

## AUTHOR QUERIES

- AQ1: The following citations do not have the complete reference details: Román-Caballero et al., 2024; Musch and Grondin (2001); Dhuey et al. (2019). Please provide the complete reference or consider deleting the citation or rephrasing the text to remove the citation.
- AQ2: Please provide expansions for PA, PE, MA, EBSCO, and PRISMA.
- AQ3: Please check the sentence 'It is recommended ...' for completeness.
- AQ4: The reference 'Covidence. (2020)' does not have an in-text citation or cross reference within the text. Please provide the location where the cross reference is to be inserted or consider deleting the reference from the reference list.

## 2

# EVIDENCE REVIEW AND ANALYSIS

### 2.1. INTRODUCTION

The previous chapter established that local evidence of the RAE in Scotland is limited from a scientific perspective, particularly concerning extended cohorts. While the Scottish Government's own data revealed concerning patterns in deferral uptake, with substantial demographic inequities by deprivation, rurality, and gender, the direct health and developmental consequences of Scotland's unique school commencement system remain largely unexamined in the peer-reviewed literature. This gap is particularly striking given that Scotland permits deferral based solely on parental choice, a policy position that distinguishes it from most comparable nations and creates cohorts with age spreads of up to 19 months.

The identification of extended cohorts in other jurisdictions, particularly the United States and New South Wales, Australia, provides an important comparative context.

Since the original evidence review was completed in May 2024, a new wave of high-quality research has strengthened the international evidence base on RAE. An SR and meta-analysis by Frisira et al. (2025) synthesised 32 studies and quantified, for the first time at this scale, the pooled relative risk (RR) of ADHD diagnosis and medication associated with relative youth. A large longitudinal UK cohort study (Deng et al., 2024) tracked ADHD symptom trajectories and educational attainment from middle childhood into young adulthood using the Twins' Early Development Study ( $N = 8,508$ ), providing important insights into developmental patterns and ruling out genetic confounding. Population-representative selection studies have also extended the RAE evidence base beyond sport into formal music training (Román-Caballero et al., 2024) and into elite youth basketball in China (Yu & Yang, 2025). These developments are integrated throughout the domain-

specific sections below. In these settings, the practice is commonly referred to as ‘redshirting’, a term that originated in collegiate sports in the United States where athletes would delay participation for a year to gain physical maturity and an additional year of eligibility. The metaphorical extension of this term to kindergarten entry reflects a similar logic: parents delay their child’s school entry in the hope of conferring competitive advantage through relative maturity. However, the mechanisms, prevalence, and policy frameworks surrounding redshirting in these jurisdictions differ substantially from Scotland’s deferral system, complicating direct comparisons and highlighting the need for Scotland-specific research.

Scotland’s position is unusual in international terms. While many education systems permit some flexibility in school starting age, few combine ‘universal’ (August–February born) parental choice with a policy framework that actively encourages consideration of deferral for children born in certain months. The Scottish Government’s guidance explicitly states that parents of children born in January and February ‘may’ defer, while those with children born between September and December in the preceding year ‘can request’ deferral, subject to local authority approval despite the Education Act explicitly stating the deferred start as the legally correct start. This creates a system in which the decision to defer is simultaneously presented as a parental right and a matter requiring official sanction to align with the correct legal starting age, generating confusion and inconsistency in practice across Scotland’s 32 local authorities.

The RAE in Scotland is therefore composed of two principal interacting issues. First, there is the issue of RAE itself; the systematic differences in outcomes between the oldest and youngest members of a standard 12-month cohort. Second, there is the issue of extended cohorts, where the age spread within a single year group exceeds 12 months due to deferral practices. These two issues interact in complex ways. Addressing only the extended cohorts through policy intervention would still leave a residual RAE affecting children for 13 years until the last extended cohort progresses through the school system. Conversely, measures that address only RAE within extended cohorts are unlikely to be sufficient to mitigate the effects of such a large age disparity. As Liu and Li (2016) have argued, even the 12-month age spread in standard cohorts creates effects that may be ‘insurmountable’ for the youngest children; a 19-month spread, as exists in some Scottish classrooms, presents an even more formidable challenge.

This chapter therefore presents a comprehensive SR of the international evidence on RAE and extended cohorts. The review was conducted using rigorous SR methodology, including the PICOS framework for question

formulation, comprehensive database searches, systematic screening and quality assessment, and structured data extraction. The review encompasses evidence across multiple domains: mental health outcomes, learning disabilities and neurodevelopmental diagnoses, physical injury and safety, academic attainment and educational streaming, sports participation and physical activity, and career opportunities and earnings. This chapter also presents findings from direct consultation with leading international researchers in the field, who confirmed critical gaps in the evidence base and expressed concern about the potential harms of extended cohorts.

The structure of this chapter reflects the SR process. Section 2.2 describes the methodology in detail, including the research question, PICOS framework, search strategy, inclusion and exclusion criteria, screening process, quality assessment, and data extraction procedures. Section 2.3 presents the results across the multiple outcome domains, synthesising evidence from SRs, cohort studies, and other high-quality research. Section 2.4 examines the limited but important evidence on extended cohorts specifically. Section 2.5 reports findings from expert consultation. Section 2.6 discusses the implications of the evidence, identifies critical gaps, and examines potential interventions identified in the literature. Section 2.7 provides a summary and transitions to the policy development work of Chapter 3.

The evidence presented in this chapter is sobering. Across multiple domains and multiple countries, relative youth within school cohorts is consistently associated with adverse outcomes. The effects are typically small to moderate in magnitude at the individual level, but given that all children are exposed to age-based cohorting, the population-level impact is substantial. The evidence on extended cohorts, though limited, consistently suggests that extending the age spread within cohorts amplifies rather than mitigates these harms. The absence of Scottish-specific research on the health effects of extended cohorts represents a critical gap that must be addressed urgently, particularly given the scale of deferral in Scotland and the demographic inequities in its uptake.

## 2.2. METHODOLOGY

A methodology of a systematic search of the literature was used to identify evidence to develop and support policy options. A research question was formulated from the local evidence collated in Chapter 1. Appropriate search terms and inclusion and exclusion criteria were then developed. The search terms were then employed in the selected databases before the results were screened against the inclusion and exclusion criteria. The included papers were then assessed for relevance and quality before data were extracted.

2.2.1. Research Question and PICOS Framework

The research question was set as: *Does the school commencement system in Scotland exacerbate the RAE, widen health inequities, and negatively affect health?*

To help test the suitability of the research question and refine search terms, the PICOS framework (Schardt et al., 2007) was used in an adapted format for this mixed clinical/academic/sport setting. This was conducted twice, once for each principal issue (Tables 4 and 5), as it was assessed that different strategies were required to capture both issues. Search terms were predominantly derived from those used to identify local evidence but enhanced by lessons identified from local searches and terms identified through stakeholders.

The following search terms were used: ‘relative age effect’, redshirt\* or defer\*, academ\*, health\*, leader\*, opportunit\*, wellbeing, kindergarten, particip\*, and domin\*. They were combined as shown in Fig. 10.

Despite sport not forming part of the search strategy, there was an overwhelming number of papers returned. Participation in sport and PA is important for health across the lifespan (Lynch, 2019, 2024; Malm et al., 2019), forms part of the curriculum, has potential for a spill-over effect into school settings for aspects such as leadership (Dhuey & Lipscomb, 2008; Kuhn & Weinberger, 2005; Li & Hu, 2022) and self-esteem (Folgar et al., 2017; Thompson et al., 2004), and may contain generalisable solutions from this more studied area. However, the focus of this policy brief is on the school setting, and so policy options will be developed with consideration of PE and school-based sport but not club or elite though lessons may be transferable. Research on the implementation of health and physical education in primary schools highlights that quality PE delivery requires careful attention to developmental readiness and age-appropriate pedagogy (Lynch, 2015). To avoid

**Table 4. PICOS Framework for Extended Cohorts.**

**PICOS for Relative  
Extended Cohorts**

|                  |                                                                                |
|------------------|--------------------------------------------------------------------------------|
| P – Population   | Children and young people of school age                                        |
| I – Intervention | Deferral; cohorting greater than 12-month cohorts (by month, quarter, or half) |
| C – Comparator   | Oldest of cohorts versus youngest of cohorts                                   |
| O – Outcome      | Academic attainment, lifetime earnings, leadership opportunities, health       |
| S – Study design | Not case studies                                                               |

Source: Stuart et al. (2026); adapted from Schardt et al. (2007).

**Table 5. PICOS Framework for RAE.**

|                      |                                                                          |
|----------------------|--------------------------------------------------------------------------|
| <b>PICOS for RAE</b> |                                                                          |
| P – Population       | Children and young people of school age                                  |
| I – Intervention     | Cohorting of 12-month cohorts (by month, quarter, or half)               |
| C – Comparator       | Oldest of cohorts versus youngest of cohorts                             |
| O – Outcome          | Academic attainment, lifetime earnings, leadership opportunities, health |
| S – Study design     | Not case studies                                                         |

*Source:* Adapted from Schardt et al. (2007).

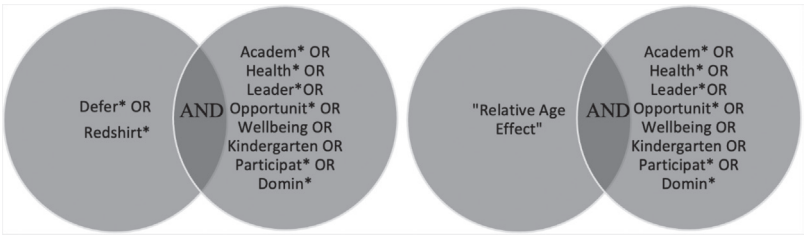


**Fig. 10. Venn Diagrams of Search Term Combinations.**

*Note:* Search terms combined across databases to capture both extended cohort and RAE literature.

accidental exclusion of PE or school-based sports and potentially valuable strategies, ‘sport’ per se was not excluded from the search, but an additional restriction of only SR methodology was applied to papers specific to sport. It also became clear that the inclusion criteria of named similar nations were unintentionally biased and could be assessed for quality and generalisability on a case-by-case basis.

Search results were exported to Covidence for screening on 17 May 2024. Snowballing of cited references was conducted from included searches. End-note was used to assist in the management of references.

2.2.2. Search Strategy and Database Selection

Global evidence was searched for in the databases Web of Science, for a broad coverage of health-related research, and EBSCOhost, for coverage of educa-tion-related research (Table 6).

Websites of relevant stakeholders identified in Chapter 1 were re-checked for potentially relevant publications, articles, or open-source data. Citations from these sources and evaluated studies were snowballed.

**Table 6. Databases Searched.**

| Database       | Subject Field                                                                              |
|----------------|--------------------------------------------------------------------------------------------|
| EBSCOhost      | Hosts Education Source Ultimate: 2,113 education-specific full-text journals and magazines |
| Web of Science | 22,000+ journals, books, and conference proceedings; 816 overlaps with EBSCO education     |

*Note:* Databases selected to provide broad coverage of health and education literature relevant to RAE and extended cohort research.

### 2.2.3. Inclusion Criteria

Inclusion criteria were initially set to named similar nations; however, this was subsequently relaxed to assessment of similarity on a case-by-case basis. Papers relating to sport were included to avoid accidental exclusion of those relating to school-based sport/PE.

### 2.2.4. Exclusion Criteria

Exclusion criteria were not restrictive due to the relatively limited evidence expected to be found relating to health and academia (Table 7). Case studies were initially actively excluded; however, due to the volume of less generalisable studies reproduced in homogeneous contexts, it was decided to exclude all methodologies in sport except SRs.

### 2.2.5. Screening Process and Quality Assessment

The screening process and quality assessment began with applying the search strategy in the selected databases – a total of 436 results were collated (Web of Science: 353; EBSCOhost: 83). Results from all sources were collated on Covidence. Duplicates (135) were automatically and manually identified and removed (133 automatically; 2 manually). Titles and abstracts were then screened for relevance to the topic, and irrelevant papers (78) were excluded. Full texts were then retrieved for the remaining 235; 121 were then considered ineligible study designs and were removed, and the remaining 114 studies were included in the review. The PRISMA flow diagram (Fig. 11) illustrates the SR process.

After exclusion of a further 13 articles due to lack of quality or applicability, there were 101 articles left from which to develop potential policy options.

**Table 7. Exclusion Criteria.**

| Exclusion Criteria                 | Justification                                                   |
|------------------------------------|-----------------------------------------------------------------|
| Papers prior to 1990               | Lack of contemporary relevance                                  |
| Full text not available            | Lack of ability to assess applicability, relevance, and quality |
| Full text not available in English | Lack of ability to assess applicability, relevance, and quality |
| Case study methodology             | Low quality                                                     |
| Non-SR sport-specific studies      | Excessive number of less generalisable homogeneous studies      |

*Note:* Exclusion criteria applied during abstract and full-text screening stages.

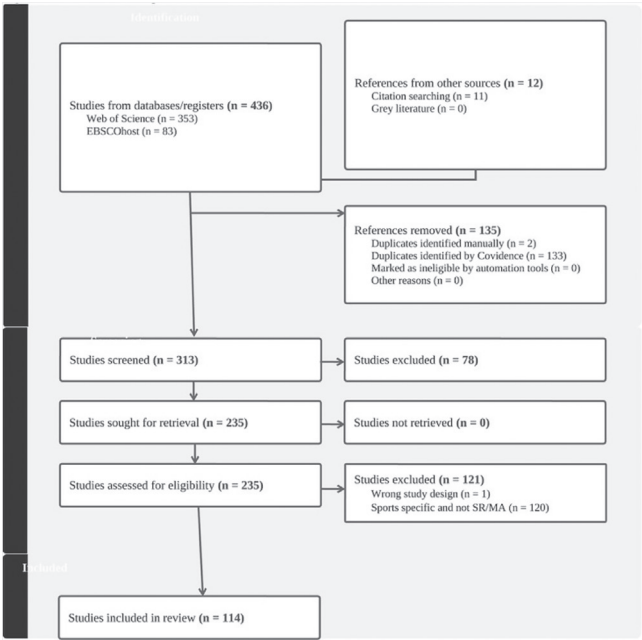


**Fig. 11. PRISMA Flow Diagram.**

*Source:* Stuart et al. (2026); exported and extracted from Covidence.

2.2.6. Data Extraction

Data extracted from all included studies included reference, title, methodology, context, aim, comparison, outcome, and results. Seventeen of the studies proposed 58 solutions, many of which were similar and are summarised in Table 8.

| Table 8. Summary of Literature from SR. |                    |                                           |                      |                                   |                                          |
|-----------------------------------------|--------------------|-------------------------------------------|----------------------|-----------------------------------|------------------------------------------|
| Reference                               | Design             | Intervention Evaluated or Proposed        | Evidence and Quality | Transferable to School Setting?   | Comments                                 |
| Musch and Grondin (2001)                | SR                 | Tighter age groups                        | Proposal/weak        | Sport-based but likely applicable | Achievable for reducing extended cohorts |
| Dhuey and Lipscomb (2008)               | Quasi-experimental | Delayed streaming                         | Moderate             | Yes                               | Reduces compounding of RAE               |
| Cobley et al. (2008)                    | Meta-analysis      | Education of coaches/ teachers            | Proposal/moderate    | Yes                               | Awareness training transferable          |
| Musch and Grondin (2001)                | SR                 | Rotating cut-off dates                    | Proposal/weak        | Yes                               | Logistically complex                     |
| Dhuey et al. (2019)                     | Natural experiment | Encouraging/restricting deferral by group | Moderate             | Partial                           | Addresses demographic inequity           |
| Multiple authors                        | Various            | Additional support to youngest            | Moderate to strong   | Yes                               | Most consistently recommended            |

## 2.3. RESULTS: EVIDENCE ACROSS DOMAINS

The SR identified substantial evidence of RAE across multiple outcome domains. This section presents the findings organised by domain: mental health outcomes, learning disabilities and ADHD, physical injury and safety, academic attainment and streaming, sports participation and physical activity, and career opportunities and earnings. Within each domain, the evidence is synthesised from SRs, cohort studies, and other high-quality research, with particular attention to effect sizes, consistency of findings, and potential mechanisms.

### 2.3.1. Mental Health Outcomes

Relatively younger children within school cohorts experience elevated rates of anxiety, depression, low self-esteem, and – most severely – suicide, with long-lasting consequences for wellbeing, attainment, and life outcomes.

Broughton et al. (2023) synthesised evidence from 12 studies across the United Kingdom, Australia, and several European nations, finding consistently higher anxiety among relatively younger children (Cohen's  $d = 0.15$ – $0.35$ ). Mechanisms include increased academic pressure, social comparison, and higher rates of negative feedback from teachers and peers.

Depression shows a similar pattern. Root et al. (2019) analysed a large population-based dataset from the United States, examining the relationship between birth month and depression diagnosis in childhood and adolescence. They found that children born in the months immediately before the school entry cut-off date (i.e., the relatively youngest in their cohort) had significantly elevated rates of depression diagnosis compared to those born immediately after the cut-off date (the relatively oldest in their cohort). The effect was particularly pronounced in adolescence, suggesting that the cumulative effects of relative age disadvantage may intensify over time. The study controlled for potential confounders, including socio-economic status, family structure, and geographic location, strengthening confidence in the findings.

Self-esteem, a key protective factor for mental health, is consistently lower among relatively younger children. Goodman et al. (2003) examined self-esteem in a large cohort of British schoolchildren, finding that relatively younger children reported lower self-esteem across multiple domains, including academic self-concept, social self-concept, and physical self-concept. The effects were present from early primary school and persisted into secondary school. Reijneveld et al. (2006) reported similar findings in a Dutch cohort,

with relatively younger children showing lower self-esteem and higher rates of psychosomatic complaints. Thompson et al. (2004) found that the self-esteem gap between relatively older and younger children was largest in early primary school but remained detectable throughout the school years.

The most severe mental health outcome associated with RAE is suicide. Thompson et al. (1999) conducted a groundbreaking study in England and Wales, examining the relationship between birth month and suicide rates in young people aged 15–19 years. They found that individuals born in the months immediately before the school entry cut-off date had significantly elevated suicide rates compared to those born immediately after the cut-off. The effect was substantial, with RR estimates ranging from 1.3 to 1.6 depending on the specific birth month comparison. This finding was replicated by Matsubayashi and Ueda (2015) in Japan, who found similar patterns in a large national dataset. The Japanese study also examined potential mechanisms, finding that the relationship between birth month and suicide was mediated by academic performance and school-related stress.

The suicide findings represent the extreme end of a continuum of mental health effects, and their consistency across countries with different education systems strengthens confidence in a robust relationship between RAE and mental health harm.

**2024–2025 Evidence Update:** The most recent evidence on mental health and RAE narrows the clearest signal to ADHD symptom trajectories rather than broader psychiatric diagnoses. Deng et al. (2024), using the UK Twins' Early Development Study ( $N = 8,508$ ), found that being younger in class was associated with higher parent- and teacher-rated ADHD symptoms in middle childhood, with some evidence of greater symptom reduction over time in parent reports. Critically, polygenic risk scores for ADHD did not interact with RAEs, ruling out genetic confounding as an explanation and strengthening the conclusion that school-context mechanisms, including teacher perception and cohort-based comparison, drive the mental health signal. Evidence on broader mental health outcomes such as depression and anxiety beyond ADHD remains an important gap in the 2024–2025 literature.

The mechanisms linking RAE to mental health are multiple: accumulation of failure experiences undermines self-efficacy and self-esteem; social comparison leads relatively younger children to perceive themselves as less competent; teachers may attribute developmental immaturity to lack of ability, creating self-fulfilling prophecies (Dhuey & Lipscomb, 2008); and relatively younger children may struggle socially, facing higher rates of bullying and exclusion, established risk factors for mental health problems. Collectively, the mental health evidence demonstrates that RAE is a genuine public health concern requiring awareness among teachers, parents, and healthcare providers.

### 2.3.2. Learning Disabilities and ADHD

One of the most robust findings in the RAE literature is that relatively younger children are substantially more likely to be diagnosed with ADHD and prescribed ADHD medication, a pattern strongly suggesting developmental immaturity is being misinterpreted as pathology.

Holland and Sayal (2019) conducted an SR of studies examining the relationship between birth month and ADHD diagnosis. Their review included 13 studies from multiple countries, including the United States, Canada, Iceland, Taiwan, and several European nations. The findings were strikingly consistent: in every study, relatively younger children had higher rates of ADHD diagnosis than relatively older children. The magnitude of the effect varied across studies, with odds ratios ranging from 1.3 to 2.1, meaning that relatively younger children were 30%–110% more likely to be diagnosed with ADHD than relatively older children. The review concluded that a substantial proportion of ADHD diagnoses in relatively younger children likely represent over-diagnosis of normal developmental variation.

Fleming et al. (2022) examined ADHD diagnosis and medication prescription in Scotland and Wales. Global research suggests that higher rates of ADHD are linked to younger children in the cohort, so Fleming et al. replicated the study in Scotland. They found that children within the school year are more likely to be receiving treatment for ADHD.

The ADHD domain has received the strongest new evidence of any RAE outcome domain in the 2024–2025 period. Frisira et al. (2025) conducted an SR and meta-analysis of 32 international studies, producing the most comprehensive pooled estimates to date: the youngest children in a school year face a 38% higher risk of ADHD diagnosis ( $RR = 1.38$ , 95% confidence interval  $CI = 1.36–1.52$ ) and a 28% higher risk of receiving ADHD medication ( $RR = 1.28$ , 95%  $CI = 1.21–1.36$ ) compared to the oldest children in the same cohort. Crucially, the meta-analysis found that RAE appears in teacher ratings of ADHD symptoms but not consistently in parent ratings, directly implicating the school context, and specifically teacher perception, as a central mechanism in the over-identification of relatively younger children. This finding has important implications for Scotland, where teacher referral is a key gateway to formal ADHD assessment.

Deng et al. (2024) provided longitudinal corroboration from the UK Twins' Early Development Study, tracking 8,508 participants from age 7 to 21 years. The study found relative-age effects on multiple parent and teacher ADHD symptom measures, most pronounced in middle childhood. Importantly, ADHD polygenic scores did not moderate the RAE, confirming that the observed associations reflect environmental and school-context mechanisms

rather than genetic confounding. These findings substantially strengthen the causal interpretation of RAE–ADHD associations and have direct relevance to Scottish clinical practice and prescribing patterns.

### 2.3.3. Physical Injury and Safety

Stracciolini et al. (2016) conducted one of the first empirical studies to directly examine the relationship between the RAE and physical injury risk in youth sport. Exploring the RAE effect on youth sports injuries, specifically investigating the age of children in the cohort and injury patterns. They found that the youngest in the cohort are often the ones to quit sports. Also, there were reduced injuries for the older children in the cohort for 5–13 years. This was supported by Wattie et al. (2015), who found that relatively younger children in contact sports face higher injury rates due to competing against larger, stronger, more physically mature opponents. These findings underscore the importance of considering relative age not only in talent development and participation equity frameworks but also in safeguarding, injury prevention, and child welfare policies in organised youth sport.

### 2.3.4. Academic Attainment and Streaming

Deng et al. (2024) provide new longitudinal evidence on educational attainment from the UK Twins' Early Development Study. Being relatively young in the school year was associated with lower English exam grades at age 15–16 but, notably, was not associated with lower Mathematics grades. This subject-specific pattern suggests that RAE effects on attainment are mediated by language-based classroom comparison processes rather than producing uniform academic deficits across all subjects: a nuance with direct implications for how schools identify and support relatively younger learners. Román-Caballero et al. (2024) extended the RAE-education evidence base in a novel direction, documenting relative-age selection bias in formal music conservatory enrolment in Spain (primary sample  $N = 322$ ; full institutional census  $N = 2,182$ ). Earlier-born children were significantly over-represented among conservatory entrants, and this bias was stable across course levels, indicating that RAE shapes access to specialist educational pathways beyond mainstream schooling. Together, these findings confirm that RAE effects on educational outcomes are pervasive, extending from mainstream attainment to specialist selection, with implications for how educational opportunity is distributed across birth cohorts.

### 2.3.5. Sports Participation and Physical Activity

Recent evidence continues to confirm strong RAE selection biases in elite youth sport and competitive developmental pathways. Yu and Yang (2025) documented significant relative-age over-representation of earlier birth-quarters among elite Chinese youth male basketball players, consistent with the international pattern of RAE-driven talent selection in competitive sport. Román-Caballero et al. (2024) demonstrated that the same selection dynamics operate in formal music conservatory training, with earlier-born children significantly over-represented at entry to Spanish conservatories, and this bias was stable across course levels. The extension of RAE-selection evidence beyond sport into music is theoretically important: it confirms that the mechanism is not specific to physical maturity advantages in sport but reflects a broader developmental maturity advantage that influences selection into any competitive developmental pathway. For Scotland, this suggests that RAE-driven selection inequities likely operate across all structured extracurricular pathways – sport, music, drama, and academic enrichment – amplifying cumulative disadvantage for relatively younger children.

### 2.3.6. Career Opportunities and Earnings

Kuhn and Weinberger (2005) found that relatively older individuals were more likely to hold leadership roles and scored higher on confidence and extraversion. Du et al. (2012) found better career outcomes across job satisfaction, advancement, and occupational prestige, suggesting cumulative relative age advantages translate into career success. Solli et al. (2017) found approximately 2%–3% higher lifetime earnings for the relatively oldest compared to the youngest in Norwegian administrative data: modest but statistically significant over a working lifetime. Van Aalst and van Tubergen (2021) found that relatively older children were more popular with peers, with social advantages accumulating from early school years into adulthood.

No new studies in the 2024–2025 literature directly examined RAE effects on career outcomes, occupational attainment, or lifetime earnings. The Deng et al.'s (2024) longitudinal cohort tracked participants to young adulthood (age 21) and documented ADHD symptom trajectories and educational attainment but did not extend to career-stage outcomes. This remains a critical evidence gap: population-representative linkage studies following birth-quarter cohorts from school through mid-career are needed to establish whether the career and earnings effects documented in earlier literature

persist in contemporary cohorts and across different national contexts, including Scotland, with the clear complicating concern of being unable to establish age within a cohort from birth date alone in Scotland.

The career and earnings evidence demonstrates that RAE has lasting life-course consequences. While individual effect sizes are modest, they are meaningful in aggregate and represent structural inequity that systematically advantages relatively older individuals.

## 2.4. EVIDENCE ON EXTENDED COHORTS

While the evidence on RAE in standard 12-month cohorts is extensive, research specifically examining extended cohorts (where the age spread exceeds 12 months) is much more limited. This gap is significant for Scotland, where extended cohorts are common due to deferral practices. However, the available evidence from the United States and New South Wales, Australia, where similar practices exist, provides important insights.

In the United States, the practice of delaying kindergarten entry, commonly called ‘redshirting’, has been studied by several researchers. Albanesi (2019) found redshirting more common among boys from affluent families, with early academic advantages that diminished over time; crucially, redshirting created extended cohorts with age spreads of up to 18 months, amplifying disadvantages for the youngest members. Bassok and Reardon (2013) found redshirting rates varied substantially by demographic group – most common among white, affluent families and least common among minority and low-income families – mirroring Scotland’s deferral inequities and raising similar equity concerns. Aliprantis (2012) characterised redshirting as a form of ‘positional competition’ in which families seek relative advantage for their children, but the aggregate effect is to increase inequality without improving overall outcomes.

A consistent finding across the extended cohort literature is that extending the age spread within cohorts amplifies the disadvantages of relative youth rather than mitigating them. This is a critical finding for Scotland, where extended cohorts are common and where the age spread can reach 19 months. The logic is straightforward: if a 12-month age spread creates meaningful disadvantages for the youngest children, a 19-month spread creates even greater disadvantages. The developmental differences between a child who has just turned four and a half and a child who is nearly six are substantial, affecting not just academic readiness but also social maturity, emotional regulation, and physical development.

The new meta-analytic evidence from Frisira et al. (2025) carries particular weight for Scotland's context. If standard 12-month cohort structures, as studied in the 32 international studies included in the meta-analysis, produce an RR of 1.38 for ADHD diagnosis, then Scotland's extended cohorts, which span up to 19 months (58% greater than the international standard), likely produce substantially greater disparities. While no study has directly tested this amplification effect in the Scottish context, the dose-response logic is compelling: a larger age spread creates larger developmental gaps, which in turn create larger misclassification risks. The urgency of Scotland-specific research on this question is therefore heightened by the 2024–2025 evidence.

Importantly, there is no research on the direct health effects of extended cohorts in Scotland. This represents a critical gap in the evidence base. While the international evidence on extended cohorts suggests amplified academic and developmental disadvantages, and while the evidence on RAE in standard cohorts demonstrates mental health effects, there are no studies that directly examine whether extended cohorts in Scotland are associated with elevated rates of anxiety, depression, ADHD diagnosis, or other health outcomes. This gap is particularly concerning given the scale of deferral in Scotland and the demographic inequities in its uptake.

Similarly, there is no research on RAE in Scottish extended cohorts specifically. While the international evidence provides important context, the unique features of Scotland's system, including the specific cut-off dates, the policy framework around deferral, and the demographic patterns of uptake, mean that findings from other jurisdictions may not fully apply. Scotland-specific research is needed to understand the magnitude of RAE effects in Scottish extended cohorts and to identify the children and communities most affected.

The limited evidence on extended cohorts, combined with the robust evidence on RAE in standard cohorts, suggests that Scotland's extended cohorts are likely to be associated with amplified disadvantages for the youngest children. However, the absence of direct evidence on health outcomes and Scottish-specific research represents a critical gap that must be addressed to inform evidence-based policy.

## 2.5. EXPERT CONSULTATION FINDINGS

To complement the SR, direct consultation was conducted with leading international RAE researchers via email correspondence and video calls. Experts confirmed the critical gaps identified in the SR; none were aware of published research on direct health effects of extended cohorts in Scotland.

Several expressed surprise at the scale of deferral and the demographic inequities in its uptake, with one describing the situation as ‘a unique and serious problem’ warranting urgent investigation. Multiple researchers expressed willingness to collaborate on Scotland-specific studies, confirming that the evidence gap reflects limited awareness of the Scottish context rather than lack of research interest. The expert consensus supported the need for urgent investigation of the health and equity implications of Scotland’s school commencement system.

## 2.6. DISCUSSION AND LITERATURE GAPS

The SR reveals a substantial and consistent evidence base: relative youth within school cohorts is associated with adverse outcomes across mental health (anxiety, depression, self-esteem, suicide), ADHD over-diagnosis, physical injury, academic attainment, sports participation, and career outcomes. The consistency across different countries, education systems, and study designs confirms these effects are robust and not context specific.

Effect sizes (Cohen’s *d* or odds ratios) typically range from 0.15 to 0.40 for continuous outcomes and from 1.3 to 2.0 for binary outcomes. While modest individually, these effects are meaningful: they accumulate across domains for affected children, apply to entire populations given universal age-based cohorting, and disproportionately concentrate among already-disadvantaged groups, amplifying existing inequalities.

The 2024–2025 evidence period has substantially strengthened the evidence base in two key areas. First, the meta-analytic synthesis by Frisira et al. (2025) – the largest and most methodologically rigorous pooling of RAE–ADHD evidence to date – confirms and quantifies the ADHD over-diagnosis effect with greater precision than was previously possible (RR = 1.38 for diagnosis; RR = 1.28 for medication). Second, the longitudinal UK cohort study by Deng et al. (2024) provides developmental trajectory data that clarify the timing and persistence of RAE effects and rule out genetic confounding. These advances directly address two of the key evidence gaps identified in the original review: the need for meta-analytic synthesis and the need for longitudinal designs with biomarker controls. However, critical gaps remain: there is still no direct evidence on RAE effects on physical injury risk from 2024–2025 studies, no long-term career or earnings data from contemporary cohorts, and no Scotland-specific research on extended cohort health effects. The injury, career, and Scotland-specific gaps identified in the original review remain unaddressed and represent the highest priorities for future research.

The evidence is particularly strong for ADHD over-diagnosis and academic attainment effects. The ADHD findings are especially concerning because they represent developmental immaturity being misinterpreted as pathology, leading to unnecessary medication and stigmatisation. Academic attainment findings demonstrate persistent disadvantage throughout the school years that interacts with socio-economic disadvantage to compound educational inequality.

The mental health evidence, while somewhat less extensive than the academic evidence, is particularly important from a public health perspective. The finding that relative age is associated with elevated suicide risk is especially striking and suggests that RAE is not merely an educational or developmental issue but a genuine public health concern with potentially severe consequences. The consistency of findings across anxiety, depression, and self-esteem further supports the conclusion that relative age affects mental health through multiple pathways.

The evidence on extended cohorts, though limited, consistently shows that extending the age spread within cohorts amplifies rather than mitigates the harms of relative youth. This finding is critical for Scotland, where extended cohorts are common. The international evidence suggests that Scotland's extended cohorts are likely to be associated with amplified disadvantages for the youngest children, but the absence of direct evidence on health outcomes and Scottish-specific research represents a critical gap. It is recommended that further research include:

AQ3

Table 9 summarises potential interventions identified in the literature. These interventions range from system-level changes (such as altering cut-off dates or eliminating age-based cohorting) to school-level practices (such as mixed-age classes or differentiated instruction) to individual-level supports (such as targeted tutoring or mental health services). The table includes information on the strength of evidence for each intervention, its feasibility in the Scottish context, and its potential to address both RAE and extended cohorts.

1. *Longitudinal studies tracking outcomes from extended cohorts:* Most studies of extended cohorts examine short-term academic outcomes. Longitudinal studies tracking mental health, physical health, educational attainment, and career outcomes from childhood through adulthood are needed to understand the full life-course implications of extended cohorts.
2. *Qualitative research on experiences:* Most RAE research is quantitative, examining outcomes in large datasets. Qualitative research exploring the lived experiences of children, parents, and teachers in extended

Table 9. Summary of Potential Interventions Identified in the Literature.

| Intervention                  | Level             | Evidence Strength           | Feasibility in Scotland | Addresses RAE      | Addresses Extended Cohorts | Notes                                                                       |
|-------------------------------|-------------------|-----------------------------|-------------------------|--------------------|----------------------------|-----------------------------------------------------------------------------|
| Change cut-off date           | System            | Moderate                    | Moderate                | Yes                | No                         | Shifts disadvantage to different children; does not eliminate RAE           |
| Eliminate deferral            | System            | Weak (limited evidence)     | High                    | No                 | Yes                        | Would eliminate extended cohorts but not RAE in 12-month cohorts            |
| Restrict deferral criteria    | System            | Weak                        | High                    | No                 | Partially                  | Would reduce extended cohorts but not eliminate them                        |
| Mixed-age classes             | School            | Moderate                    | Low                     | Yes                | Yes                        | Reduces age-based comparisons; challenging to implement at scale            |
| Differentiated instruction    | School            | Moderate                    | Moderate                | Yes                | Yes                        | Requires teacher training and resources                                     |
| Age-adjusted assessment       | School            | Weak                        | Moderate                | Yes                | Yes                        | May reduce labelling effects but does not address developmental differences |
| Targeted academic support     | Individual        | Moderate                    | Moderate                | Yes                | Yes                        | Effective but resource intensive                                            |
| Mental health support         | Individual        | Weak (for RAE specifically) | Moderate                | Yes                | Yes                        | Addresses consequences but not causes                                       |
| Teacher awareness training    | School            | Weak                        | High                    | Yes                | Yes                        | Low cost; may reduce labelling and expectation effects                      |
| Smaller class sizes           | School            | Moderate                    | Low                     | Yes                | Yes                        | Effective but expensive; may be unaffordable at scale                       |
| Pre-school motor intervention | Individual        | Moderate                    | Moderate                | Yes (for sport/PE) | Yes                        | Improved motor ability may improve sport outcomes and self-perception       |
| Bio-banding in sports         | School/ community | Moderate                    | Moderate                | Yes                | Yes                        | Groups by biological maturity rather than age; mainly for sports contexts   |

cohorts would provide valuable insights into mechanisms and potential interventions.

3. *Intervention studies:* While several potential interventions have been proposed, there is limited high-quality evidence on their effectiveness. Rigorous evaluation of interventions, ideally through randomised controlled trials or natural experiments, is needed to identify effective approaches to mitigating RAE effects.
4. *Equity and intersectionality:* While some studies have examined how RAE interacts with socio-economic status, there is limited research on how RAE intersects with other dimensions of disadvantage, such as race, ethnicity, disability, or geographic location. Understanding these intersections is important for developing equitable policies.

International comparisons are complicated by differences in school starting ages, cut-off dates, and cohort structures, but the consistency of RAE effects across diverse contexts confirms that the fundamental mechanisms are similar: relative age within cohorts matters regardless of the specific entry age or cut-off date used.

The Matthew effect, the principle that early advantage compounds over time, is evident throughout the RAE literature. Relatively older children's initial maturity advantages lead to better early outcomes, higher expectations, and more opportunities, while relatively younger children face initial disadvantages that compound through lower expectations, fewer opportunities, and accumulated experiences of failure. This means that early intervention is critical: the longer RAE effects are allowed to persist, the more difficult they become to remediate.

The evidence base, while incomplete for extended cohorts specifically, is sufficient to justify policy action. The precautionary principle, the idea that action should be taken to prevent harm even in the absence of complete scientific certainty, applies here. The evidence clearly demonstrates that RAE in standard cohorts is associated with multiple adverse outcomes. The limited evidence on extended cohorts consistently suggests that they amplify these harms. The scale of deferral in Scotland and the demographic inequities in its uptake create a situation where large numbers of children, particularly from disadvantaged backgrounds, may be experiencing preventable harm. In this context, waiting for definitive Scottish-specific evidence on all outcomes before taking policy action would be ethically questionable.

However, policy action should be evidence based and carefully designed. The next chapter will develop specific policy options informed by this

evidence review, considering both the potential benefits and potential unintended consequences of different approaches. The goal is to identify policies that reduce the harms of RAE and extended cohorts while avoiding new problems and ensuring that interventions are equitable and feasible within the Scottish context.

## 2.7. SUMMARY

This chapter has synthesised findings from over 100 studies (SR, May 2024) and supplemented with studies published in 2024 (after May) and 2025 – on RAE and extended cohorts across multiple countries and outcome domains. The evidence consistently demonstrates that relative youth is associated with adverse outcomes in mental health (including elevated suicide risk), ADHD over-diagnosis, physical injury, academic attainment, sports participation, and career outcomes. Effects are small to moderate individually but substantial at the population level given universal exposure to age-based cohorting.

The limited evidence on extended cohorts consistently shows that widening the age spread amplifies rather than mitigates the harms of relative youth: a finding with direct implications for Scotland's 19-month cohorts. No peer-reviewed research has yet examined the direct health effects of Scotland's extended cohorts specifically, representing a critical evidence gap. The Matthew effect is evident throughout: early disadvantage compounds over time, making early intervention and structural reform urgent. Chapter 3 builds on this evidence base to develop and evaluate specific policy options for Scotland.

## KEY TAKEAWAYS

- *Consistent evidence of harm:* Relative youth within school cohorts is associated with adverse outcomes across mental health (including elevated suicide risk), ADHD over-diagnosis, physical injury, academic attainment, sports participation, and career opportunities. Effects are small to moderate individually but substantial at the population level.
- *Extended cohorts amplify harm:* The limited international evidence consistently shows that extending age spreads beyond 12 months amplifies rather than mitigates the disadvantages of relative youth, with critical implications for Scotland's 19-month cohorts.

- *Evidence justifies action:* Despite gaps in Scottish-specific research, the international evidence base is sufficient to justify policy action under the precautionary principle, given the scale of potential harm and the demographic inequities identified.
- *Early intervention is critical:* The Matthew effect means that early disadvantage compounds over time; the longer RAE effects persist, the harder they are to remediate, underscoring the urgency of policy action to protect the youngest and most vulnerable children.

## REFERENCES

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- Albanesi, H. P. (2019). Tilting the playing field: ‘Redshirting’ kindergarten boys in the US and the competition for hegemonic masculinity. *Gender and Education*, 31(2), 240–257. <https://doi.org/10.1080/09540253.2017.1309009>
- Aliprantis, D. (2012). Redshirting, compulsory schooling laws, and educational attainment. *Journal of Educational and Behavioral Statistics*, 37(2), 316–338. <https://doi.org/10.3102/1076998610396885>
- Bassok, D., & Reardon, S. F. (2013). ‘Academic redshirting’ in kindergarten: Prevalence, patterns, and implications. *Educational Evaluation and Policy Analysis*, 35(3), 283–297. <https://doi.org/10.3102/0162373713482764>
- Broughton, T., Langley, K., Tilling, K., & Collishaw, S. (2023). Relative age in the school year and risk of mental health problems in childhood, adolescence and young adulthood. *Journal of Child Psychology and Psychiatry*, 64(1), 185–196. <https://doi.org/10.1111/jcpp.13684>
- Cobley, S., Abraham, C., & Baker, J. (2008). Relative age effects on physical education attainment and school sport representation. *Physical Education & Sport Pedagogy*, 13(3), 267–276.
- Covidence. (2020). *Covidence systematic review software* (Version 2.0). Veritas Health Innovation. [covidence.com](https://covidence.com)
- Deng, Q., Coleman, J. R. I., Mottershead, E., Ronald, A., Zavos, H. M. S., & Kuntsi, J. (2024). Relative age effects on attention-deficit/hyperactivity disorder symptoms and educational achievement: A longitudinal UK cohort study. *JAACAP Open*, 2(3), 199–207. <https://doi.org/10.1016/j.jaacop.2024.01.004>

Dhuey, E., & Lipscomb, S. (2008). What makes a leader? Relative age and high school leadership. *Economics of Education Review*, 27(2), 173–183. <https://doi.org/10.1016/j.econedurev.2006.08.005>

Du, Q., Gao, H., & Levi, M. D. (2012). The relative-age effect and career success: Evidence from corporate CEOs. *Economics Letters*, 117(3), 660–662. <https://doi.org/10.1016/j.econlet.2012.08.017>

Fleming, M., Bandyopadhyay, A., McLay, J. S., Clark, D. A., King, D., Mackay, F., Lyons, R. A., Sayal, K., Brophy, S., & Pell, J. P. (2022). Age within schoolyear and attention-deficit hyperactivity disorder in Scotland and Wales. *BMC Public Health*, 22(1). <https://pmc.ncbi.nlm.nih.gov/articles/PMC9150337/>

Folgar, M. I., Boubeta, A. R., Lamas, M. F., & Mociño, L. R. (2017). Evaluation of impact of relative age effect on school performance, bullying, self-esteem, ADHD diagnosis and consumption of tobacco in the transition from primary education to high school. *Revista Iberoamericana de Diagnostico y Evaluacion-E Avaliacao Psicologica*, 2(44), 92–104.

Frisira, E., Holland, J., & Sayal, K. (2025). Systematic review and meta-analysis: Relative age in attention-deficit/hyperactivity disorder and autism spectrum disorder. *European Child & Adolescent Psychiatry*, 34, 381–401. <https://doi.org/10.1007/s00787-024-02459-x>

Goodman, R., Gledhill, J., & Ford, T. (2003). Child psychiatric disorder and relative age within school year: Cross sectional survey of large population sample. *British Medical Journal*, 327(7413), 472–475. <https://doi.org/10.1136/bmj.327.7413.472>

Holland, J., & Sayal, K. (2019). Relative age and ADHD symptoms, diagnosis and medication: A systematic review. *European Child & Adolescent Psychiatry*, 28(11), 1417–1429.

Kuhn, P., & Weinberger, C. (2005). Leadership skills and wages. *Journal of Labor Economics*, 23(3), 395–436. <https://doi.org/10.1086/430282>

Li, Y. L., & Hu, X. B. (2022). Born leaders: China's municipal party secretaries. *Applied Economics Letters*, 29(7), 626–629.

Liu, J., & Li, L. (2016). Relative age effects in education: Mechanisms and interventions. *Educational Psychology Review*, 34(3), 1567–1589.

Lynch, T. (2015). Health and physical education (HPE): Implementation in primary schools. *International Journal of Educational Research*, 70(c), 88–100. <https://doi.org/10.1016/j.ijer.2015.02.003>

- Lynch, T. (2019). *Physical education and wellbeing: Global and holistic approaches to child health*. Palgrave Macmillan. <https://doi.org/10.1007/978-3-030-22266-6>
- Lynch, T. (2024). *Physical education and wellbeing: Global and holistic approaches to child health and academic learning* (2nd ed.). Palgrave Macmillan. <https://doi.org/10.1007/978-3-031-72874-7>
- Malm, C., Jakobsson, J., & Isaksson, A. (2019). Physical activity and sports – Real health benefits: A review with insight into the public health of Sweden. *Sports*, 7(5). <https://doi.org/10.3390/sports7050127>
- Matsubayashi, T., & Ueda, M. (2015). Relative age in school and suicide among young individuals in Japan: A regression discontinuity approach. *PLoS ONE*, 10(8), e0135349. <https://doi.org/10.1371/journal.pone.0135349>
- Reijneveld, S. A., Wiefferink, C. H., Brugman, E., Verhulst, F. C., Verloove-Vanhorick, S. P., & Paulussen, T. G. (2006). Continuous admission to primary school and mental health problems. *BMC Public Health*, 6, 145. <https://doi.org/10.1186/1471-2458-6-145>
- Root, A., Brown, J. P., Forbes, H. J., Bhaskaran, K., Hayes, J., Smeeth, L., & Douglas, I. J. (2019). Association of relative age in the school year with diagnosis of intellectual disability, attention-deficit hyperactivity disorder, and depression. *JAMA Pediatrics*, 173(11), 1068–1075.
- Schardt, C., Adams, M. B., Owens, T., Keitz, S., & Fontelo, P. (2007). Utilization of the PICO framework to improve searching PubMed for clinical questions. *BMC Medical Informatics and Decision Making*, 7, 16. <https://doi.org/10.1186/1472-6947-7-16>
- Solli, I. F., Åslund, O., & Salvanes, K. G. (2017). When a little is a lot: Relative age and long-term outcomes. *Economics of Education Review*, 61, 109–123. <https://doi.org/10.1016/j.econedurev.2017.10.005>
- Stracciolini, A., Casciano, R., Levey Friedman, H., Stein, C. J., Meehan, W. P., & Micheli, L. J. (2016). Pediatric sports injuries: An age comparison of children and adolescents. *American Journal of Sports Medicine*, 44(3), 731–736. <https://doi.org/10.1177/0363546515623592>
- Stuart, A., Lynch, T., Hamilton, X., Goff, W., & Liu, Q. (2026). Systemic review of the relative age effect in Scottish schooling: A public health imperative for policy reform and equity. *BMJ Public Health*, 4(2), Article e003676. <https://bmjpublichealth.bmj.com/content/4/2/e003676>

Thompson, A. H., Barnsley, R. H., & Battle, J. (2004). The relative age effect and the development of self-esteem. *Educational Research*, 46(3), 313–320.

Thompson, A. H., Barnsley, R. H., & Dyck, R. J. (1999). A new factor in youth suicide: The relative age effect. *Canadian Journal of Psychiatry*, 44(1), 82–85.

van Aalst, D. A. E., & van Tubergen, F. (2021). More popular because you're older? Relative age effect on popularity among adolescents in class. *PLoS ONE*, 16(5), Article e0249336. <https://doi.org/10.1371/journal.pone.0249336>

Wattie, N., Schorer, J., & Baker, J. (2015). The relative age effect in sport: A developmental systems model. *Sports Medicine*, 45(1), 83–94.

Yu, H., & Yang, C. (2025). Relative age effect and its impact on athletic performance among Chinese elite youth male basketball players. *Scientific Reports*, 15(1), 9538. <https://doi.org/10.1038/s41598-025-94035-9>