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Top-Seed Title Conversion, Draw Structure and Semifinal Load in Olympic and World Championship Badminton, 1992–2025

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Abstract

World rankings determine seeding at badminton's major championships, but a seed summarises pre-tournament standing rather than the probability of winning a title. Seed-to-title conversion has been estimated for single Olympic Games in judo and wrestling, but a documented literature search found no comparable analysis of badminton's major championships. This retrospective census compiled seeds and available knockout results for all 44 Olympic badminton events from 1992 to 2024 and all 65 World Championship events from 2009 to 2025. The primary comparison was top-seed title conversion in the rally-scoring era. The top seed won 10 of 25 Olympic titles from 2008 to 2024 (40%; 95% Wilson CI 23% to 59%) and 22 of 65 World Championship titles (34%; 24% to 46%), a difference of 6.2 percentage points (95% CI −14.4 to 28.0; Fisher p = 0.63). Olympic champions came from the top two seeds more often (68% vs 43%; adjusted odds ratio 2.93, 95% CI 1.09 to 7.84), although none of the six event-level contrasts was below 0.05 after Holm adjustment. Among knockout matches from 2008 to 2025 between sides in different recoded seed levels, the better-seeded side won 231 of 314 quarterfinals and semifinals (74%) but 47 of 84 finals (56%; 45% to 66%); in a model clustered by event, its odds of winning a final were less than half those in a quarterfinal (odds ratio 0.45, 0.25 to 0.80). Chinese sides won more often against non-Chinese opponents than the broad seed measure accounted for (odds ratio 1.72, 1.29 to 2.28), but nationality could not identify a mechanism. In rally-scoring finals, the finalist with the lighter semifinal won 21 of the 39 in which semifinal game counts differed (54%; 39% to 68%), an imprecise estimate that neither demonstrates nor excludes a fatigue effect. A conditional model of the Rio 2016 men's singles draw showed that a top-two seed increased the modelled probability of gold relative to a third or fourth seed by 8 to 23 percentage points across the evaluated range and could not reduce it. These results are historical base rates for title conversion, not personalised forecasts or causal estimates of national-system, fatigue or ranking-strategy effects. The dataset, source register, literature-search log and analysis code accompany the manuscript.

Keywords: Badminton; World Ranking, Seeding; Olympic Games, Knockout Tournaments, Tournament Design, Performance Analysis, Base Rates

Introduction

Rankings are among the most widely used performance indicators in individual sport. They determine qualification, seeding and prize structures, and athletes, coaches, media and funding bodies routinely read them as statements of who is best. A ranking is, however, a summary of past results constructed under particular rules, and its meaning depends on what it is used to describe. Performance indicators should be related to the structure of the sport and interpreted at the level their measurements support (Hughes & Bartlett, 2002; O'Donoghue, 2010). Describing a player's standing, explaining why a championship was won and predicting a future title are different analytical aims that require different designs and validation (Shmueli, 2010). The distinction matters particularly for championship titles. A title is not a single match but the product of a draw, a sequence of opponents, a compressed schedule and a small number of decisive contests, each with its own uncertainty. The variability of elite performers between competitions is often comparable to the margins that separate medallists (Hopkins et al., 1999; Malcata & Hopkins, 2014). A player can therefore be the most consistent performer across a season without being more likely than not to win any given championship.

These general principles take a specific form in elite badminton. The Badminton World Federation (BWF) World Ranking accumulates points over the preceding 52 weeks and, for players or pairs with more than 10 eligible tournaments, counts the 10 highest point totals; points increase with tournament grade and progress through the draw, and the ranking is used for seeding and for qualification to the World Championships and Olympic Games (Badminton World Federation [BWF], 2018). It is therefore an accumulative points system, designed to reward sustained success across a calendar, rather than an adjustive rating designed to estimate current playing strength (Stefani, 2011). A player who competes selectively may rank below their championship-specific strength, whereas one who competes consistently may rank above it. The two major championships then use this measure in different formats. World Championship draws are large knockout brackets, typically with 16 seeds. Olympic fields are smaller and constrained by national quotas; since 2012, Olympic events have opened with a group stage, from which only singles group winners and the top two doubles pairs in each group progress (BWF, 2016a; Olympedia, n.d.), and Olympic doubles events seeded only four pairs throughout 2008–2024 (Olympedia, n.d.). The seed is consequently a comparatively standardised, publicly fixed measure of pre-tournament standing. It is not a direct measure of a player's probability of winning a particular match.

Research on rankings as forecasts has concentrated on individual matches rather than championship titles. In professional tennis, differences in official ranking are strong predictors of match outcomes, and rank-based forecasts are difficult to improve upon substantially (Del Corral & Prieto-Rodríguez, 2010; Klaassen & Magnus, 2003). Models that weight past results differently, such as Bradley–Terry-type and Elo-type ratings, can nonetheless outperform the official ranking (McHale & Morton, 2011). A comparison of 11 published tennis forecasting methods found that even the most accurate misclassified more than a quarter of matches, and that accuracy was 10 to 20 percentage points lower for matches involving lower-ranked players (Kovalchik, 2016). In Grand Slam tennis from 2006 to 2019, the higher-seeded player won 79% of men's and 75% of women's matches involving at least one seed (Stefani, 2020), and seeded players outperformed unseeded players on a range of match statistics (Cui et al., 2020). Seedings themselves have been evaluated as forecasts in collegiate basketball and

professional tennis (Boulier & Stekler, 1999), and comparisons across sports show that the predictive accuracy and formal properties of ranking methods vary with both the sport and the method (Barrow et al., 2013; Vaziri et al., 2018). The frequency with which the weaker side wins also differs systematically between sports (Ben-Naim et al., 2006). These studies establish that rankings carry substantial information about single contests while leaving considerable uncertainty in each. They do not directly address how that match-level information accumulates into the probability of winning a seeded championship.

A smaller body of work has taken the title rather than the match as the outcome. Official tennis ratings have been converted into match probabilities and then into each player's simulated chance of winning a major from a known draw (Clarke & Dyte, 2000). Among 92 men's Grand Slam tournaments from 1990 to 2012, most titles were won by players entering in the top 10, but players in the upper part of the top 10 did not win significantly more titles than those in the lower part (Prieto-Bermejo & Gómez-Ruano, 2016), and agent-based modelling of men's professional tennis suggests that chance accounts for much of tournament success when leading players are closely matched (Zappalà et al., 2023). A recent systematic review of tennis nonetheless called for further research on ranking and seeding systems and competitive success (Crespo et al., 2025). The closest analogues to the present question come from Olympic combat sports. In judo, the top-ranked seed was estimated to have a 20% to 37% probability of becoming Olympic champion at London 2012 and Rio 2016 (Guilheiro & Franchini, 2017), and seeded athletes had more than five times the odds of winning an Olympic medal at Paris 2024 (Kons et al., 2025); in wrestling, first seeds at Rio 2016 had an estimated 62% to 81% probability of gold, depending on style (Doğan et al., 2019). These studies take the championship as the outcome, but each covers one or two Games in a single sport, none compares the Olympic tournament with a world championship that seeds from the same ranking, and none concerns badminton.

Tournament-design research supplies the structural link between match-level advantage and title outcomes. Seeding is intended to keep the strongest competitors apart until the late rounds, and the probability that the strongest entrant wins depends on how the draw is constructed (Horen & Riezman, 1985). Analytical, statistical and simulation studies have compared alternative seeding schemes and contest formats (Glickman, 2008; Scarf et al., 2009; Schwenk, 2000), including how reliably different formats select the strongest competitor (Ryvkin & Ortmann, 2008). Others have shown that seedings can be chosen to optimise different objectives, such as competitive intensity or the quality of late-round matches (Dagaev & Suzdaltsev, 2018; Groh et al., 2012), and have documented how rules can create incentives for strategic underperformance (Csató, 2021; Kendall & Lenten, 2017). Simulation has been used to evaluate seeding reforms in European club football (Dagaev & Rudyak, 2019) and the advantage conferred by a seed in professional judo (Brunel, 2022). Empirical studies have related the Grand Slam seeding system to match uncertainty (Del Corral, 2009) and, using a regression-discontinuity design in European club football, found no evidence that being seeded, as distinct from being strong, improved teams' tournament success (Engist et al., 2021). Olympic badminton provides a well-known example of the incentive problem: at London 2012, four women's doubles pairs, including the top seeds, were disqualified after attempting to lose group matches to obtain a more favourable knockout draw (Kendall & Lenten, 2017). A corollary of this work is that, once draw rules are fixed, the possible pathways for each seed can be enumerated in advance. Whether a

different seed position would have improved a particular player's prospects is therefore a question that can be answered conditionally from the rules rather than settled by intuition. What this literature seldom supplies is the empirical counterpart: how often, under the draw rules actually used, the top seed of a given championship has converted that position into the title.

Badminton-specific research has advanced understanding mainly at the level of the rally, the game and the match. Elite badminton is intermittent and physically demanding, with repeated high-intensity actions separated by short rest intervals (Cabello Manrique & González-Badillo, 2003; Phomsoupha & Laffaye, 2015). Temporal and notational studies have compared men's and women's play (Abián-Vicén et al., 2013; Gómez et al., 2019), documented changes in Olympic men's singles finals across editions (Laffaye et al., 2015), and related scoring dynamics to match outcome at the World Championships (Barreira et al., 2016; Wang, 2022). Outcome prediction in badminton has relied on within-match technical and tactical data to predict points or games (Sheng et al., 2025; Yuan et al., 2024) rather than on pre-tournament standing, and work on the BWF ranking has examined how tournament scheduling relates to ranking points (Hsu et al., 2025) rather than how ranking positions convert into titles. At Rio 2016, knockout matches were longer and more demanding than group matches (Chiminazzo et al., 2018; Torres-Luque et al., 2019). Rally-level analyses indicate that the rally following a long rally tends to be shorter and less demanding, with increased errors only in specific match contexts (Gómez et al., 2020), and playing two matches in one day increased a blood marker of muscle damage and reduced hip range of motion in elite junior players, although measured hip strength was maintained (Moreno-Pérez et al., 2020). Whether such effects carry over from a semifinal to a final played the next day is less clear. In international football, differences in rest days had little effect on results under modern tournament schedules except when recovery time was short (Scoppa, 2015). Small differences in readiness can matter at the decisive moment (Mujika & Padilla, 2003), but between-match fatigue cannot be inferred from a single striking final.

Other research distinguishes contextual influences that should not be collapsed into one generic explanation of championship performance. National sport-policy frameworks identify structural factors associated with international success, including funding, talent development, coaching and competition opportunities (De Bosscher et al., 2006). China's elite-sport system has historically placed substantial emphasis on Olympic performance (Hong et al., 2005), and Chinese players have won many of badminton's major titles during the period examined here. Pressure-related performance decrements have been studied experimentally and in professional tennis (Baumeister, 1984; Cohen-Zada et al., 2017; Hill et al., 2010), and host-nation advantage has been modelled across Olympic events (Balmer et al., 2003). None of these findings establishes the presence, direction or size of such an effect in badminton's major finals. Estimating them would require measures of preparation, psychological state, scheduling or crowd that published results do not contain. The present analysis therefore treats nationality as a descriptive indicator rather than as a measure of the effect of a national system.

Taken together, existing studies have examined how well rankings predict individual matches, how seeding and format affect tournament outcomes in theory and simulation, how often seeds convert their position into medals at single Olympic Games in combat sports, and how

badminton rallies and matches unfold physically and temporally. A documented literature search, with novelty criteria fixed before screening (Section 2.2; Appendix Table A2), identified no study that has estimated how often the BWF top seed converts that position into a major title across the Olympic or World Championship record, whether conversion differs between the two competitions, at which knockout stage better-seeded sides lose, or whether two popular explanations of high-profile championship defeats, semifinal load and seed position, are supported across the competition record. It therefore remains unknown whether a number-one seed should be expected to win a major title more often than not, whether the Olympic Games are less or more predictable than the World Championships, and how much of a favourite's advantage survives to the final. The present study addresses this gap at the level of the championship event and the knockout match rather than the rally or the individual player. Table 1 summarises the closest prior research in each relevant stream and the specific advance made here.

Table 1
Closest prior research and the advance made by the present study

Research stream and representative studies	**Unit of analysis and main evidence**	**What remains open**	**Advance in the present study**
Rankings as match-level forecasts: Klaassen & Magnus (2003); Del Corral & Prieto-Rodríguez (2010); McHale & Morton (2011); Kovalchik (2016); Stefani (2020)	Individual matches, mainly tennis. Rankings predict well, yet the best methods misclassify over a quarter of matches; higher seeds win about three-quarters of Grand Slam matches involving a seed.	Whether match-level advantage translates into titles at a seeded championship.	Reports title conversion and round-by-round favourite success for the same 90 modern events.
Rankings, seeds and titles in tennis: Boulier & Stekler (1999); Clarke & Dyte (2000); Prieto-Bermejo & Gómez-Ruano (2016); Zappalà et al. (2023); Crespo et al. (2025)	Seedings as forecasts; title probabilities simulated from ratings; Grand Slam winners by entry ranking; models of chance; a review calling for more research on ranking and seeding.	Base rates in a sport with smaller draws, quota-limited Olympic fields and doubles events; comparison between championships.	A census of every Olympic (1992–2024) and modern World Championship (2009–2025) badminton event, in singles and doubles.
Seeds and Olympic medals in combat sports: Guilheiro & Franchini (2017); Doğan et al. (2019); Kons et al. (2025)	One or two Games per study in judo or wrestling. Estimated probability that the top seed became champion: 20% to 37% in judo and 62% to 81% in wrestling; seeded judoka had more than five times the odds of a medal.	Multi-edition records; comparison with a world championship that seeds from the same ranking; badminton.	The complete Olympic record plus the World Championships, compared directly with uncertainty intervals and multiplicity adjustment.

Research stream and representative studies	Unit of analysis and main evidence	What remains open	Advance in the present study
Tournament-design theory and simulation: Horen & Riezman (1985); Schwenk (2000); Ryvkin & Ortmann (2008); Glickman (2008); Scarf et al. (2009); Groh et al. (2012); Dagaev & Suzdaltsev (2018); Dagaev & Rudyak (2019); Brunel (2022)	Analytical results and simulations of hypothetical or reformed draws; how reliably formats select the strongest competitor; size of the seed advantage.	Empirical performance of the draw rules actually used; resolution of specific, publicly disputed counterfactuals.	Empirical base rates under real draw rules, and exact enumeration of the Rio 2016 pathways with a closed-form gain.
Empirical effects of seeding rules: Del Corral (2009); Cui et al. (2020); Engist et al. (2021)	Match uncertainty and match statistics in Grand Slam tennis; a regression-discontinuity design finding no detectable benefit of being seeded in European club football.	Title conversion as the outcome; Olympic group-then-knockout formats.	Title-level outcomes under the Olympic group-then-knockout and World Championship knockout formats.
Badminton performance and ranking research: Laffaye et al. (2015); Chiminazzo et al. (2018); Torres-Luque et al. (2019); Yuan et al. (2024); Hsu et al. (2025); Sheng et al. (2025); BWF (2021)	Rallies, games and single editions; within-match prediction of points or games; scheduling and ranking points; a narrative of top-seeded Olympic champions without denominators.	Event-level conversion of seeding into titles across editions; late-round favourite success; semifinal load and the final.	The first multi-edition estimates of seed-to-title conversion, round-by-round favourite success and semifinal load in badminton's major championships.

Note. Studies are grouped by the question they address. The judo and wrestling percentages are published single-Games estimates from different designs and are not directly comparable with the census estimates here. The search is described in Section 2.2 and Appendix Table A2.

Addressing this gap requires clarity about what different patterns could, and could not, indicate. Four possible accounts motivate the analysis, although the available variables cannot adjudicate their mechanisms. A cumulative-uncertainty account would expect title conversion to be considerably lower than match-level advantage, because a title requires successive wins and the strength gap between opponents narrows in later rounds. An Olympic-specific account would expect conversion at the Games to differ from the World Championships, either because a four-yearly event is more volatile or because smaller, quota-limited fields concentrate titles among the strongest seeds. A load account would expect the finalist with the more demanding semifinal to lose the final more often. A draw-position account would expect that a lower seed could sometimes yield an easier pathway to the title. Several of these accounts imply overlapping observable patterns: a narrowing advantage in finals, for example, is compatible with closer opponents, greater pressure or chance variation. These accounts are therefore interpretive possibilities rather than separately identified causal models. The analysis tests their observable implications while retaining the distinction between outcome patterns and their possible causes.

The study was prompted by a single career. Lee Chong Wei of Malaysia was ranked first in the world for 348 weeks, including 199 consecutive weeks from 21 August 2008 to 14 June 2012 (Badminton Association of Malaysia, 2019). He reached three consecutive Olympic men's singles finals and won silver each time, losing to Lin Dan in 2008 and 2012 and to Chen Long in 2016; he was also beaten on court in four World Championship finals, one of which was later disqualified (BWF, 2015). Public discussion of his Rio 2016 campaign in Malaysia has included a specific counterfactual: that he should have managed his ranking below the top position so that the two Chinese players would be drawn together and eliminate one another (Haleem, 2026). A second argument concerns sequencing. Lee beat Lin Dan in a three-game semifinal lasting 83 minutes, whereas Chen Long beat Viktor Axelsen in two games, and the final followed the next day (BWF, 2016b); in a 2024 interview, Lee recalled having been completely exhausted, with less than 24 hours to recover (BadmintonPlanet, 2024). A single career, however, cannot show whether such outcomes are typical, Olympic-specific or exceptional. The present analysis therefore moves from the motivating case to the census of 109 Olympic and World Championship events, and it advances beyond prior research in three specific ways (Table 1). Relative to sports-ranking research, it changes the outcome against which a ranking is evaluated from the single match to the championship title and reports both for the same events, so that the gap between match-level advantage and title conversion is measured rather than inferred. Relative to tournament-design research, it supplies empirical base rates under the draw rules actually used, compares two championships that seed from the same ranking under different formats, and evaluates a disputed seed-position counterfactual by exact enumeration of the pathways the rules permit rather than by simulation of hypothetical draws. Relative to the Olympic seed-to-medal studies in other sports, it covers a sport's complete Olympic record and its modern World Championships rather than one or two Games, and it reports each estimate with its uncertainty, a multiplicity-adjusted family of event-level comparisons, sensitivity analyses, a documented source register and an explicitly conditional draw model. The motivating career is retained in the census rather than excluded, and the analysis is retrospective rather than prospectively registered.

Building on this rationale, four questions organise the study. First, how often do top seeds win Olympic titles, and does the rate differ from the World Championships? Second, at which knockout stage do better-seeded sides lose, and do players from the most successful national programme, China, win more often than the broad seed measure accounts for? Third, is the load of a finalist's semifinal associated with the result of the final? Fourth, under the Olympic draw rules in force at Rio 2016, could a lower seed have improved Lee Chong Wei's modelled path to gold? The intended contribution is an auditable set of historical base rates and a transparent conditional model. It is not a prediction model for individual players, an estimate of the causal effect of national systems or fatigue, or a prescription for competition scheduling. Within the limits of the search described in Section 2.2, this is the first study to quantify top-seed title conversion across the complete Olympic badminton record and the modern World Championships, and the first to evaluate a seed-position counterfactual for an Olympic badminton draw formally. Comparable seed-to-title estimates exist for single Games in judo and wrestling, and the present estimates are interpreted alongside them. The study's broader contribution to the social sciences is to show how a widely used rank-based indicator can be evaluated against the outcomes it is assumed to anticipate, while keeping description distinct from causal and predictive claims, a principle that may apply equally to rankings used

in education, employment and other competitive selection settings. For coaches, performance analysts and national federations, the study supplies benchmarks for interpreting a seed, a silver medal or a late-round defeat against realistic championship uncertainty.

Methods

Design, sample and analysis status

The study was a retrospective observational analysis of publicly available results for the complete Olympic badminton programme from Barcelona 1992 to Paris 2024 and for the World Championships from 2009 to 2025. The Olympic sample comprised 44 events: four in 1992 and five, including mixed doubles, from 1996. The World Championships are not held in Olympic years and were not held in 2020, giving 13 editions (2009, 2010, 2011, 2013, 2014, 2015, 2017, 2018, 2019, 2021, 2022, 2023 and 2025) and 65 events. Tokyo is labelled 2020 to match the Olympic edition, although the competition took place in 2021. The primary comparison was between the Olympic Games of 2008–2024 (25 events) and the World Championships of 2009–2025 (65 events). Both periods followed the change to 21-point rally scoring in 2006, and seeding in both was based on the BWF World Ranking. The Olympic Games of 1992–2004 (19 events), played under the earlier 15-point service scoring, were analysed descriptively and were not pooled with the modern era in inferential comparisons.

The analytical unit differed by research question: the event for title conversion, the knockout match for favourite success, the final for semifinal load, and a single draw for the conditional model. Matches within an event were not treated as independent observations of title conversion. Top-seed title conversion at the Olympic Games versus the World Championships (the first research question) was designated the primary comparison because it addresses the study's central question, whether a top ranking converts into a major title. The designation was made retrospectively, without a registered protocol, and the primary estimate is the risk difference with its confidence interval and Fisher's exact test; the adjusted odds ratio is supporting. The remaining event-level contrasts, the match-level and nationality models, the semifinal-load analyses, the conditional draw model and all sensitivity analyses are secondary and are treated as exploratory. No analysis protocol was prospectively registered. The reporting distinguishes the analytical population, the available measurements and the exploratory analyses, consistent with the transparency aims of observational-reporting guidance (von Elm et al., 2007); this is not a claim that an epidemiological checklist certifies the study's quality.

Literature search and criteria for novelty

Because the study's contribution rests partly on a claim of novelty, that claim was tested against explicit criteria rather than asserted. Before screening, a prior study was defined as anticipating the primary analysis if it met all three of the following criteria: (C1) it reported, at the level of the championship event, how often the top seed, or seeds in a stated position, won the title; (C2) the competition was the Olympic badminton tournament or the BWF World Championships; and (C3) it covered more than one edition of that competition, so that conversion was estimated across a competition record rather than for a single tournament. Studies meeting C1 in another sport were classed as the closest analogues, and badminton studies meeting C2 but not C1 or C3 were classed as related research. Two further criteria applied to the secondary analyses: (C4) whether any study had compared the better-seeded

side's success across the knockout rounds of badminton's major championships or had related semifinal load to the result of the final, and (C5) whether any study had formally evaluated a seed-position counterfactual under Olympic badminton draw rules.

The search was run on 18 October 2026 in OpenAlex, an open index of scholarly works that incorporates Crossref and PubMed records among other sources (Priem et al., 2022). Its title-and-abstract field was searched without date, language or document-type limits using four final strings: (A) badminton AND (seed OR ranking OR Elo OR upset); (B) badminton AND (Olympic OR championship) AND (seed OR medal OR champion); (C) seed AND (Olympic OR tennis OR judo) AND (champion OR medal); and (D) (seed OR ranking) AND tennis AND (title OR winner OR tournament). OpenAlex stems search terms, so that 'seed' also retrieves 'seeded' and 'seeding'. Every record retrieved by strings A to C was screened. For string D, which addressed the much larger tennis literature, and for a broader scoping string used to refine the others, badminton AND (Olympic OR "World Championships"), the first 100 records ranked by relevance were screened. String C was constructed to retrieve the Olympic seed-to-medal studies identified in preliminary scoping, and it retrieved all of them, which served as a check on its sensitivity. Supplementary targeted searches with a general web search engine combined seeding, ranking, title and medal terms with the names of badminton and of other Olympic individual and racket sports, including the BWF's own Olympic news pages.

Records were screened on title, and abstracts or full texts were consulted, where accessible, for records retained for further assessment. Screening was conducted by a single reviewer. The 456 screened records included 40 duplicates, leaving 416 unique records (Appendix Table A2). Of these, 394 were excluded because they did not concern competition outcomes, seeding or rankings (n = 244), addressed ranking construction or ranking trajectories without title outcomes (n = 45), analysed or predicted outcomes at the level of the match, game or rally (n = 70), described a single championship edition or national medal totals (n = 14), or examined tournament design or competitive balance without an empirical badminton title-conversion estimate (n = 21). Twenty-two records were assessed further. Eleven were badminton records that, from their titles, described single Olympic or World Championship editions, national medal performance or match-level data; eleven were analogues from other sports. No record met criteria C1 to C3, and none met C4 or C5. The nine analogues whose abstract or full text could be checked are summarised in Table 1, together with nine further studies identified by supplementary searching. A BWF retrospective of top seeds who won Olympic gold named individual champions but did not report how many top seeds there were or how many converted their seed into a title (BWF, 2021).

The search was designed to test a specific claim rather than to map the literature systematically. It used one open bibliographic index rather than subscription databases, screened only the highest-ranked records for the two broadest strings, and used English-language search terms, so studies published only in Chinese, Korean, Japanese, Indonesian or Malay, in which much badminton performance analysis appears, may have been missed. The novelty statements in this article are bounded by this search. The search strings, the search date and the record-level screening decisions are included in the reproducibility package so that the search can be checked and extended.

Data compilation, provenance and checks

For each event, the following were compiled: the seed list, with each seed's nation and final round reached; available knockout matches from the quarterfinals onwards (quarterfinals, semifinals, final and, at the Olympic Games, the bronze-medal match), with both sides' seeds and nations, the game scores and the winner; and the medallists. The source set comprised official BWF results, draw and news pages where accessible; Olympedia results and match pages (Olympedia, n.d.); and English-, German- and Indonesian-language Wikipedia event pages, used as compilation aids where official or Olympedia records were incomplete (Wikipedia contributors, 2026a, 2026b). Where one source was incomplete, missing items were taken from the other listed sources, from World Championship records on players' pages and from contemporaneous news-agency results. The source used for each item is recorded in the dataset, together with the basis for every choice between conflicting sources (Appendix Table A1). The compilation is not represented as an official BWF results file.

Every event record was checked for internal consistency: the finalists had to be the semifinal winners, the gold medallist had to be the winner of the final, the winner of each match had to have won more games, and each seed's recorded final round had to agree with the matches. All 109 event records passed these checks. Where sources disagreed, the choice and its basis were recorded; for example, three 2008 Olympic quarterfinal scores differed between Wikipedia and the BWF results pages, and the BWF record was not adopted where it showed a zero match time or reversed games. Some items remained unavailable. Quarterfinal records were missing for the World Championships of 2009–2011, 2018 and 2021 and for some events in 2013–2015 and 2019. Semifinal records were missing for the 2019 World Championship mixed doubles; semifinal scores were missing for 11 other semifinals, including the 2024 Olympic women's and mixed doubles; and the nations of some non-medal seeds were unavailable. These gaps are not assumed to be random with respect to outcome. Internal consistency establishes agreement within the compiled record; it does not establish agreement with an official record for every field. The proportion of fields independently re-verified against an official BWF or Olympic results document was not quantified, and no independent human double-entry audit is asserted.

Primary measures and their interpretation

Seeds were used as the measure of pre-tournament standing because seeding follows the BWF World Ranking at a published cut-off date. To make Olympic and World Championship events comparable, seeds were recoded into four levels: seed 1, seed 2, seeds 3–4, and seed 5 or lower or unseeded. This recoding follows from the fact that Olympic doubles events seeded only four pairs, against 8 to 16 seeds in Olympic singles and typically 16 in World Championship events. The recoding necessarily sacrifices within-band information: seeds 5 and 16 fall in the same category, as do an unseeded qualifier and a fifth seed. Event-level outcomes were whether the top seed won the title, reached the final or reached the semifinal; the recoded seed level of the champion; and whether the top two seeds contested the final. Top-seed title conversion was defined as the proportion of events won by the top seed, retaining events in which that seed withdrew or was disqualified; those events were removed in a sensitivity analysis.

A seed is interpreted here as an ordinal summary of ranking points accumulated before the event, not as a calibrated probability of winning a match or a title. It reflects the number and

grade of tournaments played as well as their results, and it is fixed weeks before competition begins. Differences in conversion between competitions may therefore reflect field composition, format, quotas or chance, in addition to any difference in the information carried by the seed. Neither the historical conversion rate nor the champion's seed distribution was treated as a necessary or sufficient condition for winning, or as an estimate of any individual player's probability of gold.

Match-level measures, nationality and semifinal load

For each knockout match, the favourite was the side in the better recoded seed level. Matches between two sides in the same level, which were mainly matches between two sides seeded fifth or lower, were excluded, as were walkovers. The favourite-win outcome therefore represents broad seeding advantage rather than exact seed-distance effects. To examine whether players from China, the most successful badminton nation in the sample, won more often than the recoded seed measure alone would suggest, each match between a Chinese and a non-Chinese side was identified from the recorded nations. This indicator describes an association with nationality. It does not measure preparation, scheduling, selection depth or any other characteristic of a national system.

Semifinal load was measured for each finalist as the number of games played in its semifinal and the total points played in it, with both sides' points summed. Match duration was not consistently available and was therefore not used as a load measure. Only the rally-scoring era was used for the main load analysis, because points played under the earlier service-scoring system are not comparable. Retired and walkover semifinals were excluded. Games and points are crude proxies for physiological and psychological strain: they do not capture rally intensity, the interval between semifinal and final, emotional significance or recovery practices (Phomsoupha & Laffaye, 2015). A null association on these measures would therefore not establish that semifinal demands are irrelevant to the final.

Statistical analysis and uncertainty

Proportions are reported with Wilson 95% confidence intervals, which have better coverage than the conventional Wald interval in small samples and near the boundaries (Brown et al., 2001; Wilson, 1927). Differences between Olympic and World Championship proportions in the modern era are reported as risk differences with Newcombe hybrid-score 95% intervals (Newcombe, 1998) and were compared with two-sided Fisher's exact tests. Logistic regression additionally adjusted two event-level comparisons, top-seed title conversion and a top-two-seed champion, for discipline (singles or doubles) and year. Seven event-level outcomes were compared. Because 'champion seeded 1–4' and 'champion seeded 5 or lower, or unseeded' are complements, these comprised six distinct tests, and a Holm adjustment (Holm, 1979) was applied across those six. The primary comparison is reported both unadjusted and within that family.

Match-level outcomes were modelled with logistic generalised estimating equations (GEE) clustered by event (Liang & Zeger, 1986). The favourite-win model included competition, round, discipline and whether both sides were top-four seeds. For the nationality analysis, each match was entered twice, once from each side's perspective, without an intercept; the model estimated the association of a seed advantage, coded +1, 0 or −1, and of being the Chinese side against a non-Chinese opponent, with standard errors clustered by match. A

second model added an interaction testing whether the Chinese association differed at the Olympic Games. Final-round and bronze-medal proportions for the better-seeded side were also compared with 50% using two-sided exact binomial tests. For semifinal load, the proportion of finals won by the finalist with the lighter semifinal was compared with 50% in the same way, and the semifinal points played by champions and runners-up were compared with a Wilcoxon test. A symmetric GEE model, with each final entered once from each finalist's perspective and standard errors clustered by final, then estimated the association of the difference in semifinal points or games with winning, controlling for seed advantage.

Analyses used Python with SciPy (Virtanen et al., 2020) and statsmodels (Seabold & Perktold, 2010). Given the modest number of events, effect sizes and confidence intervals are emphasised, and nominal p values are treated as graded evidence rather than binary decisions (Hopkins et al., 2009; Wasserstein & Lazar, 2016). No equivalence bound or smallest practically important difference was specified, so a non-significant result is not interpreted as evidence of no meaningful difference (Altman & Bland, 1995; Lakens, 2017). Olympic and World Championship estimates are compared directly rather than by contrasting a significant result in one competition with a non-significant result in the other (Gelman & Stern, 2006). The historical proportions are descriptive quantities for the enumerated record; inferential intervals concern hypothetical repetition beyond that record and depend on the stated assumptions.

Conditional draw model for Rio 2016

At Rio 2016, the men's singles seeds were Lee Chong Wei (1), Chen Long (2), Lin Dan (3) and Viktor Axelsen (4), with 13 seeds in total. The first and second seeds were placed at the heads of groups at opposite ends of the draw, and the third and fourth seeds were drawn by lot to group positions in opposite halves (BWF, 2016a). Two scenarios were compared. In scenario A, Lee is seeded first or second and Chen occupies the other top-two position, as happened; Lin is then drawn into Lee's half or Chen's half with equal probability. In scenario B, Lee is seeded third or fourth, so that Chen and Lin, as seeds 1 and 2, are placed at opposite ends and Lee is drawn into one of their halves. Let p_C and p_L be Lee's probabilities of beating Chen and Lin, respectively, and q the probability that Chen beats Lin. Assuming that all three players reach their projected meetings, Lee's probability of gold is

Scenario A: $P_A = ½\, p_L\, p_C + ½\, [q\, p_C + (1 − q)\, p_L]$

Scenario B: $P_B = p_C\, p_L$

so that the gain from a top-two seed is $P_A − P_B = ½\, [q\, p_C\, (1 − p_L) + (1 − q)\, p_L\, (1 − p_C)]$, which cannot be negative. The gain was evaluated over the range 0.2 to 0.8 for p_C and p_L, with q set to 0.5 and 0.7.

The model is deliberately restricted. It conditions on the three leading players reaching their projected meetings, treats the match probabilities as fixed and independent of the path, and ignores the other seeds and the group stage. It therefore identifies the direction and approximate size of the seed-position effect within that conditional scenario. It does not estimate Lee's unconditional probability of gold, and it does not incorporate fatigue, tactical match-ups or the possibility that another player would eliminate one of the three.

Sensitivity analyses and computational reproducibility

Sensitivity analyses repeated the event-level comparison after excluding events in which the top seed withdrew or was disqualified, and split the results by discipline and by period (2008–2013, 2014–2019 and 2020–2025, with Tokyo 2020, held in 2021, in the final period). The match-level analysis was repeated separately for singles and doubles and with retirements excluded. The semifinal-load analysis was repeated for finals between two top-four seeds, where differences in seeding were smallest. An illustrative calculation applied the fitted match models to Lee Chong Wei's seven on-court finals, with and without the disqualified 2014 result. These calculations describe how improbable his record was under the fitted models; they are not tests of a hypothesis about an individual player.

The reproducibility package separates the compiled event and match records, the source register, the record of conflicts resolved and the derived variables. The analysis script reproduces the reported estimates from the compiled data, and input files, software versions and numerical outputs are recorded, following reproducible-computation principles (Sandve et al., 2013). A data dictionary identifies the meaning and provenance of each field, supporting the reuse aims of the FAIR principles without claiming formal FAIR certification (Wilkinson et al., 2016). The provenance statement deliberately retains the secondary sources used rather than presenting the compilation as an all-official record.

Results

Top-seed title conversion: the primary comparison

The top seed won 10 of 25 Olympic titles in 2008–2024 (40%; 95% CI 23% to 59%) and 22 of 65 World Championship titles in 2009–2025 (34%; 24% to 46%; Table 2). The risk difference was 6.2 percentage points (95% CI −14.4 to 28.0; Fisher p = 0.63; Holm-adjusted p = 0.66). In the earlier Olympic period, the figure was 8 of 19 (42%; 23% to 64%). In both competitions and in both Olympic periods, the top seed was therefore more likely to lose than to win, although the upper confidence limits for both Olympic periods exceeded 50%. Conversion was similar in singles (4 of 10 Olympic and 7 of 26 World Championship events) and doubles (6 of 15 and 15 of 39). After adjustment for discipline and year, the odds of the top seed winning did not differ clearly between competitions (odds ratio [OR] 1.40, 95% CI 0.52 to 3.73; Table 3). This interval is wide enough to include a substantially higher or lower Olympic conversion rate, so the result does not establish that the two competitions are equivalent.

Table 2

Event-level outcomes for top seeds and champions, by competition

Outcome	OG 1992–2004 (19 events)	OG 2008–2024 (25 events)	WC 2009–2025 (65 events)	OG 2008–2024 minus WC, pp (95% CI)	Fisher p	Holm p
Top seed won the title (primary)	8/19 (42) 23–64	10/25 (40) 23–59	22/65 (34) 24–46	6.2 (−14.4 to 28.0)	0.63	0.66
Top seed reached the final	11/19 (58) 36–77	17/25 (68) 48–83	33/65 (51) 39–63	17.2 (−5.6 to 36.2)	0.16	0.49
Top seed reached the semifinal	12/19 (63) 41–81	18/25 (72) 52–86	38/65 (58) 46–70	13.5 (−9.0 to 31.8)	0.33	0.66

Outcome	OG 1992–2004 (19 events)	OG 2008–2024 (25 events)	WC 2009–2025 (65 events)	OG 2008–2024 minus WC, pp (95% CI)	Fisher p	Holm p
Champion was seed 1 or 2	12/19 (63) 41–81	17/25 (68) 48–83	28/65 (43) 32–55	24.9 (1.9 to 43.6)	0.059	0.29
Champion was seed 1–4	14/19 (74) 51–88	21/25 (84) 65–94	39/65 (60) 48–71	24.0 (2.3 to 39.5)	0.045	0.27
Champion seeded 5 or lower, or unseeded	5/19 (26) 12–49	4/25 (16) 6–35	26/65 (40) 29–52	−24.0 (−39.5 to −2.3)	0.045	n/a
Top two seeds contested the final	8/19 (42) 23–64	8/25 (32) 17–52	10/65 (15) 9–26	16.6 (−1.6 to 37.4)	0.087	0.35
Top seed withdrew or was disqualified	0/19 (0)	1/25 (4)	3/65 (5)	—	—	—
Top seed won: singles	2/8 (25)	4/10 (40)	7/26 (27)	—	—	—
Top seed won: doubles	6/11 (55)	6/15 (40)	15/39 (38)	—	—	—
Champion from China	8/19 (42)	14/25 (56)	33/65 (51)	—	—	—

Note. Values are n/N (%), with the Wilson 95% confidence interval (%) beneath in the first seven rows. OG = Olympic Games; WC = World Championships. The difference is in percentage points (pp), with a Newcombe hybrid-score 95% interval. p values are from two-sided Fisher's exact tests. The Holm adjustment covers the six distinct event-level tests; the seed-5-or-lower row is the complement of the seed 1–4 row and is not a separate test (n/a). The first row is the designated primary comparison; all other rows are secondary. Seeds were recoded into four levels (1, 2, 3–4, and 5 or lower or unseeded) because Olympic doubles seeded only four pairs. Withdrawals: 2012 Olympic women's doubles (top seeds disqualified) and three World Championship events.

Wilson intervals, risk differences and Holm-adjusted values are recalculated from the tabulated counts. Odds ratios adjusted for discipline and year for the first and fourth outcomes are reported in Table 3.

Top-seed conversion increased descriptively over time. Pooling both competitions, the top seed won 8 of 30 titles in 2008–2013 (27%; 14% to 44%), 10 of 30 in 2014–2019 (33%; 19% to 51%) and 14 of 30 in 2020–2025 (47%; 30% to 64%); the adjusted per-four-year OR was 1.42 (1.00 to 2.01). Excluding events in which the top seed withdrew or was disqualified changed the conversion rates only slightly, to 10 of 24 Olympic (42%) and 22 of 62 World Championship titles (35%). The top seed withdrew or was disqualified in one Olympic event, the 2012 women's doubles, and in three World Championship events. These are retrospective summaries of the enumerated record, not forecasts for a future edition

Table 3
Models of title conversion, favourite success and the Chinese association

Term	Odds ratio (95% CI)	p	Model
A. Event level (90 events, 2008–2025)			
Top seed won the title: Olympic Games (vs World Championships)	1.40 (0.52–3.73)	0.51	Logistic regression
Top seed won the title: singles (vs doubles)	0.68 (0.27–1.70)	0.41	
Top seed won the title: per four years	1.42 (1.00–2.01)	0.049	
Champion was seed 1 or 2: Olympic Games (vs World Championships)	2.93 (1.09–7.84)	0.033	Logistic regression
Champion was seed 1 or 2: singles (vs doubles)	1.22 (0.51–2.91)	0.66	
Champion was seed 1 or 2: per four years	1.17 (0.84–1.64)	0.34	
B. Match level: better recoded-seed side won (398 matches, 88 events)			
Olympic Games (vs World Championships)	1.23 (0.80–1.90)	0.35	GEE clustered by event
Semifinal (vs quarterfinal)	0.96 (0.57–1.62)	0.88	
Final (vs quarterfinal)	0.45 (0.25–0.80)	0.007	
Singles (vs doubles)	0.91 (0.61–1.34)	0.62	
Both sides top-four seeds	1.05 (0.61–1.81)	0.86	
C. Match level: side won (515 matches, 2008–2025)			
Seed advantage (better vs equal seed level)	2.02 (1.63–2.50)	< 0.001	Symmetric GEE clustered by match
Chinese side against a non-Chinese side	1.72 (1.29–2.28)	< 0.001	
Chinese association × Olympic Games	1.09 (0.60–1.98)	0.77	Added in a second model

Note. Panel A: 25 Olympic and 65 World Championship events; the intercept is omitted. Panel B: quarterfinals, semifinals and finals of the same events with a favourite defined by the recoded seed; matches between sides of equal seed level and walkovers are excluded. Panel C: every knockout match entered twice, once from each side's perspective, without an intercept; seed advantage is coded +1, 0 or −1. GEE = generalised estimating equations. Nominal p values are shown. The Panel A Olympic term for title conversion supports the primary comparison reported in Table 2; all other terms are secondary and exploratory.

Concentration of titles among the highest seeds

Although top-seed conversion did not differ clearly between competitions, Olympic titles were more concentrated among the highest-seeded players (Figure 1). The Olympic champion was one of the top two seeds in 17 of 25 events (68%; 48% to 83%), against 28 of 65 at the

World Championships (43%; 32% to 55%), a risk difference of 24.9 percentage points (1.9 to 43.6; Fisher p = 0.059; adjusted OR 2.93, 1.09 to 7.84). The champion was one of the top four seeds in 84% and 60% of events, respectively (risk difference 24.0 percentage points, 2.3 to 39.5; p = 0.045), so titles for players seeded fifth or lower, or unseeded, were correspondingly rarer at the Games (16% against 40%). Both top-two seeds contested the final in 32% of Olympic and 15% of World Championship events (p = 0.087), and the top seed reached the final in 68% and 51%, respectively (p = 0.16). Much of the Olympic concentration came from second seeds, who won 7 of 25 Olympic titles (28%) but 6 of 65 World Championship titles (9%).

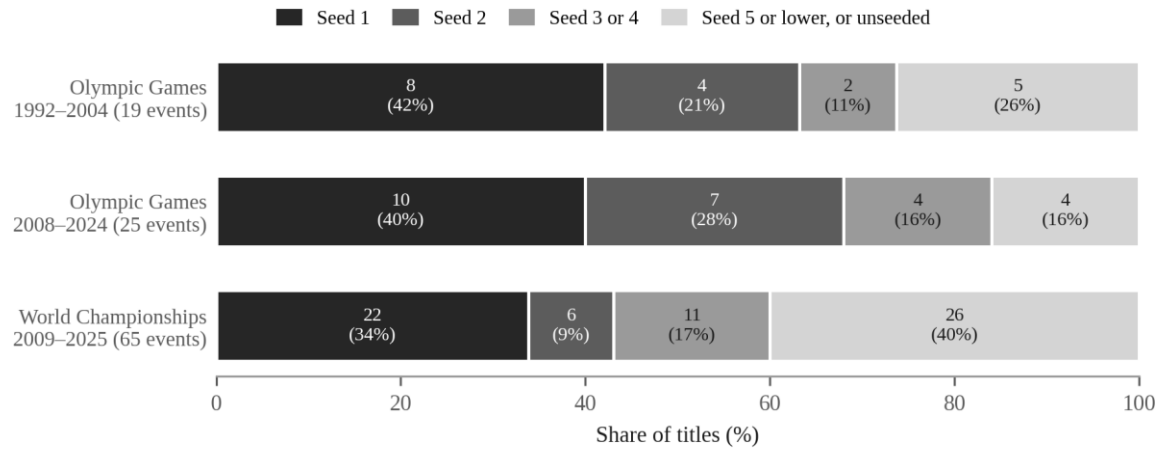


Figure 1 Seed of the champion in Olympic and World Championship badminton events

Note. Counts and percentages of events. Seeds are recoded into four levels (1, 2, 3–4, and 5 or lower or unseeded) because Olympic doubles seeded only four pairs. The Olympic Games of 1992–2004 used 15-point service scoring and are shown descriptively. The figure describes the enumerated record and does not adjust for discipline or year.

The Newcombe interval for the top-two contrast excludes zero whereas the Fisher test does not reach 0.05, a discrepancy that reflects the conservatism of the exact conditional test; neither result should be treated as decisive. These secondary contrasts were consistent in direction but individually imprecise. After Holm adjustment across the six distinct event-level tests, no contrast remained below 0.05; the smallest adjusted p values were 0.27 for a top-four champion and 0.29 for a top-two champion (Table 2). The adjusted logistic estimate for a top-two champion (p = 0.033) would likewise not remain below 0.05 under the same correction. The concentration of Olympic titles among the highest seeds is therefore a descriptive pattern supported by the direction and size of several related estimates rather than a multiplicity-robust finding. It also cannot distinguish an effect of format from the influence of smaller, quota-limited fields or of the particular players who contested these Games.

Where better-seeded sides lose

Among matches in which the two sides occupied different recoded seed levels, the better-seeded side won 74% of quarterfinals at both the Olympic Games (59 of 80) and the World Championships (69 of 93), and 78% (35 of 45) and 71% (68 of 96) of semifinals (Figure 2). In finals, its advantage narrowed to 64% (16 of 25; 95% CI 45% to 80%) at the Olympic Games and 53% (31 of 59; 40% to 65%) at the World Championships. In the GEE model, the odds of

the better-seeded side winning a final were less than half those in a quarterfinal (OR 0.45, 0.25 to 0.80), whereas semifinals did not differ clearly from quarterfinals (OR 0.96, 0.57 to 1.62; Table 3). The better-seeded side did not fare clearly better at the Olympic Games once round was controlled for (OR 1.23, 0.80 to 1.90), and singles did not differ clearly from doubles (OR 0.91, 0.61 to 1.34).

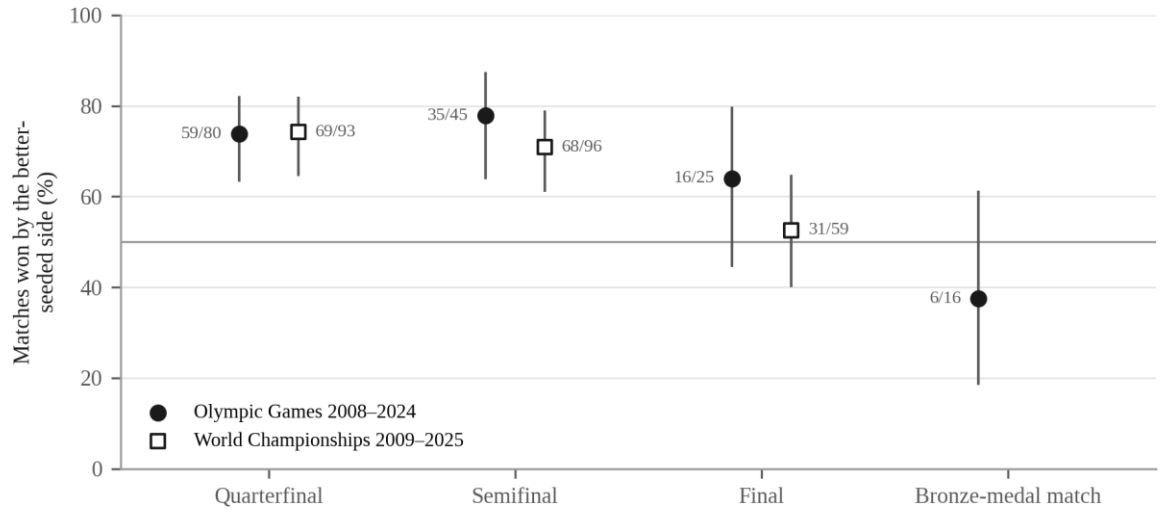


Figure 2 Matches won by the better-seeded side, by round and competition, 2008–2025

Note. Points are proportions with Wilson 95% confidence intervals; labels give wins/matches. “Better seeded” is defined by the four recoded seed levels (1, 2, 3–4, and 5 or lower or unseeded). Matches between sides in the same recoded level and walkovers are excluded. The World Championships have no bronze-medal match. Finalists are selected by winning earlier rounds, so the narrowing in finals describes late-round composition rather than an independent effect of the final.

Pooling the two competitions, better-seeded sides won 231 of 314 quarterfinals and semifinals (74%; 68% to 78%) but 47 of 84 finals (56%; 45% to 66%), a final-round proportion that did not differ clearly from an even contest (binomial $p = 0.33$). The pattern held in both disciplines: better-seeded sides won 6 of 10 Olympic and 11 of 24 World Championship singles finals, and 10 of 15 and 20 of 35 doubles finals. Excluding the one final decided by retirement did not change these figures materially. In the Olympic bronze-medal match, the better-seeded of the two losing semifinalists won 6 of 16 matches (38%; 18% to 61%). Because finalists are selected by winning earlier rounds, the narrowing advantage in finals describes the composition of late-round contests and should not be read as an independent effect of the final itself.

Chinese sides relative to recoded seeding

Chinese sides won more often than the recoded seed measure alone accounted for. In 515 knockout matches from 2008 onwards, being in the better recoded seed level was associated with higher odds of winning (OR 2.02, 1.63 to 2.50). Independently of that broad seed advantage, being the Chinese side against a non-Chinese opponent was associated with further increased odds (OR 1.72, 1.29 to 2.28; $p < 0.001$; Table 3). The association was similar at the Olympic Games and the World Championships (interaction OR 1.09, 0.60 to 1.98). Descriptively, Chinese sides won 78% of their matches against non-Chinese opponents when

better seeded and 44% when worse seeded; in matches not between a Chinese and a non-Chinese side, the worse-seeded side won 34%. China won 14 of the 25 modern Olympic titles and 33 of the 65 World Championship titles, and in 8 and 18 of these, respectively, the Chinese champion was not the top seed. Because the seed measure is coarse, this association may partly reflect within-band strength differences, the repeated presence of a small number of exceptional players or national selection depth, as well as any championship-specific preparation.

Semifinal load and the final

No clear association was detected between semifinal load and the result of the final (Table 4). Both semifinal scores were available for 78 rally-scoring finals, 22 Olympic and 56 World Championship. In 39 of them, the two finalists had played a different number of games in their semifinals, and the finalist with the shorter semifinal won 21 (54%; 95% CI 39% to 68%; binomial p = 0.75). Measured by points, the finalist with the lighter semifinal won 40 of 76 finals (53%; 42% to 63%; p = 0.73). The median semifinal comprised 74 points for champions and 75 for runners-up (Wilcoxon p = 0.56). With seed advantage controlled, each additional 10 points of semifinal load relative to the opponent was associated with an OR of 0.95 (0.81 to 1.11) for winning the final, and each additional semifinal game with an OR of 0.86 (0.46 to 1.62). The result was similar in finals between two top-four seeds, where the finalist with fewer semifinal games won 10 of 19. Under the earlier service-scoring system, the finalist with fewer semifinal games won 7 of 8 finals (p = 0.07), a sample too small to support a conclusion.

Table 4
Semifinal load and the result of the final

Measure	Result
Rally-scoring finals with both semifinal scores	78 (Olympic Games 22; World Championships 56)
Finals in which the finalists' semifinals differed in games	39
Won by the finalist with fewer semifinal games	21 (54%; 95% CI 39–68; binomial p = 0.75); Olympic Games 7/9, World Championships 14/30
Finals in which semifinal points differed	76
Won by the finalist with fewer semifinal points	40 (53%; 95% CI 42–63; binomial p = 0.73); Olympic Games 13/21, World Championships 27/55
Semifinal points played, median (IQR): champions / runners-up	74 (70–104) / 75 (69–110); Wilcoxon p = 0.56
Finals between two top-four seeds: won by the finalist with fewer semifinal games	10/19
GEE: seed advantage, OR (95% CI)	1.13 (0.71–1.80)
GEE: semifinal points difference, per 10 points, OR (95% CI)	0.95 (0.81–1.11); p = 0.50
GEE: semifinal games difference, per game, OR (95% CI)	0.86 (0.46–1.62); p = 0.65

Measure	Result
Service-scoring era (Olympic Games 1992–2004): finals with unequal semifinal games; won by the lighter	8; 7 (binomial p = 0.07)

Note. Semifinal load is the number of games and the total points (both sides) played in each finalist's semifinal. Retired and walkover semifinals are excluded. Proportions use Wilson 95% intervals and two-sided exact binomial tests against 50%; semifinal points were compared with a Wilcoxon test. The GEE model enters each final twice, once from each finalist's perspective, with standard errors clustered by final. Games and points are proxies for load; match duration, rally intensity and the interval before the final were not available. OR = odds ratio.

These intervals are compatible with no association and with moderate associations in either direction. The upper limit of the game-based interval, 68%, would correspond to a material advantage for the less-loaded finalist, whereas the lower limit, 39%, would correspond to a disadvantage. The analysis therefore does not support a general claim that a heavier semifinal determines the final, but it also does not establish that semifinal load is unimportant. The Olympic subgroup, in which the lighter-semifinal finalist won 7 of 9 finals decided after unequal game counts, is too small to be interpreted separately.

The Lee Chong Wei record and the conditional Rio 2016 draw model

Table 5 sets Lee's major-championship record against these base rates. He was the top seed at two Olympic Games and five World Championships, and the second seed at one Olympic Games and two World Championships. He appeared in seven Olympic and World Championship finals and was beaten on court in each, four times by Lin Dan and three times by Chen Long; his 2014 World Championship result was subsequently disqualified following an anti-doping rule violation (BWF, 2015). Measured by games, his semifinal was the heavier of the two before three of his on-court final defeats (the 2008 and 2016 Olympic Games and the 2013 World Championships), the lighter before one (2011) and equal before three. The load pattern therefore does not distinguish his defeats. Lee was the better-seeded side in five of the finals and the worse-seeded side in two. Under the seed-only match model, the probability of losing all seven would be 0.14%, with 4.1 wins expected; allowing for the observed Chinese association, the corresponding figures were 1.2% and 3.2 wins. Excluding the disqualified 2014 result, the probabilities of losing every final were 0.46% and 2.7%, respectively. His record was improbable under either fitted model, but less so once the association between Chinese opponents and winning was included.

Table 5
Lee Chong Wei's Olympic and World Championship men's singles record, 2004–2018

Championship	Seed	Result	Decisive opponent (seed) and score from Lee's side	Semifinal load: Lee / final opponent (games, points)
Olympic Games 2004	Unseeded	Lost in second round	Chen Hong (2)	—
Olympic Games 2008	2	Silver	Lin Dan (1): 12–21, 8–21	3, 107 / 2, 72
Olympic Games 2012	1	Silver	Lin Dan (2): 21–15, 10–21, 19–21	2, 69 / 2, 64
Olympic Games 2016	1	Silver	Chen Long (2): 18–21, 18–21	3, 110 (83 min) / 2, 71
World Championships 2009	1	Quarterfinal	—	—
World Championships 2010	1	Quarterfinal	—	—
World Championships 2011	1	Silver	Lin Dan (2): 22–20, 14–21, 21–23	2, 64 / 3, 110
World Championships 2013	1	Silver	Lin Dan (unseeded): 21–16, 13–21, 17–20 retired	3, 111 / 2, 74
World Championships 2014	1	Final lost on court; result later disqualified	Chen Long (2): 19–21, 19–21	2, 58 / 2, 79
World Championships 2015	Unseeded	Silver	Chen Long (1): 14–21, 17–21	2, 68 / 2, 66
World Championships 2017	2	Lost opening match	Brice Leverdez (unseeded)	—
World Championships 2018	2	Withdrew	—	—

Note. Scores are shown from Lee's side. The 2016 semifinal duration is from BWF (2016b); durations were not compiled for other matches. Lee's 2014 World Championship result was disqualified following an anti-doping rule violation (BWF, 2015). Lee did not compete at the 2019 World Championships and retired in June 2019. Quarterfinal opponents for 2009 and 2010 are omitted because World Championship quarterfinal records for those editions were not compiled (Section 2.3).

The conditional draw model shows that a lower seed would not have helped Lee at Rio if Lee, Chen and Lin all reached their projected meetings (Figure 3). Under the rules in force, Chen and Lin could be in the same half only if Lee was one of the top two seeds and Lin was then drawn into Chen's half. As a third or fourth seed, Lee would have been certain to need to beat both players, one in the semifinal and the other in the final, under that conditional scenario. As a top-two seed, he faced this double task with a probability of one-half, and whether he was first or second made no difference. With evenly matched players ($p_C = p_L = q = 0.5$), his conditional modelled probability of gold was 37.5% as a top-two seed and 25.0% as a third or fourth seed. Across the evaluated parameter range, the top-two position was worth between 8 and 23 percentage points, and the gain was positive throughout. The unfavourable Rio path, a semifinal against Lin followed by a final against Chen, was the outcome of the random allocation of the third seed's half, not a consequence of Lee holding the number-one ranking. This conclusion is conditional on the model's assumptions and does not imply that Lee's real-world probability of gold was 37.5%.

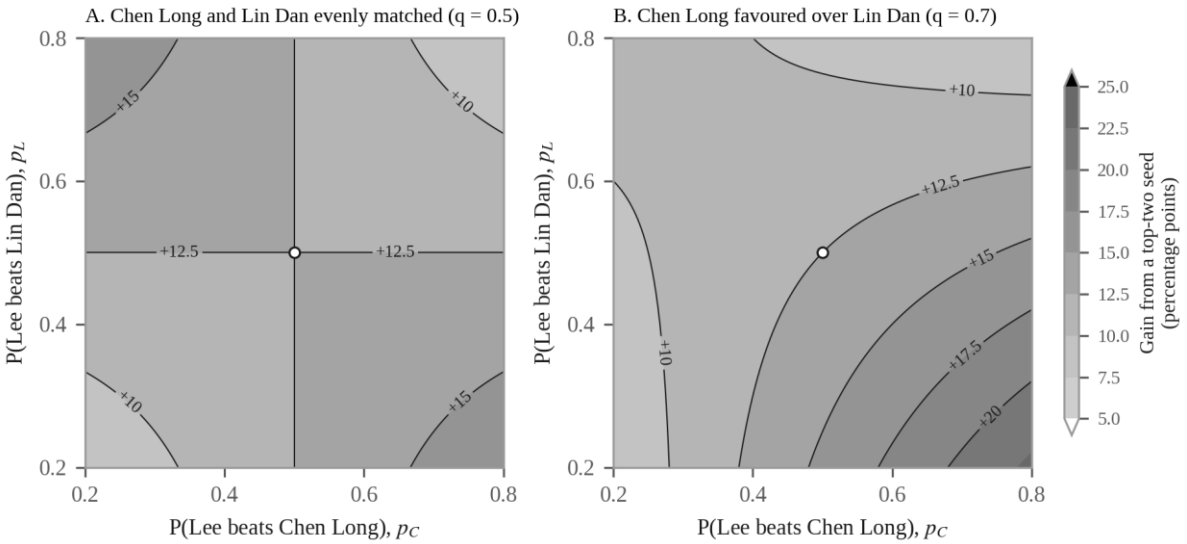


Figure 3 Conditional modelled gain in Lee Chong Wei's probability of gold at Rio 2016 from a top-two seed rather than seed 3 or 4

Note. Conditional on Lee Chong Wei, Chen Long and Lin Dan reaching their projected meetings, the gain is $\frac{1}{2}[q\,p_C(1 - p_L) + (1 - q)p_L(1 - p_C)]$ (Section 2.7), where p_C and p_L are Lee's probabilities of beating Chen and Lin and q is the probability that Chen beats Lin. The white point marks evenly matched players ($p_C = p_L = 0.5$), where the conditional gain is 12.5 percentage points. The model does not estimate Lee's unconditional probability of gold.

Discussion

A strong indicator, not a probability above one-half

The study found that a top badminton seed was a strong indicator of championship strength but did not convert into a title in most major events. This is a more specific conclusion than either saying that rankings are unreliable or that a number-one ranking should deliver gold. Across 109 Olympic and World Championship events, the top seed won roughly a third to two-fifths of titles, while better-seeded sides won about three-quarters of quarterfinals and

semifinals. The two observations are compatible. Winning a title requires successive victories, so even a strong match-level advantage compounds into a much lower probability of winning the whole event. As a descriptive illustration, multiplying the observed Olympic better-seeded win rates in the quarterfinal (0.74), semifinal (0.78) and final (0.64) gives approximately 0.37, close to the observed 40% Olympic top-seed conversion. This calculation is not an individual-player probability model, because opponents differ across rounds and the rates are pooled across seed levels, but it illustrates why a ranking can be highly informative without making the title more likely than not. At match level, the 74% of quarterfinals and semifinals won by better-seeded sides is broadly similar to the 75% to 79% of Grand Slam tennis matches involving a seed that the higher seed won from 2006 to 2019, although the tennis figure includes early rounds against unseeded players (Stefani, 2020).

The pattern is consistent with forecasting research in tennis, where ranking differences are strong predictors of individual matches while substantial uncertainty remains in each contest (Del Corral & Prieto-Rodríguez, 2010; Klaassen & Magnus, 2003; Kovalchik, 2016), and with tournament-design work showing that the strongest entrant's title probability depends on the draw as well as on match-level superiority (Horen & Riezman, 1985; Scarf et al., 2009). The narrowing advantage in finals is an expected consequence of seeding: by the final, the remaining players are usually among the strongest in the field, and their ranking difference may be small relative to normal variability in elite performance (Malcata & Hopkins, 2014). Pressure in finals may add further uncertainty (Baumeister, 1984; Hill et al., 2010), although psychological state was not measured. The Olympic bronze-medal result, in which the better-seeded semifinal loser won only 6 of 16 matches, could be compatible with motivational effects after a semifinal defeat, but the sample is small and no such mechanism can be inferred. Because the BWF ranking is an accumulative points system rather than an adjustive strength rating (Stefani, 2011), some of the remaining uncertainty may reflect the ranking's construction rather than the inherent unpredictability of championship matches; the present design cannot apportion uncertainty between those sources. A practical implication is that title-conversion rates and finals records should be reported alongside rankings when championship programmes are evaluated, rather than treating the ranking alone as the outcome of interest (Hughes & Bartlett, 2002).

Olympic concentration without Olympic-specific conversion

The expectation that the Olympic Games are uniquely unpredictable was not supported. Top-seed conversion did not differ clearly between the Olympic Games and the World Championships, whereas Olympic champions came from the top two seeds more often and Olympic finals were more often contested by the top two seeds. These secondary contrasts were consistent in direction, but none survived adjustment for the six event-level comparisons and their intervals were wide. The evidence therefore supports reporting distinct estimates and their uncertainty rather than concluding that the two competitions operate according to demonstrably different mechanisms (Gelman & Stern, 2006). Several structural features could contribute to the observed concentration. Olympic fields are smaller and restricted by national quotas, which removes some of the depth present at the World Championships, and the group stage used since 2012 provides a different early-round pathway (BWF, 2016a; Olympedia, n.d.). At Rio 2016, knockout matches were also longer and more demanding than group matches (Chiminazzo et al., 2018; Torres-Luque et al., 2019), suggesting that the format alters the physical as well as the competitive pathway. The

emphasis that leading nations place on the Games is another plausible explanation (De Bosscher et al., 2006; Hong et al., 2005), but it was not measured here. At match level, the better-seeded side's advantage at the Games did not differ clearly from that at the World Championships once round was controlled for (OR 1.23, 0.80 to 1.90). The main empirical contrast is therefore the concentration of finalists and champions among the highest seeds, not a general claim that all Olympic matches are more predictable.

The Chinese association: description, not mechanism

Chinese sides had higher odds of winning than the broad seeding measure accounted for, and the size of this association (OR 1.72) approached that of being in the better seed level (OR 2.02). The two players who beat Lee in his seven on-court finals, Lin Dan and Chen Long, won eight Olympic and World Championship men's singles titles between them during the period studied. This association should not be read as evidence that the Chinese system caused championship overperformance through selective scheduling, peaking or any other policy. It may also reflect the repeated presence of exceptional champions, national selection depth under per-nation quotas, within-band strength differences obscured by the recoded seed, or other unmeasured characteristics. Repeated appearances by the same players also introduce dependence that clustering by match does not fully address. Championship-specific preparation remains one plausible interpretation, consistent with national sport-policy frameworks (De Bosscher et al., 2006), but it was not tested. The broader point is that season-long ranking and championship-specific performance are related but not identical constructs, and a nationality indicator can describe the gap between them without explaining it.

Semifinal load: absence of evidence is not evidence of absence

The lack of a clear association between semifinal load and the final result is an important qualification of the Rio narrative, but it should not be overstated. Lee's 83-minute semifinal against a long-standing rival may well have affected his final, and he later described having been exhausted (BadmintonPlanet, 2024). Across 78 rally-scoring finals, however, the finalist with the lighter semifinal did not win clearly more often. The intervals were wide, and games and points played are imperfect proxies for physiological and emotional strain (Phomsoupha & Laffaye, 2015). Rally-level and field studies show that demanding play can produce short-term changes in subsequent rallies and in markers of muscle damage (Gómez et al., 2020; Moreno-Pérez et al., 2020). Evidence from international football suggests that differences in rest matter mainly when recovery time is short (Scoppa, 2015); the interval between a badminton semifinal and final is shorter still, but the football evidence cannot be transferred numerically to an individual racket sport. The present data therefore do not establish that semifinal load determines final outcomes; any effect was not clearly detectable with the measures and sample available (Altman & Bland, 1995). Direct measures of match duration, rally density, heart rate or perceived exertion, linked to the timing of the final, would be required to estimate such an effect. A single striking case cannot establish a general mechanism, although recovery planning remains a reasonable preparation for the specific scenario of a long, emotionally charged semifinal.

Ranking management, draw rules and the Rio counterfactual

The draw analysis gives a clear answer to the Malaysian counterfactual within its assumptions. Under the Olympic rules, the only configuration in which Lee could avoid having to beat both Chinese players was that in which he was a top-two seed and Lin was drawn into Chen's half.

Dropping to third or fourth seed would have guaranteed that Chen and Lin occupied opposite ends of the draw, so that Lee would have needed to beat both if all three leading players reached their projected meetings. Being first rather than second made no difference. Across the modelled parameter range, the top-two position was never worse and produced a conditional advantage of 8 to 23 percentage points; algebraically, the gain is non-negative under the model as specified. Lee's semifinal against Lin was therefore the result of the random allocation of the third seed's half, not of holding the number-one ranking. Deliberate underperformance to manipulate a seed would, in any case, breach the obligation to compete genuinely, as the London 2012 disqualifications showed (Kendall & Lenten, 2017). The legitimate form of ranking management is scheduling: balancing seed protection against travel, fatigue, match practice and preparation, a trade-off that has been examined in badminton through the timing and number of tournaments entered (Hsu et al., 2025). More generally, the analysis illustrates how tournament-design reasoning can resolve a public strategic argument by enumerating the pathways that the rules permit (Csató, 2021; Dagaev & Suzdaltsev, 2018).

Practical interpretation for national programmes

The historical rates provide context for planning rather than targets. At the modern Olympic Games, the top seed won 40% of titles and a top-two seed won 68%; these are event-level base rates, not personalised probabilities for a particular athlete. Communicating that distinction in advance can help programmes, media and funders evaluate a silver medal or a late-round defeat against realistic championship uncertainty rather than against ranking position alone. Because a top-two seed carried a structural advantage in the conditional draw model, and Olympic titles were concentrated among the highest seeds, obtaining and protecting a high seed remains a reasonable objective. The present data do not, however, identify an optimal competition schedule or show that fewer ranking events cause better major-championship performance. Once a protected seed is reasonably secure, the marginal value of additional events can be weighed against match practice, tactical learning, travel, recovery and preparation rather than judged solely by ranking points.

The Olympic draw rules also make the probabilities of semifinal pairings calculable in advance. For a top-two seed, each of the two possible third- and fourth-seed opponents is equally likely, so tactical preparation, recovery protocols and communication plans can be rehearsed for each pathway, including consecutive matches against two different elite opponents. Because finals were much closer contests than earlier knockout rounds, final-specific preparation may deserve particular attention, while recognising that recovery alone should not be expected to determine many results. For mid-sized badminton nations such as Malaysia, whose Olympic badminton record includes six silver medals and no gold medal (Olympedia, n.d.), the base rates suggest that developing several genuine high-seeded contenders across the five events creates more championship opportunities than relying on one leading player in one event. This study did not model nation-level gold probabilities directly, and the descriptive increase in top-seed conversion across periods is suggestive rather than definitive.

Contribution relative to sports-ranking and tournament-design research

Set against the prior research summarised in Table 1, the study adds three things. First, it supplies multi-edition title-conversion base rates for a sport in which none had been

estimated. The modern Olympic top-seed conversion rate of 40% is slightly above the 20% to 37% estimated for top-ranked judo seeds at London 2012 and Rio 2016 (Guilheiro & Franchini, 2017) and well below the 62% to 81% estimated for first seeds in Rio 2016 wrestling (Doğan et al., 2019). These estimates come from different designs, seeding depths and numbers of Games, so the comparison is descriptive, but it is consistent with evidence that the predictability of contests differs systematically between sports (Ben-Naim et al., 2006), and it places badminton between judo and wrestling in how often the top seed converts that position into Olympic gold.

Second, the study evaluates a ranking against two outcomes in the same events, the match and the title. Better-seeded sides won about three-quarters of quarterfinals and semifinals, yet the top seed won fewer than half of titles, and the narrowing of the favourite's advantage in finals was measured directly. This links the match-level forecasting literature (Kovalchik, 2016; Stefani, 2020) to the title-level questions posed by tournament design (Ryvkin & Ortmann, 2008) with observed rather than simulated outcomes, and it complements rating-based simulation of title chances (Clarke & Dyte, 2000). Third, the Rio analysis shows how the tournament-design approach of enumerating the pathways that draw rules permit (Groh et al., 2012; Horen & Riezman, 1985) can settle a specific public argument about ranking strategy, complementing simulation-based evaluations of seeding regimes (Brunel, 2022; Dagaev & Rudyak, 2019). The study does not estimate the causal effect of being seeded on title chances, which Engist et al. (2021) approached with a regression-discontinuity design at the seeding cut-off in European club football. Such a design would have little power in a record of 109 events with as few as four seeds per Olympic doubles draw, so the estimates reported here should be read as base rates under the seeding that occurred rather than as effects of seeding itself.

Limitations

The analysis covers the complete Olympic badminton record and the modern World Championships, but the modern-era comparison rests on 25 Olympic and 65 World Championship events, and several intervals are wide. It is also a historically specific basis for generalisation: one national programme won 14 of the 25 modern Olympic titles and 33 of the 65 World Championship titles. Repeated players, partnerships and national systems create dependence across events and editions beyond the event- and match-level clustering used here. The census of these periods removes sampling incompleteness within that frame, not uncertainty about future championships or other competition levels. The study is retrospective, the motivating case was known in advance, and no prospectively registered protocol was available. Apart from the primary comparison, all analyses are exploratory, and confidence intervals and nominal p values should be read as assumption-dependent summaries rather than certification of a stable sporting regularity. The novelty assessment is likewise bounded by the literature search described in Section 2.2, which used one open bibliographic index and targeted web searches, screened only the highest-ranked records for the two broadest strings, was conducted by a single reviewer and used English-language terms; relevant analyses published in other languages or indexed elsewhere may have been missed.

Independent source verification remains partial. The data were compiled from several public sources because official results were not fully accessible in machine-readable form, and

Wikipedia event pages were used as compilation aids where official or Olympedia records were incomplete. All 109 event records passed internal consistency checks, and conflicts were resolved and documented, but some items rest on a single source, and the proportion of fields re-verified against an official results document was not quantified. Successful consistency checks do not exclude a consistent transcription error. Several quarterfinal records are missing, mainly from World Championships, and these gaps are not assumed to be random with respect to outcome. The statistical intervals are conditional on the compiled record and do not incorporate uncertainty about unaudited source values. A field-level audit against official BWF and Olympic results books would strengthen the evidence base.

Seeds are an imperfect proxy for playing strength. They are fixed at a cut-off date, reflect the number and mix of events played as well as results, and are coarsened here into four levels. The recoding removes within-band differences and may attenuate or distort estimates of seed advantage and of other covariates, including the Chinese association. The semifinal-load measures use games and points rather than duration, rally intensity or physiological data, and the interval between semifinal and final was not modelled. Nationality was used only as a descriptive indicator; the observed Chinese association cannot identify a mechanism and may partly reflect unmeasured player or seed differences. Home advantage, which has been documented across Olympic events (Balmer et al., 2003) and may be relevant to the Beijing 2008 Olympic Games and to World Championships held in China, was not modelled.

The draw model assumes that the three leading players reach their projected meetings and treats their match probabilities as fixed and path-independent. It establishes the direction of the seed-position effect within that conditional scenario, not Lee's unconditional probability of gold. The illustrative calculation for Lee's seven finals depends on the fitted models and is sensitive to the inclusion of the disqualified 2014 result. Future research should use exact seed differences or Elo-type ratings alongside seed bands (Hvattum & Arntzen, 2010; Kovalchik, 2016), incorporate match duration, ball-in-play and recovery-interval data, evaluate predictive performance prospectively on championships not used to develop the models, and extend the analysis to the BWF World Tour Finals and other high-grade events.

Conclusion

A number-one badminton seed was a strong indicator of championship strength from 1992 to 2025, but it converted into a major title in only a minority of events. The top seed won 40% of modern Olympic titles and 34% of World Championship titles, a difference that was imprecisely estimated. Olympic champions were more concentrated among the top two seeds, but this secondary pattern did not survive adjustment for multiple event-level comparisons. Better-seeded sides won about three-quarters of quarterfinals and semifinals, yet their advantage narrowed markedly in finals. Chinese sides won more often than the broad seed measure accounted for, although the design does not identify why. No clear association was detected between semifinal load and the final result, and the intervals did not exclude a meaningful effect. Under the conditional Rio 2016 draw model, a lower seed would have made Lee Chong Wei's projected path no easier and generally harder. His record is therefore better read as an illustration of cumulative tournament uncertainty than as evidence that holding the number-one ranking was strategically harmful. The study's contribution is an auditable set of historical base rates, the first for seed-to-title conversion in badminton's major championships that a documented literature search could identify, set

alongside single-Games estimates from judo and wrestling, together with a transparent conditional model. Claims about national-system effects, fatigue, optimal scheduling or individual prediction require measurements and designs beyond those supplied by the published competition record.

Declarations

Disclosure statement

No potential conflict of interest was reported by the author.

Ethics and data scope

The study used publicly available competition results. It involved no direct participant recruitment, intervention or collection of private personal information. Named athletes are discussed only in relation to their publicly reported competition results and public statements. No institutional ethics-approval or exemption number is asserted in this manuscript.

Data and code availability

The accompanying reproducibility package supplies the compiled seed, match and medallist records for the 109 Olympic and World Championship events, the source used for each item, the record of conflicts resolved and known gaps, a data dictionary, the executable Python analysis script, and the literature-search strings, search date and record-level screening log. The package reproduces the main numerical results reported here. It is a documented compilation from public sources, not an official BWF results file, and its source limitations are retained explicitly.

Relationship to prior work

The Lee Chong Wei case and the Rio 2016 ranking debate are discussed in a book manuscript in preparation (Haleem, 2026). The cross-event dataset, the conditional draw model and the analyses reported here are new and have not been published elsewhere.

Use of generative AI

Generative AI assisted with data compilation, statistical-code preparation and checking, literature retrieval, including the structured search and first-pass screening reported in Section 2.2, and language and structural revision. The author reviewed and verified the data, code, references, declarations and interpretations and takes full responsibility for the final work. The consistency checks described in the Methods do not represent an assertion that a separate human double-entry audit has been completed.

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