representativeness by determining whether differences existed between training activities and competition, and less frequently ($n = 7$; 37%)[38,40,41,46–48,50] by analysing the relationships between training activities and competition.

Quantification of performance

Technical variables. Most studies evaluated the representativeness of training activities using technical variables ($n = 12$; 63%; Table 4).[33–37,41,46–51] To collect technical data, all studies used video recordings, computerised notational analyses ($n = 11$; 92%),[33,35–37,41,46–51] commercial data providers ($n = 4$; 33%; Champion Data,[36,37,49] Hawkeye[33]) and/or manual notational analyses ($n = 2$; 17%).[34,46] For six studies (50%),[33,35–37,49,50] the methods of data collection for competition differed to those for training activities (e.g., commercial data providers vs computerised notational analysis).[36]

Studies investigating team sports ($n = 10$; 83%; Australian rules football,[35–37,41,49–51] football[34,47,48]) only quantified technical variables on a team level as opposed to position-specific or an individual player-level. Possession variables (e.g., number of disposals, kicks or passes; sequences of disposal events) were quantified most often ($n = 9$; 90%),[35–37,41,47–51] followed by offensive ($n = 3$; 30%; e.g., number of goals or shots)[49–51] and defensive variables ($n = 3$; 30%; e.g., number of tackles, number of defenders applying pressure).[34,49,51] A full list of operational definitions were provided by four studies

Table 4. Technical variables quantified to determine representativeness of training activities.

Study	Technical variable		Competition	Training		
				Activity 1	Activity 2	Activity 3
Australian rules football (n=6)						
Bonney et al. (2020)[41]			*Competition*	*SSG*		
	Kicks (n)		5.34 ± 3.74	**11.83 ± 2.40**		
	Kick efficiency (%)		50.13 ± 9.52	**59.83 ± 5.19**		
	Disposal time (n)	<2s	1.13 ± 0.64	**3.33 ± 0.82**		
		2–4s	0.63 ± 0.52	**4.00 ± 1.55**		
		>4s	0.38 ± 0.74	**1.50 ± 0.84**		
Browne et al. (2020)[36]			*Competition*	*Match Simulation*	*SSG*	
	Disposals (n) §		3478	1298	2677	
	Disposal efficiency (%) §		54–89	49–84	77–87	
Corbett et al. (2017)[35]			*Competition*	*Activity Clusters**		
	Kicks under pressure (%) §	Under pressure	73	13–33		
		No pressure	27	67–79		
	Kicks at velocities (%) §	Moving (Velocity NS)	61	38–74		
		Stationary	39	26–34		
	Time in possession (%) §	Kicks <2s	49	17–74		
		Kicks >2s	51	25–69		
Green et al. (2025)[51]			*Competition*	SSG		
	Team won ball (n)	Offence win	26.01 ± 4.06	**17.93 ± 5.62**		
		Defence win	9.19 ± 2.46	**2.75 ± 2.12**		
		Stoppage	9.39 ± 3.08	**0.00 ± 0.12**		
	Gain possession (n)	Mark	0.22 ± 0.24	**1.75 ± 0.90**		
		General play	23.46 ± 3.00	**14.51 ± 6.14**		
		Groundball	20.60 ± 3.82	**5.71 ± 5.90**		
	Disposal type (n)	Kick	13.41 ± 2.71	**7.31 ± 6.33**		
		Handball	22.91 ± 3.34	**11.24 ± 4.91**		
		Tackled no disposal	8.04 ± 2.19	**2.20 ± 2.15**		
	Duration (n)	0–1s	25.54 ± 4.08	**6.60 ± 3.37**		
		1–2s	12.74 ± 0.78	**8.37 ± 1.71**		
		2–3s	3.99 ± 2.22	3.38 ± 1.46		
		3+s	2.12 ± 1.32	3.36 ± 2.69		
	Movement (n)	Dynamic	36.93 ± 5.67	**16.90 ± 6.40**		
		Stationary	8.75 ± 3.72	**3.54 ± 6.18**		
	Pressure (n)	No pressure	0.53 ± 0.96	**1.87 ± 3.16**		
		Corralling	11.15 ± 4.48	**5.98 ± 7.42**		
		Chasing	6.55 ± 3.41	**3.72 ± 2.55**		
		Closing	12.27 ± 1.89	**3.12 ± 2.99**		
		Physical	14.49 ± 3.89	**5.39 ± 4.33**		
	Carrier density (n)	No opponents	0.77 ± 0.89	**1.57 ± 3.16**		
		1 opponent	14.33 ± 2.24	11.05 ± 7.07		
		2 opponents	17.84 ± 5.26	**6.21 ± 4.79**		
		3 opponents	7.95 ± 2.43	**1.50 ± 3.30**		
		3+ opponents	4.57 ± 3.60	**0.36 ± 2.20**		
	Disposal distance (n)	0–25m	24.23 ± 3.10	**13.35 ± 4.23**		
		25–40m	9.58 ± 4.37	**5.24 ± 4.93**		
		Tackled no disposal	8.04 ± 2.19	**2.20 ± 2.15**		
	Receiver density (n)	Uncontested	26.69 ± 3.77	**13.19 ± 2.89**		
		Even	4.93 ± 2.05	**1.64 ± 1.72**		
		Superior	0.00 ± 0.00	0.00 ± 0.00		
		Inferior	0.12 ± 0.41	**0.00 ± 0.00**		
		Leading	2.09 ± 1.17	**0.00 ± 0.24**		
		No receiver	1.18 ± 1.11	**0.12 ± 0.38**		
		Shot at goal	2.35 ± 2.16	2.37 ± 1.61		
		Tackled no disposal	8.04 ± 2.19	**2.20 ± 2.15**		

(continued)

Table 4. Continued.

Study	Technical variable		Competition	Training		
				Activity 1	Activity 2	Activity 3
Ireland et al. (2019)[37]	Disposals		Competition	Match Simulation		
	Data reported as n/120 min of gameplay					
	Time in possession (n)	0–1s	2.37 ± 0.93	**3.54 ± 1.07**		
		1–2s	2.37 ± 1.12	**4.57 ± 1.71**		
		2–3s	0.65 ± 0.48	**1.28 ± 0.79**		
		3–4s	0.23 ± 0.27	**0.39 ± 0.29**		
		4+s	0.23 ± 0.27	0.34 ± 0.35		
	Type of play (n)	General	9.51 ± 3.84	10.39 ± 3.93		
		Stoppage	1.33 ± 1.56	1.10 ± 1.04		
	Speed of disposing player (n)	Dynamic	5.61 ± 2.41	**9.87 ± 3.74**		
		Static	5.24 ± 3.09	**10.26 ± 3.26**		
	Speed of receiving player (n)	Dynamic	6.77 ± 3.22	**10.48 ± 3.27**		
		Static	4.08 ± 1.90	**9.63 ± 3.29**		
	Disposal distance (n)	0 – 5m	4.03 ± 2.32	**9.84 ± 2.73**		
		5–15m	5.6 ± 2.40	**8.66 ± 3.32**		
		15m+	1.21 ± 0.89	1.6 ± 0.99		
	Type of pressure (n)	Implied	6.68 ± 3.32	**13.22 ± 4.36**		
		Physical	3.10 ± 1.70	3.24 ± 1.36		
		No pressure	1.06 ± 0.63	**3.63 ± 1.21**		
	Direction of pressure (n)	Front on	4.09 ± 2.30	9.48 ± 3.24		
		Side on	2.63 ± 1.64	**4.31 ± 1.65**		
		Chase	4.20 ± 1.77	**4.10 ± 1.74**		
	Proximity of target opposition (n)	0–5m	6.92 ± 3.25	**11.13 ± 3.65**		
		5m +	3.22 ± 1.52	**5.43 ± 1.96**		
		No pressure	0.71 ± 0.60	**3.52 ± 1.16**		
	Prior disposal type (n)	Crumb/ground ball	5.54 ± 2.49	4.68 ± 1.80		
		Free kick/mark	1.34 ± 0.70	**2.01 ± 0.81**		
		Handball	3.97 ± 2.47	**13.43 ± 4.4**		
	Kicks Data reported as n/120 min of gameplay		*Competition*	*Match Simulation*		
	Time in possession (n)	0–1s	2.63 ± 1.57	**1.44 ± 0.82**		
		1–2s	3.86 ± 1.90	4.64 ± 2.22		
		2–3s	1.77 ± 0.87	**2.3 ± 0.92**		
		3–4s	0.9 ± 0.52	**1.27 ± 0.45**		
		4+s	2.92 ± 1.06	**2.05 ± 0.72**		
	Type of play (n)	General	11.05 ± 3.51	10.64 ± 3.76		
		Stoppage	1.04 ± 1.03	0.49 ± 0.58		
	Speed of disposing player (n)	Dynamic	6.31 ± 2.71	6.48 ± 2.69		
		Static	5.78 ± 2.06	5.23 ± 2.07		
	Speed of receiving player (n)	Dynamic	6.36 ± 2.7	6.41 ± 2.71		
		Static	5.73 ± 1.76	5.25 ± 1.94		
	Kick distance (n)	0 – 20m	2.43 ± 2.09	2.74 ± 1.21		
		20–40m	5.31 ± 1.99	6.06 ± 2.09		
		40m+	4.35 ± 1.59	**2.91 ± 1.35**		
	Type of pressure (n)	Implied	7.25 ± 2.84	7.03 ± 2.92		
		Physical	1.19 ± 0.83	**0.44 ± 0.31**		
		No pressure	3.63 ± 1.54	4.23 ± 1.41		
	Direction of pressure (n)	Front on	3.92 ± 1.45	3.76 ± 1.68		
		Side on	2.61 ± 1.45	2.42 ± 1.25		
		Chase	2.82 ± 1.31	**1.9 ± 0.99**		
	Proximity of target opposition (n)	0–5m	7.88 ± 2.83	**5.55 ± 2.25**		
		5m +	2.23 ± 1.12	**3.37 ± 1.52**		
		No pressure	1.36 ± 0.92	**12.64 ± 1.12**		
	Prior disposal type (n)	Crumb/ground ball	2.50 ± 1.40	**1.54 ± 0.81**		
		Free kick/mark	5.49 ± 1.89	5.76 ± 1.67		
		Handball	4.10 ± 2.36	4.41 ± 2.51		

(continued)

Table 4. Continued.

Study	Technical variable		Competition		Training: Activity 1	Activity 2	Activity 3
Tribolet et al. (2022)[49]			*Competition*		*Match Simulation*		
	Kicks (n·min^{-1})		2.21 ± 0.25		**1.63 ± 0.30**		
	Kick efficiency (%)		63.87 ± 5.90		60.57 ± 11.65		
	Handballs (n·min^{-1})		1.56 ± 0.25		**1.36 ± 0.26**		
	Handball efficiency (%)		82.70 ± 3.23		86.52 ± 7.05		
	Goals (n·min^{-1})		0.11 ± 0.03		**0.19 ± 0.10**		
	Shots on goal (n·min^{-1})		0.21 ± 0.03		0.27 ± 0.12		
	Turnovers (n·min^{-1})		0.72 ± 0.08		**0.42 ± 0.14**		
	Tackles (n·min^{-1})		0.67 ± 0.11		**0.23 ± 0.15**		
	Marks (n·min^{-1})		0.94 ± 0.23		1.03 ± 0.30		
Wallace et al. (2024)[50]	*Data reported as n/60 min of gameplay*		*Competition*		*Match Simulation*		
	I-50 entries (n)		23.49 ± 3.91		**47.22 ± 19.20**		
	Received (%)	Mark	23.76		**42.53**		
		General play	65.17		**51.22**		
		Free kick	11.07		**6.25**		
	Time in possession (%)	0–1s	16.60		**7.34**		
		1–2s	34.35		**39.54**		
		2–3s	17.75		**18.89**		
		3s+	31.30		**34.24**		
	Launch Zone (%)	Wing	66.98		**61.14**		
		Corridor	33.02		**38.86**		
	Landing Zone (%)	Wing skinny	51.91		**47.01**		
		Wing fat	0.76		**0.82**		
		Corridor	24.62		**27.85**		
		Corridor left	9.83		11.28		
		Corridor right	12.88		13.04		
	Pressure (%)	Set position	29.10		**35.60**		
		Physical	12.60		**6.66**		
		Corralling	15.36		13.99		
		Chasing	13.84		10.05		
		Closing	15.74		**17.26**		
		No pressure	13.36		16.44		
	Decision (%)	Handball	96.76		**94.29**		
		Kick	3.24		5.71		
	Distance (%)	Shallow (35 – 50m)	59.54		**53.40**		
		Deep (0–35m)	40.46		**46.60**		
	Disposal endpoint (%)	Uncontested	14.69		**42.66**		
		Defensive uncontested	8.30		7.34		
		Even contest	40.36		25.00		
		Offensive outnumber	5.25		**2.17**		
		Defensive outnumber	15.27		**4.21**		
		Ground ball/to space	16.13		**18.48**		
		Coach	0.00		0.14		
	Efficiency (%)	Effective	47.23		**67.53**		
		Neutral	18.89		11.41		
		Ineffective	33.87		21.06		
Football (n=3)							
Gabbett et al. (2008)[34]			*Competition*		*SSG*		
	Passing contacts (n)		NAT	28.12± 7.97	**30.14 ± 12.90**		
			INT	29.13 ± 8.97			
	Dribbling contacts (n)		NAT	17.14 ± 4.94	**16.23 ± 6.96**		
			INT	14.21 ± 6.05			
	Tackling contacts (n)		NAT	10.18 ± 4.94	**7.26 ± 2.92**		
			INT	10.08 ± 5.14			
	Trapping contacts (n)		NAT	21.98 ± 28.12	**26.31 ± 9.78**		
			INT	24.09 ± 8.07			

(continued)

Table 4. Continued.

Study	Technical variable			Competition		Training		
						Activity 1	**Activity 2**	**Activity 3**
Olthof et al. (2019a)[47]				*Competition*		*SSG (4v4 + GK)*	*SSG (6v6 + GK)*	*SSG (8v8 + GK)*
	Passes (n·min^{-1})			U13s	0.7 ± 0.13	**1.9 ± 0.44**	**2.0 ± 1.45**	1.0 ± 0.15
				U15s	0.9 ± 0.19	**1.9 ± 0.65**	**1.7 ± 0.32**	1.4 ± 0.65
				U17s	0.7 ± 0.19	**2.3 ± 0.60**	**1.7 ± 0.54**	1.3 ± 0.21
				U19s	0.8 ± 0.26	**2.4 ± 0.50**	**1.7 ± 0.49**	**1.4 ± 0.17**
	Effective playing time (%)			U13s	69.70 ± 5.55	85.10 ± 9.68	90.20 ± 1.32	80.80 ± 1.45
				U15s	67.60 ± 9.15	80.10 ± 5.98	79.30 ± 7.95	84.80 ± 5.78
				U17s	66.30 ± 7.27	81.90 ± 4.58	85.20 ± 6.23	77.90 ± 9.18
				U19s	69.50 ± 5.41	86.80 ± 6.16	83.90 ± 6.94	91.30 ± 5.11
Olthof et al. (2019b)[48]				*Competition*		*Match simulation*		
	Transitions (n·min^{-1})			6.40 ± 1.70		**4.4 ± 0.50**		
	Effective playing time (min) §			30.50 ± 3.30		8.70 ± 1.10		
	Relative playing time (%)			67.70 ± 6.40		**14.00 ± 1.90**		
	Ball possession duration (s)			8.7 ± 1.1		**14.0 ± 1.9**		
	Game pace (passes per minute) (n·min^{-1}) **			10.94 ± 1.69		**8.59 ± 1.58**		
	Forward pass efficiency (%) **			15.21 ± 5.84		20.97 ± 7.04		
	Incorrect pass efficiency (%) **			50.00 ± 9.21		**47.30 ± 2.54**		
Tennis (n=1)								
Krause et al. (2019)[33]				*Competition*		*Technical*		
	Shots (n) §		Serve only	11228		2719		
			Serve returner			624		
			Serve + 3rd			1601		
			Return only			967		
			Return + 4th			1097		
	Serves (n) §	Deuce court	Serve only	1541		1461		
			Serve returner			370		
			Serve + 3rd			424		
		Ad court	Serve only	1419		1270		
			Serve returner			254		
			Serve + 3rd			397		
	Serve efficiency (%)	Deuce court	Serve only	68.33		**61.05**		
			Serve returner			63.78		
			Serve + 3rd			72.88		
		Ad court	Serve only	68.71		**61.02**		
			Serve returner			64.96		
			Serve + 3rd			74.56		
	Serve return (n) §	Deuce court	Return only	962		485		
			Return + 4th			229		
		Ad court	Return only	893		377		
			Return + 4th			289		
	Serve return efficiency (%)	Deuce court	Return only	81.29		**70.31**		
			Return + 4th			75.55		
		Ad court	Return only	80.40		**68.44**		
			Return + 4th			75.43		
	3rd shot in rally (n) §		Serve + 3rd	1439		456		
	3rd shot in rally efficiency (%)		Serve + 3rd	84.64		**72.37**		
	4th shot in rally (n) §		Return + 4th	1119		253		
	4th shot in rally efficiency (%)		Return + 4th	82.40		79.84		
Taekwondo (n=1)								
Maloney et al. (2018)[46]				*Competition*		*Match Simulation*		
	Kicks (n)			67.40 ± 13.23		**55.80 ± 12.14**		

NS = not stated. **Bold** = training activity is significantly different from competition ($p<0.05$). § = statistical significance was not reported between training activities and competition. Competition: INT. = international, NAT = national, U = under. Training: GK = goalkeeper, SSG = small-sided game. *Activity clusters were defined through means of hierarchal clustering measures and defined groups of training activities with similar physical and technical skill profiles, when related to competition. ** Displayed as mean ± SE.

(33%),[33,36,50,51] three studies (25%)[35,37,47] provided some operational definitions, and three (25%)[41,48,49] studies provided no operational definitions. In three studies,[37,50,51] technical variables were quantified according to situational variables (e.g., pitch location, defensive pressure). Two studies (17%) explored the influence of contextual factors on technical variables; match outcome,[49] and playing standard (international, national league).[34] Lastly, technical variables were quantified for the whole-match ($n = 5$; 42%),[33,37,41,46,49] quarter-match ($n = 1$; 8%),[35] segmental ($n = 1$; 8%; 15 min periods),[34] phase of play ($n = 3$; 18%; I-50 entries,[50] disposals[36,51]), or possession ($n = 2$; 18%).[47,48] Data were either quantified as absolute (n=3; 25%)[34,36,41] or relative ($n = 6$; 50%; per minute of ball-in-play data,[47,48] per 60 min,[37] per 120 min,[50] and per minute[49,51]).

Technical variables were quantified for three types of training activities; match simulations ($n = 6$; 50%),[36,37,46,48–50] SSGs ($n = 5$; 50%),[34,36,41,47,51] and technical ($n = 1$; 8%),[33] whilst Corbett et al.[35] quantified technical variables according to activity clusters (or groups), which involved categorising 35 distinct training activities into five groups via a cluster analysis approach. Only one study[47] investigated the influence of task constraints on the representativeness of technical variables; number of players (4v4, 6v6, 8v8) during SSGs. Studies predominantly ($n = 10$; 83%) reported significant differences between technical variables during training activities and competition (team-sports: $n = 8$; 80%[34,37,41,47–51]; individual sports: $n = 2$; 100%).[33,46] Furthermore, significant differences were reported for technical variables during match simulations ($n = 5$; 83%),[37,46,48–50] SSGs ($n = 4$; 80%),[34,41,47,51] and technical activities ($n = 1$; 100%).[33] Within these studies, the proportion of variables which were significantly different during respective training activities and competition ranged from 25% to 100% (mean = 75.4 ± 31.0%).

Physical variables. Representativeness of training activities was quantified using physical variables in 10 studies (53%; Table 5).[34,35,38–44,48] To collect physical data, researchers used global positioning system (GPS) units ($n = 4$; 40%),[35,38,40,41] accelerometers ($n = 4$; 40%),[38,42–44] heart rate monitors ($n = 2$; 20%),[39,44] local positioning system (LPS) units ($n = 2$; 20%),[42,48] video-based time motion analyses ($n = 1$; 10%),[34] and rate of perceived exertion (RPE) (borg scale; $n = 1$; 10%).[39]

Studies investigating team sports ($n = 9$; 90%; Australian rules football,[35,41,43] basketball,[42,44] football[34,38,40,48]) quantified physical variables for individual players, with three studies (33%)[34,40,43] quantifying position-specific data. Physical variables were quantified for the whole-match ($n = 5$; 56%),[38,40,41,43,44] quarter-match ($n = 2$; 22%),[35,42] segmental ($n = 1$; 11%; 15-min),[34] or possession ($n = 1$; 11%).[48] Physical variables were predominantly quantified relative to match duration ($n = 5$; 78%)[35,38,40,42,43] or ball-in-play time ($n = 1$; 11%),[48] with only three studies (33%)[34,41,44] reporting absolute data. Only one study (11%)[44] quantified internal load (i.e., the psychophysiological response to work performed) variables (e.g., mean heart rate, RPE), whilst all remaining studies quantified external load variables (i.e., the work performed), including distance ($n = 5$; 56%[34,35,38,41,48]; e.g., total distance covered, high-speed running or sprinting distance), arbitrary units ($n = 4$; 44%[38,42–44]; e.g., PlayerLoad), velocity ($n = 3$; 33%[34,38,48]; e.g., maximum velocity), frequency ($n = 3$; 33%[34,38,42]; e.g., number of sprints) and time ($n = 2$; 22%[34,38]; e.g., time spent in velocity zones, mean sprint duration) variables. In contrast, only one study (10%)[39] investigated an individual sport (tennis), with only internal load variables quantified (mean heart rate; maximum heart rate; RPE), and analysed segmentally (per game). Two studies (18%) explored the influence of contextual factors on physical variables; match outcome,[39] and playing standard (international, national league).[34,43]

Physical variables were quantified for five different categories of training activities; SSGs ($n = 7$; 70%),[34,38,40–44] match simulations ($n = 5$; 50%),[39,40,42,43,48] tactical ($n = 1$; 10%),[43] offensive/defensive drills ($n = 1$; 10%),[44] and open/closed skills ($n = 1$; 10%),[43] in addition, Corbett et al.[35] quantified physical variables according to activity clusters (or groups). Of the eight studies investigating representativeness of SSGs, only one study[40] compared physical variables between differing task constraints, manipulating the number of players, rules pitch size and area per player. Task constraints were reported albeit not compared in other studies; playing area ($n = 5$; 63%),[34,38,40,41,44] number of players ($n = 5$; 63%),[34,35,38,40,41] rule constraints ($n = 3$; 38%; possession-based,[40] minimum number of kicks before a goal attempt,[41] use of multiple balls[34]), time constraints ($n = 3$; 38%),[35,38,42] equipment ($n = 1$; 13%) (i.e., inclusion of smaller goals),[40] removal of stoppages ($n = 1$; 13%).[42] Isolated SSGs[41,42,44] or grouped SSGs (i.e., various task constraints analysed as SSG)[40] were analysed.

Significant differences in physical variables between training activities and competition were reported in half of the studies ($n = 5$; 50%).[38,39,41,44,46,48] The proportion of variables which were significantly different during training activities compared to competition ranged between 17 and 100% (mean = 57.0 ± 25.2%). Significant differences were reported for physical variables during SSGs ($n = 3$; 33%),[38,41,44] match simulations ($n = 2$; 50%),[39,48] and offensive/defensive drills ($n = 1$; 100%).[44]

Tactical variables. The representativeness of training activities was quantified using tactical variables in five studies (26%; Table 6).[45–49] To collect tactical data, studies used commercial data providers ($n = 2$; 40% Champion Data,[49] Hawkeye[33]), LPS ($n = 2$; 40%),[47,48] computerised notational analysis ($n = 2$; 40%),[47,48] and GPS ($n = 1$; 20%).[45]

Table 5. Physical variables quantified to determine representativeness of training activities.

Study	Physical variable		Competition		Training		
					Activity 1	Activity 2	Activity 3
Australian rules football (n=3)							
Bonney et al. (2020)[41]			*Competition*		*SSG*		
	Total distance (m)		8776.38 ± 1198.87		**1590.33 ±103.86**		
	Total distance covered (m·min^{-1})		104.51 ±13.64		**132.53 ± 8.66**		
	Maximum velocity (m·s^{-1})		7.10 ± 0.43		**5.88 ± 0.20**		
	HI running per quarter (%)		61.34 ± 7.05		**68.86 ± 5.15**		
Boyd et al. (2013)[43]			*Competition*		*Match Simulation*	*Tactical*	
	PlayerLoad (A.U.·min^{-1}) §	Midfielders	Elite	16.03 ±4.21	15.34 ± 2.84	9.51 ± 3.26	
			Sub-elite	15.07 ± 2.02			
		Nomadics	Elite	14.96 ± 2.35	14.30 ± 2.89	8.06 ± 3.24	
			Sub-elite	13.03 ± 2.36			
		Deeps	Elite	11.01 ± 2.63	11.68 ± 3.34	8.73 ± 3.26	
			Sub-elite	10.34 ± 1.59			
		Ruckmen	Elite	14.91 ± 3.30	10.62 ± 2.57	5.87 ± 2.70	
			Sub-elite	12.78 ± 5.49			
	Low-velocity (<2 m·s^{-1}) PlayerLoad (A.U.·min^{-1}) §	Midfielders	Elite	4.19 ± 1.33	3.29 ± 0.69	4.23 ± 1.42	
			Sub-elite	3.88 ± 0.88			
		Nomadics	Elite	4.21 ± 0.90	3.43 ± 2.52	3.58 ± 1.35	
			Sub-elite	3.69 ± 0.65			
		Deeps	Elite	3.75 ± 0.90	3.20 ± 2.59	3.49 ± 1.58	
			Sub-elite	3.81 ± 1.56			
		Ruckmen	Elite	4.41 ± 0.78	3.27 ± 0.53	3.27 ±1.16	
			Sub-elite	3.81 ± 0.81			
			Competition		*Closed Skill*	*Open Skill*	*SSG*
	PlayerLoad (A.U.·min^{-1}) §				10.84 ± 2.72	10.46 ± 3.37	15.52 ±4.95
	Low-velocity (<2 m·s^{-1}) PlayerLoad (A.U.·min^{-1}) §				3.39 ± 1.54	3.03 ± 0.90	6.07 3.39
Corbett et al. (2017)[35]			*Competition*		*Activity Clusters**		
	Metres per minute (m·min^{-1}) §		130.5		49.0–204.1		
	HI running per minute (m·min^{-1}) §		33.5		0.5–144.1		
	% of distance in HI running (%) §		26		0–72		
Football (n=4)							
Casamichana et al. (2012)[38]			*Competition*		*SSG*		
	Distance covered (m·min^{-1})		113.0± 8.9		**118.3 ± 18.7**		
	Distance covered in velocity zones (m·min^{-1}) **	0.0–6.9 km·h^{-1}	2530.12 ± 54.55		2471.22 ± 42.84		
		7.0–12.9 km·h^{-1}	2607.76 ± 85.68		**3068.27 ± 112.45**		
		13.0–17.9 km·h^{-1}	1135.21 ± 26.77		1135.21 ± 66.93		
		18.0–20.9 km·h^{-1}	289.16 ±26.77		289.16 ± 26.77		
		>21.0 km·h^{-1}	240.96 ±26.78		**240.96 ± 26.78**		
	Time spent in velocity zones (%) **	0.0–6.9 km·h^{-1}	63.22 ± .38		**59.10 ± 1.47**		
		7.0–12.9 km·h^{-1}	25.93 +0.85		**31.23 ± 1.14**		
		13.0–17.9 km·h^{-1}	7.33 ± .62		8.09 ± 0.47		
		18.0–20.9 km·h^{-1}	1.51 ±0.09		1.28 ± 0.24		
		>21.0 km·h^{-1}	0.90 ±0.38		**0.43 ± 0.19**		
	Maximum speed (km·h^{-1})		27.0 ±1.8		**20.3 ± 2.6**		
	Player workload (A.U.·min^{-1})		13.5 ±1.5		**15.8 ± 2.7**		
	Exertion index (A.U.·min^{-1})		2.0 ±.9		**5.1 ± 1.5**		

(continued)

Table 5. Continued.

Study	Physical variable		Competition		Training		
					Activity 1	Activity 2	Activity 3
	Work:rest ratio (A.U)		2.4 ±0.5		**3.5 ± 2.2**		
	Sprints ($n \cdot h^{-1}$)	Total	15.3 ± 6.1		**7.5 ± 11.3**		
		0–5m	1.0 ± 1.2		0.6 ± 2.8		
		5–10m	4.6 ± 2.6		2.6 ± 6.3		
		10–40m	9.1 ± 4.2		**4.3 ± 7.8**		
		>40m	0.4 ± 1.0		**0.0 ± 0.0**		
	Mean sprint distance (m)		15.2 ± 3.2		**4.4 ± 6.7**		
	Maximum sprint distance (m)		34.4 ± 12.4		**4.8 ± 7.4**		
	Mean sprint duration (s)		2.3 ± 0.5		**0.7 ± 1.1**		
	Maximum sprint duration (s)		5.1 ± 1.7		**0.8 ± 1.2**		
	RHIE ($n \cdot h^{-1}$)		9.4 ± 4.5		12.9 ± 12.6		
	Mean efforts per RHIE (n)		3.8 ± 0.5		4.0 ± 1.8		
	Maximum efforts per RHIE (n)		5.6 ± 1.9		**4.2 ± 1.9**		
	Mean duration of efforts in RHIE (s)		3.6 ± 0.7		**3.0 ± 1.1**		
	Maximum duration of efforts in RHIE (s)		10.0 ± 2.9		**5.4 ± 2.8**		
	Duration between efforts in RHIE (s)		10.5 ± 1.4		11.9 ± 8.7		
	Maximum duration between efforts in RHIE (s)		19.2 ± 2.0		**16.1 ± 4.0**		
	Duration between RHIE (s)		340.4 ± 208.4		**19.6 ± 33.3**		
	Maximum duration between RHIE (s)		736.0 ± 399.5		**20.3 ± 34.4**		
Djaoui et al. (2017)[40]			*Competition*		*Match Simulation*	*SSGs***	
	Maximal sprinting speed ($km \cdot h^{-1}$) §	All players	28.66 ± 1.93		24.49 ± 2.31	23.64 ± 3.08	
		CD	29.53 ± 1.34		23.07 ± 0.32	22.89 ± 3.53	
		WD	30.25 ± 1.48		25.95 ± 1.54	24.82 ± 3.12	
		CM	26.48 ± 0.95		24.10 ± 1.64	22.95 ± 2.44	
		WM	29.40 ± 0.57		23.20 ± 5.37	24.13 ± 2.81	
		FWD	27.00 ± 0.00		27.00 ± 0.00	23.02 ± 3.04	
	Competition maximal sprinting speed (%) §	All players			85.73 ± 9.37	82.67 ± 1.074	
		CD			78.18 ± 2.53	77.62 ± 12.30	
		WD			85.83 ± 4.49	82.10 ± 10.11	
		CM			91.05 ± 5.79	86.70 ± 8.98	
		WM			79.10 ± 19.80	82.07 ± 9.62	
		FWD			100.00 ± 0.00	85.26 ± 11.27	
Gabbett et al. (2008)[34]			*Competition*		*SSG*		
	Distance covered (m) §	INT	9968 ± 1143		4448 ± 1304		
		NAT	9706 ± 484				
	Work:rest ratio (n:n) §	INT	1:12		1:13		
		NAT	1:16				
	Distance covered in velocity zones (m)** §	Walking	INT	3184.75 ± 381.14	1298.45 ± 458.66		
			NAT	3378.55 ± 303.62			
		Jogging	INT	4315.25 ± 542.63	2280.36 ± 781.66		
			NAT	4308.79 ± 510.33			
		Striding	INT	1505.17 ± 497.41	542.64 ± 180.87		
			NAT	1124.03 ± 297.16			
		Sprinting	INT	968.99 ± 310.08	381.14 ± 135.66		
			NAT	NS			
	Distance covered in velocity zones (%) ** §	Walking	INT	32.18 ± 3.96	29.15 ± 5.98		
			NAT	35.05 ± 4.04			
		Jogging	INT	43.06 ± 4.12	51.22 ± 6.91		
			NAT	44.15 ± 3. 96			
		Striding	INT	15.08 ± 3.96	12.12 ± 3.04		

(continued)

Table 5. Continued.

Study	Physical variable		Competition		Training		
					Activity 1	Activity 2	Activity 3
			NAT	11.11 ± 3.04			
		Sprinting	INT	10.03 ± 3.10	9.17 ± 3.89		
			NAT	9.02 ± 3.03			
	Time spent in velocity zones (s)** §	Standing	INT	881.82 ± 168.18	259.09 ± 136.36		
			NAT	727.27 ± 200.00			
		Walking	INT	2809.09 ± 281.82	1118.18 ± 359.09		
			NAT	3054.55 ± 204.54			
		Jogging	INT	1509.09 ± 190.91	804.55 ± 245.45		
			NAT	1536.36 ± 263.64			
		Striding	INT	272.73 ± 86.36	100.00 ± 31.82		
			NAT	213.64 ± 54.54			
		Sprinting	INT	154.55 ± 59.09	68.18 ± 13.64		
			NAT	140.91 ± 45.45			
	Time spent in velocity zones (%)** §	Standing	INT	15.90 ± 3.42	12.31 ± 7.48		
			NAT	13.09 ± 3.43			
		Walking	INT	50.18 ± 3.59	47.53 ± 8.26		
			NAT	54.39 ± 2.96			
		Jogging	INT	26.81 ± 3.74	34.13 ± 6.23		
			NAT	26.96 ± 4.83			
		Striding	INT	4.83 ± 1.40	4.21 ± 1.24		
			NAT	3.90 ± 0.93			
		Sprinting	INT	2.96 ± 0.62	2.81 ± 0.62		
			NAT	2.65 ± 0.62			
	Repeated sprints (n) §	INT	4.8 ± 2.8		1.0 ± 1.4		
		NAT	1.0 ± 1.0				
	Efforts per repeated sprint (n) §	INT	3.4 ± 0.8		3.3 ± 0.5		
		NAT	3.2 ± 0.4				
	Duration of efforts (s) §	INT	2.1 ± 0.7		1.9 ± 0.7		
		NAT	2.9 ± 1.1				
	Recovery between repeated sprints (s) §	INT	5.8 ± 4.0		8.3 ± 4.4		
		NAT	7.8 ± 5.4				
	Recovery between efforts (min) §	INT	19.4 ± 22.4		38.2 ± 16.6		
		NAT	94.4 ± 44.1				
Olthof et al. (2019b)[48]			*Competition*		Match simulation		
	Distance covered ($m \cdot min^{-1}$) **		184.24 ± 19.02		**158.70 ± 17.39**		
	HI Distance covered (%) **		6.25 ± 2.22		6.36 ± 3.15		
	Sprints (n·min of ball-in-play^{-1}) **		0.17 ± 0.13		**0.14 ± 0.15**		
Basketball (n = 2)							
Montgomery et al. (2010)[44]			*Competition*		*SSG*	*Offensive Drills*	*Defensive Drills*
	Mean HR ($beats \cdot min^{-1}$) §		162 ± 7		147 ± 10	147 ± 5	152 ± 7
	Peak HR ($beats \cdot min^{-1}$) §		173 ± 6		171 ± 12	165 ± 6	170 ± 7
	Predicted VO_2 max ($ml \cdot kg \cdot min^{-1}$) §		51.2 ± 3.4		40.2 ± 7.1	42.3 ± 3.0	45.1 ± 3.6
	Predicted VO_2 max (%)§		70 ± 16		59 ± 10	63 ± 6	66 ± 5
	Accumulated load ($A.U. \cdot min^{-1}$)		279 ± 58		**171 ± 84**	**55 ± 15**	**58 ± 26**
	RPE (A.U.) §		7		9	7	7

(continued)

Table 5. Continued.

Study	Physical variable		Competition	Training		
				Activity 1	Activity 2	Activity 3
Svilar et al. (2019)[42]	****		*Competition*	*Match Simulation*	*SSG*	
	PlayerLoad (A.U.·min^{-1}) §		11.13 ± 2.00	11.27 ± 3.61	13.15 ± 1.65	
	Accelerations (n·min^{-1}) §		2.19 ± 0.84	1.92 ± 0.97	2.20 ± 0.76	
	High-band accelerations (>3.5 m·s^{-2}; n·min^{-1}) §		0.38 ± 0.25	0.33 ± 0.26	0.25 ± 0.20	
	Decelerations (n·min^{-1}) §		2.38 ± 0.63	2.40 ± 1.08	2.95 ± 0.88	
	High-band decelerations (<-3.5 m·s^{-2}; n·min^{-1}) §		0.25 ± 0.19	0.24 ± 0.22	0.36 ± 0.27	
	Jumps (n·min^{-1}) §		1.11 ± 0.53	1.13 ± 0.64	1.76 ± 0.76	
	High-band jumps (n·min^{-1}) §		0.25 ± 0.21	0.23 ± 0.25	0.38 ± 0.21	
	Changes of direction (n·min^{-1}) §		10.62 ± 3.26	10.61 ± 4.40	13.25 ± 3.69	
	High-band changes of direction (<-3.5 m·s^{-2}; n·min^{-1}) §		0.79 ± 0.45	0.73 ± 0.46	0.95 ± 0.58	
Tennis (n=1)						
Fernández-Fernández et al. (2015)[39]			*Competition*	*Match Simulation*		
	HR (beats·min^{-1})	Winners	158.9 ± 8.3	160.3 ± 3.0		
		Losers	168.0 ± 6.7	161.7 ± 6.3		
	Maximum HR (%)	Winners	79.7 ± 4.3	80.6 ± 3.1		
		Losers	84.8 ± 3.2	**81.5 ± 3.3**		
	RPE (A.U)	Winners	12.9 ± 1.2	11.9 ± 2.0		
		Losers	15.0 ± 0.8	12.0 ± 1.8		

Bold = training activity is significantly different from competition ($p<0.05$). § = statistical significance was not reported between training activities and competition. Physical variable: HI = high-intensity. RHIE = repeated high-intensity exercise. A.U = arbitrary unit. HR = heart rate. RPE = rate of perceived exertion. Competition: CD = central defender. WD = wide defender. CM = central midfielder. WM = wide midfielder. FW = forward. NAT = national. INT = international. Training: SSG = small-sided game. *Activity clusters were defined through means of hierarchal clustering measures and defined groups of training activities with similar physical and technical skill profiles, when related to match play **Values displayed as mean ± SE ***Displayed as a combined mean of all 14 SSG activities. **** Data displayed as relative to match/activity duration.

Table 6. Tactical variables quantified to determine representativeness of training activities.

Study	Tactical variable		Competition	Training		
				Activity 1	Activity 2	Activity 3
Australian rules football (n=1)						
Tribolet et al. (2022)[49]			*Competition*	*Match Simulation*		
	Field length (m)		158.64 ± 4.63	**155.57 ± 0.75**		
	Field width (m)		132.38 ± 4.73	132.35 ± 5.90		
	Length per width ratio		1.20 ± 0.09	1.18 ± 0.05		
	Space per player (m^2)		457.39 ± 12.94	453.00 ± 12.21		
	Passing network connectedness		97.12 ± 14.18	95.31 ± 10.77		
	Passing network outdegree variability		104.46 ± 16.55	**114.24 ± 11.45**		
	Passing network indegree variability		98.01 ± 11.08	**111.73 ± 12.01**		
Football (n=3)						
Couto et al. (2024)[45]			*Competition*	*SSG (width; L 40m x W26m)*	*SSG (length; L 26m x W 40m)*	
	Team length (m) §		34.0 ± 4.1	6.8 ± 0.9	9.6 ± 1.3	
	Relative team length (m)		0.32 ± 0.04	**0.26 ± 0.03**	**0.24 ± 0.03**	
	Team width (m) §		40.7 ± 4.1	14.8 ± 3.0	13.7 ± 1.7	
	Relative team width (m)		0.60 ± 0.06	**0.37 ± 0.07**	**0.53 ± 0.07**	
	Length per width ratio (A.U.)		0.84 ± 0.08	**0.48 ± 0.13**	**0.71 ± 0.13**	
	Space exploration index (A.U.)		20.5 ± 2.1	**5.7 ± 0.5**	**7.1 ± 0.9**	
	Stretch index (A.U.)		24.5 ± 1.3	**16.8 ± 7.0**	**14.4 ± 5.4**	
Olthof et al. (2019a)[47]			*Competition*	*SSG (4 vs 4 + GK)*	*SSG (6 vs 6 + GK)*	*SSG (8 vs 8 + GK)*
	Team length (m) *	U13	34.17 ± 1.87	**16.56 ± 1.57**	**19.90 ± 1.56**	**26.56 ± 2.19**
		U15	35.83 ± 1.46	**16.88 ± 2.08**	**23.02 ± 2.61**	**29.17 ± 2.08**
		U17	35.10 ± 1.15	**15.83 ± 1.46**	**24.48 ± 1.77**	30.94 ± 1.56
		U19	34.17 ± 1.46	**15.94 ± 1.77**	**22.50 ± 1.25**	27.19 ± 1.35
	Team width (m) *	U13	40.25 ± 2.20	**17.67 ± 2.45**	28.22 ± 1.72	34.36 ± 1.71
		U15	39.02 ± 1.47	**18.53 ± 2.33**	**25.52 ± 3.44**	34.11 ± 2.21
		U17	41.23 ± 2.70	**18.16 ± 1.47**	**25.15 ± 2.33**	**30.31 ± 2.57**
		U19	41.35 ± 2.33	**18.04 ± 1.84**	**26.01 ± 3.44**	34.36 ± 1.96
	Team surface area (m^2) *	U13	957.04 ± 62.54	**145.77 ± 17.87**	**367.61 ± 41.48**	621.13 ± 46.00
		U15	969.72 ± 81.33	**152.11 ± 36.70**	**348.59 ± 66.79**	659.15 ± 52.04
		U17	1014.08 ± 81.02	**145.77 ± 24.16**	**373.94 ± 54.03**	583.10 ± 58.86
		U19	1033.10 ± 99.77	**139.44 ± 24.20**	342.25 ± 54.25	595.77 ± 77.66
	Interpersonal distance (m) ** §	U13	23.38 ± 0.84	15.04 ± 1.63	18.08 ± 0.85	20.55 ± 1.13
		U15	23.45 ± 0.99	15.61 ± 1.62	17.66 ± 1.83	21.05 ± 1.05
		U17	24.01 ± 0.92	15.04 ± 0.85	18.08 ± 1.27	20.06 ± 1.06
		U19	24.15 ± 1.13	14.90 ± 1.20	17.58 ± 1.49	20.27 ± 1.13
Olthof et al. (2019b)[48]			*Competition*	Match simulation		
	Team length (m)		34.8 ± 1.6	33.6 ± 1.9		
	Team width (m)		41.6 ± 2.7	43.0 ± 1.9		
	Length per width ratio (A.U.)		0.9 ± 0.1	**0.8 ± 0.1**		

(continued)

Table 6. Continued.

Study	Tactical variable		Competition	Training		
				Activity 1	Activity 2	Activity 3
	Team surface area (m^2)		1035.0 ± 104.4	1011.9 ± 84.2		
	Inter-team distance (m)		5.4 ± 0.4	5.4 ± 0.8		
	Stretch index (m)	x	10.1 ± 0.4	9.7 ± 0.6		
		y	11.1 ± 0.8	11.3 ± 0.5		
Taekwondo (n=1)						
Maloney et al. (2018)[46]			*Competition*	*Match simulation*		
	Peak interpersonal distance (m)**		1.77 ± 0.08	**1.87 ± 0.12**		
	Peak attack initiation interpersonal distance (m)**		1.88 ± 0.14	**2.06 ± 0.19**		

Bold = training activity is significantly different from competition ($p<0.05$). § = statistical significance was not reported between training activities and competition. A.U. = arbitrary unit. U = under. Training: SSG = small-sided game. GK = goalkeeper. * Displayed as mean ± SE. ** Converted to SI unit.

For one study (20%),[49] the methods of data collection for competition differed to those for training activities (i.e., commercial data provider vs computerised notational analysis).

Studies investigating team sports ($n = 4$; 80%; Australian rules football,[49] football[45,47,48]) quantified tactical variables which provide insight into collective behaviour of the team (e.g., team length/width, team surface area, space per player, interpersonal distance). Two studies explored the influence of contextual factors on tactical variables (match-outcome,[49] age-group; U13 – U19[47]). The only study[46] investigating tactical variables of individual sports (taekwondo), examined tactical behaviour in relation to the opponent (i.e., peak interpersonal distance, peak attack initiation interpersonal distance). Tactical variables were quantified for the whole-match ($n = 2$; 40%),[46,49] half-match ($n = 1$; 20%),[45] or possession ($n = 2$; 40%).[47,48]

Tactical variables were quantified for only two training activities; match simulations ($n = 3$; 60%)[46,48,49] and SSGs ($n = 2$; 40%).[45,47] Both studies analysing SSGs[45,47] quantified and compared representativeness of multiple SSGs, manipulating individual task constraints (playing area,[45] number of players[47]). All studies reported significant differences in tactical variables between training activities and competition. The proportion of variables which were significantly different to competition ranged between 14 and 100% (mean = 70.6 ± 37.1%).

Discussion

This study aimed to 1) systematically review the scientific literature evaluating the representativeness of training activities in sports, 2) identify the methods used to assess representativeness and, 3) summarise how training activities can be designed to more (or less) closely mirror the demands of competition. The review included 19 studies, predominantly investigating the representativeness of training activities within team sports ($n = 16$; 84%), with Australian rules football the most researched sport ($n = 8$; 42%). Studies quantified technical ($n = 12$; 63%), physical ($n = 10$; 53%), and tactical ($n = 5$; 26%) variables. SSGs ($n = 13$; 68%) and match simulations ($n = 11$; 58%) were the most investigated training activities. Of the studies which evaluated differences between training activities and competition ($n = 17$; 89%), 14 studies (82%) reported a statistically significant difference in at least one variable. Further, of the 112 variables (technical $n = 50$; physical $n = 45$; and tactical $n = 17$) quantified across studies, 69% were significantly different between training and competition environments. This systematic review provides insight into the evidence-base investigating the representativeness of training

activities, offering coaches a foundation for more rigorous planning and reflection. This can help lead to the development of tools such as the representative practice assessment tool (RPAT) used for assessing and enhancing practice task designs in tennis.[52] By highlighting these discrepancies, coaches are better positioned to design training environments that more closely replicate competitive demands, thereby improving the precision and effectiveness of prescribed sessions.

Methodological considerations for evaluating representativeness of training activities

There are several key methodological limitations within the included studies to be aware of when interpreting the results, comparing data between studies, and informing practical applications.

Firstly, studies predominantly investigated the representativeness of training activities for team sports, and specifically invasion sports (Australian rules football, football, basketball), with the only individual sport studies investigating net-wall (tennis) and combat (taekwondo) sports. Due to the differing internal logic between sport types,[53] the resulting physical, technical, tactical and psychological characteristics of performance may differ due to the differing phases or moments of the game (e.g., invasion games; in possession, out of possession, transition, set pieces) and the subsequent interactions which may occur (e.g., between teammates, between the opposition). Therefore, there may be limited value in comparing the representativeness of training activities between sports (or sport types), and a need for future research to develop a sport-specific evidence-base investigating the representativeness of training activities.

Secondly, there was homogeneity observed in the participants across studies, for example, predominantly male (63%), senior (63%), and competing at national playing standards (53%). Due to the population-specific (e.g., physiological, biomechanical) and contextual differences (e.g., training provision, competition structures) which exist between sporting populations (i.e., male and female, senior and youth), it may be inappropriate to inform applied practices from research derived from other populations.[54,55] Therefore, future research should aim to develop a population-specific evidence-base relating to the representativeness of training activities, to inform the design, delivery and review of coaching practices which are appropriate for the respective population.

Thirdly, the sample size of studies was either limited (i.e., single team samples (84%), low number of observations), and/or poorly reported (e.g., number of competitions/training sessions observed, number of individual training competition/training activity observations). Consequently, single team samples may have limited generalisability to the wider populations due to team-specific strategies or philosophies which may influence performance during competition or training. Further, the low (or unclear) number of observations contributing to analyses and subsequent results may not sufficiently account for such between-competition[56–58]/session[59–61] variation in observations. Therefore, future research should aim to adopt a multi-team data collection approach and conduct data collection over a greater longitudinal period (e.g., competitive season) to increase the number of competition/training observations and account for such variation, whilst also ensuring a sufficient level of and clarity in description of the methods adopted (i.e., number of observations, inclusion criteria) to aid interpretation of results and comparisons between studies.

Lastly, there are specific considerations and necessary cautions for comparing the physical, technical or tactical characteristics quantified across studies. Considering physical variables, due to between-system differences (e.g., video-based time-motion analyses, GPS units, optical tracking), sampling frequencies (e.g., GPS; 10 Hz,[35,38,45] 15 Hz[40]),[62] manufacturer-specific data processing methods (e.g., GPS; Catapult[35,38,42] vs SPI Elite GPSports[40])[63] and variable definitions (e.g., high-speed running threshold: 14.4 $km \cdot h^{-1}$ [35]; 19.8 $km \cdot h^{-1}$ [48]) direct comparison between studies may not be appropriate.[62,63] Likewise, readers should be cautious of absent/inconsistent operational definitions for variables[64] and absence of reliability assessments when comparing technical variables. Further, particular caution is required when evaluating the representativeness of training activities where studies have implemented differing methods of data collection to quantifying characteristics during training and during competition.[33,35–37,49,50] Future research should ensure consistency in data collection between training and competition environments, and where this is not possible, assess the interchangeability of data obtained via differing data collection methods.[65,66] Accordingly, coaches should interpret training and competition data with caution, recognising that methodological inconsistencies may lead to misleading conclusions about performance demands.

Representativeness of training activities

Match simulations (or full-sided games)[67] are training activities played to regulation rules, and thus should be the training activity expected to most closely replicate the demands of competition activity.[48] However, results from this review showed match simulations often failed to replicate competition demands. Across all studies analysing match simulations, 72% (± 22%) of variables quantified were significantly different to competition. This finding challenges the assumption that match simulations replicate the demands of competition.[18] Recognising this discrepancy is a key component of a coach's reflective process.[3] Effective reflection requires challenging the 'why' training environments designed to mirror competition often fail to do so. Several methodological and contextual factors may contribute to the variation between environments. One of which is the lack of pressure or challenge present in the competitive environment (e.g., lack of

crowd noise, unpredictability of officiants etc.).[68] Research reports that coaches combat this factor by introducing performance scores[69] or using audio cues to mimic the stadium environment/pressure within training.[70] All actions appeared to increase playing effort and demands within these studies. However, within this review, no study reported implementing any of these methods to increase performance demands; if done, this may have elicited demands closer to competition performance. Further investigating environment manipulation may offer insights into how performance demands can be more effectively elicited in match simulation training. The representativeness of match simulations may be compromised by coach-prescribed load management strategies[71–73] which can reduce training intensity to competition. This is especially relevant in collision sports[74,75] (such as Australian rules football)[76,77] where coaches often adjust training loads to mitigate injury risk. Whilst these precautions aim to maximise performance, they may limit the fidelity of match-based training activities. Equally, it may be the case coaches deliberately manipulate aspects of skill learning in a periodised manner. Indeed, frameworks have been developed related to how coaches may effectively develop skills over time (see Farrow & Robertson[78] and Otte, Millar & Klatt[79] for examples). Coaches should critically evaluate the intended aim of each session/drill to determine whether a match simulation is the most appropriate format.[80] Where replicating competition demands is not the primary objective, coaches should consider alternative training modalities (e.g., SSGs).

The most frequently analysed training activity within the review was SSGs. These training activities also lacked representativeness, with 77% (±27.6%) of variables significantly different to competition. This demonstrates that, despite their popular use within traditional coaching[81] and literature,[82–84] SSGs may not adequately represent the physical and tactical demands of competition. The lack of resemblance to competition may reflect intentional design as opposed to a misinterpretation of representativeness. SSGs have frequently been reported to have an objective of skill acquisition,[82] decision-making,[82,85] and tactical awareness.[83,86] Furthermore, this review revealed 26 different SSG formats, highlighting flexibility of this training activity. This difference also reflects the nuanced planning processes regarding a coach's session design, where task constraints and intended outcomes shape the structure and objective of each SSG format.[85] In total, two studies[45,47] specifically analysed variations in playing numbers and field dimensions, respectively. Both studies demonstrated that manipulation of task constraints can affect performance outcomes, reinforcing the importance of understanding how the planning process can directly influence the outcomes of a training activity. Aside from this, Djaoui et al.[40] examined compounded task constraints (e.g., combinations of playing numbers, pitch dimensions and rule variations) and reported significant differences from various training activities. This would indicate that task constraints can interact between each other to achieve specific performance outcomes as opposed to operating in isolation. Therefore, judging the effectiveness of SSGs solely by how closely they replicate full-match conditions may not be an appropriate protocol. Future research examining SSGs and representativeness should report session aims and coach intentionality to clarify whether observed mismatches reflect a deliberate technical focus or a failure to represent match demands. From a coaching perspective, this highlights the need for critical reflection on the purpose and design of SSGs, ensuring that task constraints are intentionally aligned with specific learning outcomes rather than implicitly assumed to mirror match play. Coaches should therefore interrogate the extent to which SSG-derived data informs decision-making, recognising that misalignment between training design and competitive demands may reflect intentional pedagogy or, conversely, limitations in reflective practice.

After considering two game-based formats, it is important to acknowledge drill-based training activities. Whilst they were less commonly reviewed ($n = 4$),[33,35,43,44] 57.1% (± 53.5%) of variables within these studies deviated significantly from the values observed within competition. These activity types tend to focus on skill development (ongoing refinement and improvement of a skill over time) and do not encompass a full competition environment,[87] potentially explaining the high differences between training and competition. Drill-based activity can be designed to target isolated components of competition, rather than the full match environment. This is reflected in the results of this review with both match simulations and SSGs showing higher percentage of variables deviating significantly between training activities and competition, than in drill-based training. Acknowledging this can reveal that representativeness should be interpreted relative to the intended focus of the activity. A drill may be representative of a specific set play or tactical moment in isolation, even if it does not reflect the broader demands of a full match environment. Krause's research[33] demonstrates how drill-based activities can replicate phases of match play. For example, the serving drills produced fault percentages likened to match conditions, despite focusing exclusively on the serve, an isolated but essential component of a tennis match.[88] This highlights how drill-based activities, whilst seeming to lack the contextual demands of a game-based activities, offer action fidelity. To reinforce this, Pinder et al.,[18] emphasised that training environments do not need to mirror competition directly. These environments should instead provide adequately comparable situations and challenges which align with those typically seen within competition contexts.

Task constraints and the representativeness of training activities

Whilst only a minority of studies ($n = 3$)[40,45,47] within this review directly compared task constraints (e.g., playing

numbers and field dimensions), many other studies reported the structure of their training activities and how these structures could influence representativeness. Although studies applying only one task constraint[33,34,37,41–43,50] do not establish direct causality to representativeness, variations in how these constraints are implemented (e.g., removal of[41] vs inclusion of stoppages[50]) can lead to different performance outcomes. This implies that deliberate manipulation of task constraints can alter the functionality and fidelity of training activities.

Player numbers were a commonly analysed task constraint manipulated within the studies of this review ($n = 9$; 75%)[34,36,38,40,41,45,47,50,51] and are also frequently utilised within literature.[83,86,89] Training formats with playing numbers closer to match conditions (e.g., 8vs8, 9vs9 in football) are more likely to elicit demands comparable to competition,[47] likely due to preservation of functionality and perception-action coupling. In contrast, training formats with much smaller playing numbers (e.g., 2vs2) exhibit higher technical demands (e.g., passing frequency),[89] and a reduction in task representativeness observed. These findings were observed within the present review.[40,47] Utilisation of small playing numbers are useful when aiming to overload specific skill within training formats,[90] whereas larger playing numbers to preserve aspects of match conditions.[47] It should be acknowledged that many of the results presented from the reviewed studies were descriptive rather than comparative. These insights offer practical recommendations for coaches to adopt for their particular context rather than definitive laws governing practice.[17] The application of deliberate task constraint manipulation enables coaches to refine prescriptions of training, achieving precise session outcomes.

Area-based task constraints (e.g., field size, space per player) appeared as frequently analysed within this review ($n = 10$; 83%).[34,36,38,40,41,44,45,47,50,51] The results presented amongst the reviewed studies indicate that altering field width can alter tactical variables (e.g., length per width ratio, stretch index).[45] Djaoui et al.[40] described that field area does not consistently change the rate of maximal sprinting speeds, larger playing areas did tend to produce higher sprinting velocities. In wider research, larger playing areas are associated with increased between-session variability regarding technical outputs,[89] In contrast, analysis of smaller playing areas result in an increased display of technical action density (shots, tackles, passes), but a reduction of representativeness.[89] Recognising these patterns highlight the need for coaches to holistically review their administered task constraints to minimise unwanted fluctuations amongst comparable training activities. Increased space per player has shown to provide more time for prompt decision-making and technical skills execution.[89] Reduced functionality and action fidelity within segments of a session can impede skill transfer into a competition environment, as performers have been less exposed to realistic opposition tactics (e.g., high/low defensive pressure).[91] As a practical example for coaches, reducing pitch size to increase passes and tackles may support technical repetition but is unlikely to expose players to realistic defensive spacing. Conversely, increasing space per player may better replicate opposition structure and decision-making demands, even if technical actions occur less frequently.

Despite numerous studies manipulating task constraints to create a representative training environment, there remains a limited understanding of how specific task constraints can be utilised to achieve representativeness. Among the reviewed studies, prescribed task constraints varied considerably, with only 5vs5,[40,45] 6vs6[40,47] and 8vs8[40,47] formats appearing across multiple studies within the same sport. However, differences in pitch dimensions and time durations make comparisons difficult. Even where formats overlapped, studies focused on different performance variables. Couto et al.[45] examined tactical variables, Djaoui et al.[40] analysed sprinting speed and Olthof et al.[47] analysed a wider range of variables across multiple domains (technical and tactical) none of which aligned across studies. Practitioners should consider how training tasks can be designed to better align with the demands of competition. This includes ensuring that key informational constraints, task dynamics, and environmental conditions are sufficiently represented to support effective skill transfer.[92] Furthermore, to advance both research and practice, future studies should build on existing analyses, across a wider population rather than examining formats in isolation. Greater consistency across studies would allow coaches to interpret findings more precisely and apply task constraints with greater accuracy and confidence. As clearer empirical guidance emerges, coaching expertise in constraint manipulation will continue to develop.

Representative variables during training activities

Technical variables were the most frequently analysed variable across the reviewed studies, with team possession-based variables receiving significant attention. However, when compared to match data, 65% of possession-based variables differed significantly, suggesting possession during training activities are not reflective of competition. Although possession-based metrics are commonly used to assess technical performance, they require further refinement to accurately reflect game conditions. Research surrounding possession length in elite male European league football has indicated team success within match play.[93–95] Furthermore, Bradley et al.[96] discovered that football teams operating with increased ball possession percentages perform more high intensity running and execute greater technical events (e.g., passes). In contrast, research within youth female match play revealed that a team with a higher individual number of possessions had low ball retention characteristics,[97] which can offer insights towards further

prescription of training activities. Team-based findings should be approached with caution, as inter-team variation, driven by factors such as location,[98] individual player skill,[99] and previous match outcome,[98] could make results context-dependent.[100] Coaches who plan and deliver sessions with match representative constraints (e.g., spatial limitations, defensive pressure) would be able recreate the prolonged possessions observed in competition within their training that can drive performance.

The present review revealed that 57.0% (± 25.2%) of all physical variables differed significantly between competition and training. The large standard deviation observed was likely due to the diverse range of activity aims and methodologies used amongst studies. This disparity is also reported in wider research, specifically in Avila-Moreno et al. systematic review examining physical demands in basketball.[101] Their research found that competition elicited higher internal and external loads than training, despite its shorter duration. Due to methodological diversity across studies, comparisons remained descriptive. This does not inherently mean methodology within studies should be uniform, as RLD is inherently contextually dependent, but rather demonstrates the need for clearer articulation of the intended performance outcomes and how task constraints are used to enable this. Of the three variable types examined (physical, technical, tactical) physical variables across all training activities proved the most representative of competition demands. Within specific training activities, match simulations yielded the highest average representativeness of competition demands (33.3 ± 16.7), however still remaining highly variable across studies (ranging from 50%[44] to 16.6%[46] of physical variable differing significantly from competition environments). Despite this, their overall similarity to competition remained limited, with a mean representativeness of just above 50%. Variation in physical training is often due to a coach's targeted stimuli, such as high-intensity training, aerobic condition or recovery-based work. The variability typically reflects the dynamic needs of the team, influenced by factors like such as seasonal periodisation[102] and proximity to matchday.[103] This highlights the need for coaches to standardise or contextualise training activities to replicate competition load for physical variables.

Tactical variables were the least analysed across the reviewed literature, with only 17 unique variables (26 in total) examined across five studies. Of these, 14 variables were statistical compared resulting in 70.6 ± 37.1% of variables showing significant differences. Notably, four training activities (of 8 activities quantifying tactical variables; 50%) reported no representative tactical outputs when related to competition, suggesting that the small sample size and high proportion of unrepresentative training variables may reflect the complexity and context-dependence of tactical behaviour. This has been explored in both rugby union and football, whereby differing tactics emerged amongst successful and unsuccessful teams,[104] and within-team analysis.[83,105,106] Both studies, and the present review, reveal how tactical representativeness is difficult to assess without accounting for variation amongst contexts, populations and training environments. For coaches that are planning training activities and designing sessions, the first aim should be to establish their team's tactical identity. After doing this training should then be tailored to cater to the context-specific environment which has been established. Further, the prescribed training, should be consistently reviewed and altered to account for the dynamic nature of a team's tactics and structure.[10]

Lastly, no study evaluated the representativeness of psychological characteristics (e.g., visual exploratory activity) during training activities. The limited research investigating psychological characteristics is reflective of wider literature within sport, where physical,[107] technical,[108] and tactical[109] performance has predominantly been investigated to understand training and competition demands. This may be consequential of the methodological challenges in quantifying psychological characteristics of performance. Typically sport psychology research has quantified non-behavioural variables (e.g., collected via questionnaire or interview-based methods pre- or post-performance),[110] or has utilised performance outcomes (e.g., physical, technical or tactical actions, win/loss) as outcome variables for assessing the efficacy of psychological interventions on sporting performance.[111] However, such approaches would be inappropriate for evaluating the representativeness of training activities for psychological characteristics. Therefore, future research is warranted which provides insight into the functionality of a training activity (i.e., the degree to which an athlete is able to use the same information sources during competition to help contextualise decisions and movements),[18] for example quantifying visual exploratory activity (e.g., scanning),[112,113] to inform the design, delivery and review of representative training environments.

Limitations

This systematic review has implemented a methodologically rigorous approach to reviewing the scientific literature evaluating the representativeness of training activities. For example, the review adhered to the PRISMA guidelines,[27] searching relevant electronic databases, with no date nor language restrictions, whilst using search terms relating to representative learning design, training activities and sport coaching. Further, two researchers independently completed the two-stage screening process (CF, AHA), whilst the lead researcher completed data extraction for all studies, and subsequently, all data was checked independently by another researcher (AHA). However, as in all research, there are limitations which should be acknowledged.

To be eligible for inclusion, studies were required to quantify performance in both training and competition environments to evaluate representativeness, therefore, excluding studies which only quantified performance during training or competition. Given the body of evidence which exists investigating training or competition demands in isolation within different sports[114] (e.g., football,[84] rugby league,[115,116] Australian rules football,[117] volleyball,[118] tennis[119]) and populations (e.g., youth[120] and senior,[121] female[122] and male,[114] competitive standard[101,123]), a critical understanding of the findings within this evidence-base may be useful in lieu of the limited research studies explicitly comparing training and competition demands. Further, whilst no explicit language restrictions were applied to eligibility criteria, only English search terms were included in the search strategy. Therefore, this may have limited the identification of studies written in other languages, and consequentially there may be a language bias within the study,[124] particularly given all included studies were written in English. Additionally, as part of our data extraction process, we did not contact authors if data was not distinguishable from the article itself and only utilised available data. This may have precluded some information relevant to the review. However, this approach was used to ensure transparency, reproducibility and consistency across studies. Another limitation of this review was that over half of the included studies were identified through manual reference searching, indicating that the initial search terms (e.g., 'representative learning' OR 'ecological dynamics') did not capture all eligible studies and may have skewed the evidence base toward studies published after the emergence of and in the location where RLD was first coined. Future research exploring representativeness of training activities should consider strategic inclusion of key words to aid inclusion in literature searches, whilst review articles should aim to identify alternative keywords which may be used within such research and further refine their search terms to avoid unintentional bias toward studies examining RLD, compared to solely representativeness. Lastly, this review has discussed the heterogeneity of included studies (i.e., participants, data collection methods) and the potential implications. Researchers and practitioners should be cautious in their interpretation of data and findings presented, whilst future research requires clearer reporting of methods adopted (e.g., number of training observations, inclusion criteria for observations, description of training activities) and greater consistency in the methods adopted (e.g., operational definitions, inclusion criteria for observations) to facilitate comparisons between studies.

Conclusion

This review provides an evidence-informed basis to support the systematic planning, delivery and evaluation of representative coaching practice. Across the research, three key findings emerged. Firstly, methodological inconsistencies were prevalent across all studies. Operational definitions, sampling frequencies, and reliability assessments were frequently omitted, and activities labelled similarly (e.g., SSGs or match simulations) varied in format, duration and the measured outcomes. Both of which limited cross-study comparisons. Comprehensive reporting of data collection procedures and reliability checking is essential to improve methodological clarity and interpretability. Ensuring methodological homogeneity would directly benefit coaches and strengthen the knowledge base from which they draw upon. This would enable coaches to make more informed, evidence-based decisions when designing and reflecting on training sessions.

Secondly, there was a concentrated evidence base, with most studies analysing male participants competing at national level or higher and focusing on team sports. Whilst this makes up a large demographic, the outcomes may not be representative of other populations such as youth or female athletes. Furthermore, there was a focus towards technical and physical variables with training activities restricted mostly to SSGs and match simulation (most of which failed to reflect competition). Expanding the evidence-base to include more diverse groups and training modalities can improve specificity to practical environments. This would further allow coaches to integrate context-relevant training activities into their practice, leading to elevated action fidelity and effectiveness of prescribed coaching interventions. It should also be noted that RLD by design makes it difficult to generalise and so further research to provide a greater understanding of how RLD is determined, measured, discussed and maintained would also be highly valuable to the field.

Third, whilst planning and reflection are crucial in effective coaching, many training activities (particularly match simulations) failed to replicate the physical, technical and tactical demands of competition. This pronounced mismatch demands coaches to design each session plan with representativeness at the forefront of session design and to reflect critically on whether real-game benchmarks are being met. To better support coaching practice, future research must improve reporting standards, expand athlete sampling and clarify how specific constraints shape representativeness. Closing this gap will enhance skill transfer, promote effective decision-making and, ultimately, prepare athletes and teams to perform at the highest of standards within competition.

Finally, from a coach education perspective, these findings underscore the importance of developing coaches' capacity to critically engage with research and training design principles. Rather than merely relying on teaching activity structures such as small-sided games or match simulations, coach education programmes should prepare coaches to evaluate the rigour of existing research that they may read

to inform their practice. Equally, there should be a focus on the representativeness of training activities in relation to competitive demands. Integrating representative learning design principles within formal coach education and continuing professional development may promote more intentional planning, delivery, and reflection of practice. Put simply; by including research literacy and critical decision-making skills, coach education can better support the translation of evidence into effective, context-specific coaching practice.

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All data are presented within the manuscript.

Declaration of AI use

The authors report generative AI was not used in their research or preparation of this manuscript.

Supplemental material

Supplemental material for this article is available online.

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