

1 **TITLE**

2 DE-PASS Best Evidence Statement (BEST) – Modifiable determinants of physical activity and sedentary
3 behaviour in children and adolescents aged 5-19 years: A protocol for systematic review and meta-analysis

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148 **ABSTRACT**

149 **Introduction:** Physical activity among children and adolescents remains insufficient, despite the
150 substantial efforts made by researchers and policymakers. Identifying and furthering our
151 understanding of potential modifiable determinants of physical activity behaviour (PAB) and sedentary
152 behaviour (SB) is crucial for the development of interventions that promote a shift from SB to PAB. The
153 current protocol details the process through which a series of systematic literature reviews (SLRs) and
154 meta-analyses (MAs) will be conducted to produce a best-evidence statement (BEST) and inform policy
155 makers. The overall aim is to identify modifiable determinants that are associated with changes in PAB
156 and SB in children and adolescents (aged 5-19 years) and to quantify their effect on, or association
157 with, PAB/SB.

158 **Methods and analysis:** A search will be performed in MEDLINE, SportDiscus, Web of Science,
159 PsychINFO and Cochrane Central Register of Controlled Trials. Randomized controlled trials (RCTs) and
160 controlled trials (CTs) that investigate the effect of interventions on PAB/SB and longitudinal studies
161 that investigate the associations between modifiable determinants and PAB/SB at multiple time points
162 will be sought. Risk of bias assessments will be performed using adapted versions of Cochrane's RoB
163 2.0 and ROBINS-I tools for RCTs and CTs, respectively, and an adapted version of the National Institute
164 of Health's tool for longitudinal studies. Data will be synthesised narratively and, where possible, MAs
165 will be performed using frequentist and Bayesian statistics. Modifiable determinants will be discussed
166 considering the settings in which they were investigated and the PAB/SB measurement methods used.

167 **Ethics and dissemination:** No ethical approval is needed as no primary data will be collected. The
168 findings will be disseminated in peer-reviewed publications and academic conferences where possible.
169 The BEST will also be shared with policy makers within the DE-PASS consortium in the first instance.

170 **Systematic review registration:** CRD42021282874

171

172 **Strengths and limitations of this study**

- 173
- 174 • Modifiable determinants will be summarized and described within the settings in which they
175 were investigated to contextualize how they interact with other determinants and
176 subsequently affect physical activity and sedentary behaviour in children and adolescents.
 - 177 • The body of evidence from high quality research will be summarised, accounting for
178 differences in study designs, methodological quality and measurement methods of physical
179 activity and sedentary behaviour of children and adolescents.
 - 180 • Bayesian meta-analysis will be used in addition to frequentist meta-analysis to allow for
181 assessment of the plausibility of the results and provide more nuanced conclusions regarding
182 the effectiveness of physical activity and sedentary behaviour interventions in children and
183 adolescents.
 - 184 • Modifiable determinants reported in study designs which are not included in the current works
185 may be overlooked and should be investigated in future reviews as they may provide insights
186 into potentially effective interventions.
 - 187 • While our aim is to quantify the effect of modifiable determinants on physical activity and
188 sedentary behaviour of children and adolescents, the analyses of most included studies might
189 not permit the quantification, thus a narrative approach will be adopted.

190

191 **INTRODUCTION**

192 Physical inactivity among children and adolescents is a global public health issue. Four in five (81%)
193 adolescents across the world do not meet the World Health Organisation’s (WHO) physical activity (PA)
194 guidelines.[1,2] Physical inactivity is a contributing factor to the high prevalence of cardiovascular,
195 metabolic and bone-health related conditions.[3] Reducing levels of physical inactivity from a young
196 age has a positive impact on physical and mental health as children and adolescents transition into
197 adulthood.[4] It is therefore important to promote physical activity behaviour (PAB) and minimize
198 sedentary behaviour (SB) as part of a healthy lifestyle in children and adolescents to mitigate the
199 negative effects of physical inactivity.[5] In the global action plan on PA 2018–2030, the WHO adopted
200 a target to reduce physical inactivity worldwide by 15% by 2030.[6] To achieve this target, evidence-
201 based policies need to be created and adopted worldwide.[7] Furthermore, the fact that PA guidelines
202 are currently not met in a large proportion of young people points towards a lack of understanding
203 and insufficient translation of the evidence behind what makes children and adolescents physically
204 active into policy and public interventions.[9,10] Therefore, a better understanding of the
205 determinants of PAB/SB is a crucial first step in developing interventions that lead to a sustained
206 increase in PAB and reduced SB and a foundation for PA policy development.[8,11] In the current
207 protocol, we refer to ‘determinants’ of PAB or SB as mechanisms that drive and explain behaviour
208 adaptation in specific contexts.[11,12] We focus on modifiable determinants, signifying those which
209 are malleable and can be altered through interventions, and present opportunities to intervene from
210 public health and policy perspectives.[11,13] Using a rigorous methodology, our goal is to synthesise
211 high-quality evidence on the effectiveness and association of key modifiable determinants on PAB/SB
212 and produce a Best Evidence Statement (BEST) which can inform future interventions. We also aim to
213 identify the settings for interventions that are most readily translatable to policy.

214 The current evidence of the effectiveness of modifiable determinants on PAB/SB is fragmented due to
215 considerable variations in the methodologies used and the methodological quality across the available
216 studies, which has contributed to largely inconclusive findings in systematic literature reviews (SLRs)
217 and meta-analyses (MAs).[8–10,13–18] To limit the variations across studies and extract trustworthy
218 evidence, it is important to identify high-quality studies. Factors that contribute to methodological
219 quality include research design and PAB/SB measurement methods. A range of research designs have
220 been applied in existing PA research (e.g., cross-sectional, longitudinal, randomised controlled trials
221 (RCTs) and controlled trials (CTs). Potential causality between modifiable determinants and the
222 outcome measures can be indicated by RCTs and CTs, and well-designed RCTs can minimise bias
223 through randomisation and intention-to-treat analyses.[8,19,20] However, challenges in
224 randomisation of PAB/SB interventions have been recognised,[21] therefore, CTs might be the next

225 most credible alternative. Whilst RCTs are regarded as the ‘gold standard’, high-quality longitudinal
226 studies can provide indications of a causal relationship between modifiable determinants and the
227 outcome measures by virtue of the repeated measurements over time.[9] Furthermore, RCTs and CTs
228 can be short-lasting and may not capture the prolonged exposures that can be explored in longitudinal
229 follow-ups.[8] Therefore, we consider RCTs, CTs and longitudinal studies to be amongst the highest
230 quality of evidence appropriate to develop the BESt.

231 Methods for measurement of PAB/SB contribute to the disparities in the methodologies used between
232 studies. Data obtained from self-report methods are generally considered to be less sensitive to
233 change than data obtained via device-based methods due to recall errors, under-/overestimation or
234 interpretation discrepancies.[14,15,22,23] On the one hand, device-based measurements are deemed
235 to be more sensitive to behaviour change and can detect cognitively salient behaviours, such as time
236 spent in SB.[23] On the other hand, many studies rely on self-report measurements as they are less
237 costly, logistically easier to implement and are more applicable in some domains of behaviour (e.g.,
238 strength training) than device-based measurements.[23] Given that both device-based and self-report
239 methods present strengths and weaknesses, we consider it methodologically appropriate to include
240 both in BESt, provided that validity and reliability of the instruments are assessed and reported
241 thoroughly in the included studies. However, as previous research has shown low levels of agreement
242 between the two measurement methods, we will conduct separate analyses per method within SLRs
243 and MAs.[24]

244 Over the years, PAB/SB measurements have been used to assess different forms of PA, such as
245 structured PA (e.g., physical education), leisure-time PA and active transport PA, and different domains
246 where sedentary time is spent, such as screen-based activities (e.g., doing homework on computers),
247 leisure-based activities (e.g., sitting and reading), and transport-related activities (e.g., sitting in a
248 bus).[15] Recently, there has been an increased emphasis on identifying the settings (or contexts) in
249 which PAB/SB take place and the determinants at work within the settings, so that the settings of the
250 most impactful, modifiable determinants can be targeted when translating research into policy.[9,25]
251 Answering the questions about what works for whom (children and/or adolescents), why
252 (determinants and their interactions) and when/where (settings) is critical to advance our
253 understanding of the implementation and possible effectiveness of interventions.[26] Therefore, to
254 produce the BESt, we aim to investigate the modifiable determinants in their respective settings in
255 SLRs and MAs so that our results can inform future interventions within settings that speak to policy
256 makers.

257 The current protocol will be used to produce a series of SLRs and MAs aiming to investigate the
258 effectiveness of modifiable determinants on PAB/SB in children and adolescents using high-quality
259 evidence available. Investigating the modifiable determinants of PAB/SB in their respective settings
260 will help contextualize their modifiability and effect. Therefore, to produce the BEST, it is important to
261 ascertain methodological rigour which is set apart from previous efforts in understanding PAB/SB
262 determinants in children and adolescents. By considering the settings of the modifiable determinants,
263 our results can readily inform policy makers and future PA interventions.

264 **Objectives**

265 The overarching aim of the proposed SLRs and MAs is to identify modifiable determinants that are
266 associated with changes in PAB and SB in children and adolescents (aged 5-19). Specific aims are:

- 267 • To investigate which modifiable determinants of PAB and SB have been targeted in
268 interventions designed to promote PA in children and adolescents in RCTs and CTs.
- 269 • To investigate which modifiable determinants are associated with PAB and SB in children and
270 adolescents in longitudinal studies.
- 271 • To investigate the strength of the association between such modifiable determinants and
272 PAB/SB in children and adolescents.

273 **METHODS AND ANALYSIS**

274 The current protocol was registered in the International prospective register of systematic reviews
275 (PROSPERO) on 12/10/2021 with the registration number: CRD42021282874. The reporting in the
276 current protocol manuscript was guided by the Preferred Reporting Items for Systematic Review and
277 Meta-Analysis Protocols (PRISMA-P).[27]

278 The modifiable determinants that have been targeted in all included studies will be listed and analysed
279 narratively in SLRs. Meta-analytic methods will be applied to the data from intervention and
280 longitudinal studies. Analyses will be performed for different categories of studies based on (i)
281 methods for measurement of PAB/SB (e.g., self-report, device-based) and (ii) age (e.g., children aged
282 5-12 years, adolescents aged 12-19 years) in a series of SLRs and MAs with varying focus. Study settings
283 (e.g., school, home, community) will also be identified.

284 **Population**

285 Studies targeting children and adolescents with and without disabilities aged 5-19 years will be
286 included. According to the International Classification of Functioning, Disability and Health (ICF)[28],
287 disability is an umbrella term for impairments, activity limitations and participation restrictions,
288 denoting the negative aspects of the interaction between an individual and that individual's contextual
289 factors. Studies that include children and/or adolescents with any reported ongoing diagnosed medical

290 conditions known to affect PA participation and includes patients under treatment on all levels of care
291 will be excluded (e.g., studies including cancer patients or individuals with anterior cruciate ligament
292 injury, or studies where the intervention takes place in a clinical setting). Studies that report data for
293 ages exceeding the specified age range will be excluded, unless data for a sub-group within the eligible
294 mean age can be extracted.

295 **Types of studies**

296 We will include studies examining modifiable PAB/SB determinants in RCTs, CTs and longitudinal
297 studies. RCTs and CTs that investigate the effectiveness of interventions aiming to promote PA or
298 reduce SB in children and adolescents, should include control groups or other intervention groups, that
299 are matched to the experimental groups, and report pre- and post-intervention measurements of both
300 outcome measures and modifiable determinants. Longitudinal studies should investigate the
301 association between modifiable determinants of PA and PAB/SB in children and adolescents and report
302 measurements of both the modifiable determinants and PAB/SB at least at two time-points. No control
303 groups or comparisons will be required for the longitudinal studies. Length of follow-up or length of
304 intervention in any of the study designs will not be restricted, data will be extracted if reported for
305 participants within the specified age range (5-19 years).

306 **Outcomes**

307 The main outcome measures targeted in the current protocol are PAB and SB. Physical activity is
308 defined as any bodily movement produced by skeletal muscles that requires energy expenditure, thus
309 including any modality of movement at any intensity.[2] As such, PAB encompasses behaviours of
310 sedentary, light, moderate and vigorous intensity PA and SB includes any waking behaviour
311 characterised by an energy expenditure of 1.5 METs or lower while sitting, reclining or lying.[2,29]
312 Therefore, we will categorise PAB into light, moderate and vigorous intensity and SB-based types of
313 activities reported in the included studies. Any of the two types of measurement methods for PAB/SB,
314 including self-report methods (e.g., questionnaires, diaries, recall), and device-based methods (e.g.,
315 accelerometers, pedometers) will be included.[23] Moreover, we target studies which have reported
316 modifiable determinants as secondary measures. Modifiable determinants will be identified based on
317 the context of each study, where manipulation of the determinant is hypothesized to have an effect
318 on PAB/SB. Where possible, we will explore the mediating effect of the modifiable determinants in the
319 changes in PAB/SB by analysing the structural relationship between the modifiable determinants and
320 PAB/SB.

321 **Comparators**

322 The main comparator will include PAB/SB measurement methods. The included studies will comprise
323 those adopting self-report or device-based measures of PAB/SB or both as outcome measures. Self-

324 report and device-based measures will be analysed separately. In studies where both device-based
 325 and self-report measures are reported, the data for both measurement methods will be extracted and
 326 analysed separately. In addition, to strengthen the BESt, results from the respective measurement
 327 methods will be compared to provide further indication of the strength of the evidence yielded from
 328 studies, depending on their measurement methods for PAB/SB. Classification of the settings in which
 329 the modifiable determinants were targeted will be identified once data have been extracted.

330 **Search strategy**

331 A search will be performed in MEDLINE (Ovid), PsycINFO (EBSCO), Web of Science, Sport Discus, and
 332 Cochrane Central Register of Controlled Trials (CENTRAL). The piloted search strategy is presented in
 333 Table 1. The search strategy is built using the main outcome measures of (1) PAB and (2) SB, and
 334 synonyms of PAB/SB that are commonly used in PA research; (3) the targeted study designs (i.e., RCTs,
 335 CTs and longitudinal studies) and related terms; (4) determinant and synonyms that are commonly
 336 used in PA research; (5) the targeted population, to identify children and adolescents and synonyms
 337 that are commonly used in PAB/SB research; and (6) measurement methods for PAB/SB such as
 338 accelerometer or pedometer for device-based methods and diary and activity recall for self-report
 339 methods.

340 For languages other than English, studies will be included if an English version is available, or if a
 341 translation can be obtained through members of the review team. We will include studies published
 342 from 2010 - which was the year when the first global PA guidelines were published by WHO[30] and
 343 around the time previous SLRs with similar aims were published.[31,32] Only peer-reviewed studies
 344 will be included and grey literature such as research reports, working papers, conference proceedings
 345 and theses will be excluded during the search and at the initial screening of the studies.

346 Table 1. The search terms, Boolean commands and field indicators, presented for each domain.

Domain	Search terms
Outcome: Physical activity behaviour ¹	("Physical activ*") OR (exercise) OR (sport*) OR (play) OR (exertion) OR (recreation) OR (training) OR ("motor activit*") OR ("physical performance") OR ("physical movement") OR ("physical effort") OR (exergaming)
OR	
Outcome: Sedentary behaviour ¹	(sedentar*) OR ("screen time") OR (gaming) OR ("computer use") OR (sitting) OR (inactiv*) OR ("seated posture") OR ((watch* or view*) N/2 (TV or television))
AND	
Target population ¹	(child*) OR (youth) OR (adolescen*) OR ("young people") OR ("school age*") OR (p?ediatric) OR (juvenile) OR (teen*)
AND	
Study design ²	(RCT) OR ("control* trial*") OR (quasi) OR (longitudinal) OR (intervention*) OR (prospective) OR ("follow up")
OR	

Determinants ²	(determinant*) OR (antecedent*) OR (predictor*) OR (mediator*) OR (moderator*) OR (exposure*)
AND	
Measurement methods ²	(acceleromet*) OR ("activity profile") OR (recall) OR (diary) OR ("activity monitor*") OR ("heart rate monitor*") OR ("direct observation") OR (actigraph*) OR ("activity track*") OR ("self report*") OR (survey) OR (pedomet*) OR (wearable*)
¹ Restricted search to title, abstract and keywords	
² Search in entire study	

347

348 **Study records**

349 At the initial screening, records of grey literature and duplicates from the different databases will be
350 excluded. The initial screening will be performed before the start of the blinded review process by one
351 member of the review team. For this, EndNote x9[33] – a reference management software will be
352 used. The same member of the review team will upload the resulting list to Covidence[34] – an online
353 tool for SLRs in which the blinded review process, including title and abstract screening, full-text
354 screening, study selection, data extraction and risk of bias assessment, will be completed. Covidence
355 allows the distribution of studies among several reviewers in a process based on the PRISMA flow
356 diagram for SLRs.[35]

357 Several workshops will be held before the commencement of the respective stages (i.e. study
358 screening, risk of bias assessments and data extraction) to ensure that all reviewers will be proficient
359 in the procedures and to ensure agreement among them. As the review team consists of 31 members,
360 an online communication tool – Slack[36] – will be used to maintain communication among the
361 members of the review team throughout the review process to respond to queries and provide
362 updates on the process. A core group of the review team will guide and support the review team
363 members throughout the review process.

364 **Screening process**

365 At title and abstract screening and full-text screening, each study will be screened by two blinded
366 independent reviewers of the review team. Any conflicts between the independent reviewers will be
367 resolved by a third reviewer, who is a member of the core group. An equal number of studies will be
368 distributed among reviewers and random studies are selected by Covidence to be distributed to each
369 reviewer. At the first stage, titles and abstracts will be assessed for eligibility using a pre-piloted
370 decision tree based on the inclusion/exclusion criteria expected to be found in either the title or
371 abstract. The full-text version of the studies that remain after title and abstract screening will then be
372 uploaded to Covidence. At the second stage, full texts will be assessed for eligibility using the full
373 inclusion/exclusion criteria. Reasons for exclusion of studies at the full-text stage will be recorded.
374 Following the full-text screening, the included studies will be checked by one reviewer to exclude any

375 duplicate reporting, that is, reporting of the results from the same sample in multiple studies or studies
376 that have been published more than once. For this purpose, study information will be compared
377 between studies, such as authors, study locations and settings, intervention content and design,
378 sample size, demographic information and ethical committee approval number.[37] If duplicate
379 reporting is detected among included studies, the reviewers will attempt to identify the main study
380 which was duplicated. If the main study cannot be identified, the study with the longest follow-up or
381 highest number of measurement time points will be selected for inclusion.[38,39]

382 **Data extraction**

383 A data extraction form will be created in Covidence and piloted ahead of the data extraction stage. The
384 data extraction from each study will be completed by two independent reviewers. If any information
385 or data are missing, or if clarifications are needed, the corresponding author of the respective studies
386 will be contacted. If a response is not provided before data extraction completes, or if the reporting
387 remains incomplete, the study will be excluded. Following the independent data extraction, the two
388 reviewers will perform a consensus procedure to resolve any conflicts and ascertain the correctness of
389 the extracted data.

390 The data extracted will include the following items:

- 391 • Study/intervention description: Study design, brief study intervention description, description
392 of intervention design and content, description of control group activity, study setting.
- 393 • Sample information: Sample size, sample age (including age by sex), sex (including grouping
394 based on sex; % Male, % Female), population type (disability/non-disability).
- 395 • Outcome measures and modifiable determinants: PAB/SB outcome measurement method
396 type (e.g., self-report, device-based) and instrument (e.g., ActiGraph, Youth Activity Profile, 7-
397 day recall), length of device-based PAB/SB measurement (days), days of the week for device-
398 based PAB/SB measurement (weekdays/weekend day), wear-time requirement for device-
399 based PAB/SB measurement, unit of measure for PAB/SB, reported validity and reliability of
400 PAB/SB measurements, modifiable determinant measurement instruments and their reported
401 validity and reliability.
- 402 • Time frames: Intervention length (weeks), intervention location (country), number of
403 measurement time points, length of follow-up (weeks).
- 404 • Results data: PAB/SB outcome data (mean, measures of variance), modifiable determinant
405 data (mean, measures of variance).

406 **Risk of bias**

407 Different scales will be used for the assessment of risk of bias depending on the study design of each
408 included study. For RCTs, a modified version of the Cochrane risk of bias tool for randomized trials (RoB
409 2.0) will be used.[40] For CTs without randomization, a modified version of Cochrane’s Risk of Bias in
410 Non-randomized Studies - of Interventions (ROBINS-I) will be used.[41] The Cochrane tools, RoB 2.0
411 and ROBINS-I, are modified to include an additional domain concerning the bias in measurement of
412 the determinants. For longitudinal studies, an adapted version of the National Institutes of Health (NIH)
413 quality assessment tool will be used.[42] The adaptation of the latter tool involves the
414 exclusion/addition of items relevant to longitudinal studies, based on the tool used by Kontostoli et
415 al.[43]

416 The two independent reviewers who extract the data from the respective studies will perform the risk
417 of bias assessment to ensure familiarity with the studies. The risk of bias assessment will be completed
418 in forms created in Covidence with the respective risk of bias tools as templates. Following the
419 independent data extraction, the two reviewers will perform a consensus procedure to resolve any
420 conflicts and ascertain the correctness of the assessment.

421 **Data synthesis**

422 Data extraction will yield a data file containing data for the included RCTs, CTs and longitudinal studies,
423 and include populations with and without disabilities. A summary table will be created describing the
424 overall characteristics of the included studies with information on the methods (i.e., intervention
425 description for intervention studies/exposure for longitudinal studies), settings, modifiable
426 determinants, sample characteristics (i.e., sample size, age), and outcomes (i.e., outcome measures,
427 measure type, number of measures, measurement time points). Results of the risk of bias assessment
428 will be reported in a separate table.[44]

429 Findings will be synthesised narratively to identify and list the modifiable determinants and the settings
430 they were investigated in. Studies for disability and non-disability populations, and studies reporting
431 PAB/SB measured using self-report and device-based methods will be discussed separately. The
432 findings will be discussed considering the different settings and the quality of evidence included in the
433 review.

434 Most data extracted from the included studies are expected to be continuous. Where possible, meta-
435 analytic methods will be applied. MAs will be performed using both frequentist and Bayesian
436 approaches to statistical inference in JASP statistics software.[45] MAs will be performed for
437 intervention studies (RCTs and CTs) to investigate the effect of the interventions on PAB/SB and
438 determinants and for longitudinal studies to investigate the strength of the association between

439 identified modifiable determinants and PAB/SB. For studies including more than one experimental
440 group or modifiable determinant, each will be included in the MAs.

441 Direct effect will be investigated in frequentist pairwise comparisons, for which the standardized mean
442 difference (SMD) and the 95% confidence intervals (CI) will be calculated. We expect the presence of
443 heterogeneity among included studies in each MA due to the nature, settings or types of interventions.
444 Therefore, the MAs will be conducted using random effects models. For intervention studies, the post-
445 intervention data will be used to calculate the between-group difference while controlling for baseline
446 differences. For longitudinal studies, the within-group difference will be calculated as control groups
447 are not expected to be included in longitudinal studies. For data interpretation, effect size values of
448 $SMD < 0.50$ indicate small, of $0.50 \leq SMD < 0.80$ indicate medium, and of $SMD \geq 0.80$ indicate large
449 effects.[46] Heterogeneity will be identified using Cochrane's Q, which is based on a Chi-square test
450 using the confidence interval size in relation to the degrees of freedom. Heterogeneity will also be
451 quantified by using I^2 , which represents the degree (in %) of methodological consistency across studies
452 using the Chi-square statistic Q in relation to the degrees of freedom. For interpretation of
453 heterogeneity, $I^2 < 25\%$ indicates low heterogeneity, $25\% < I^2 < 50\%$ indicates moderate heterogeneity,
454 and $I^2 > 75\%$ indicates high heterogeneity.[47] Benchmarks will be used to give an approximation for
455 the level of heterogeneity: 0% to 40%: might not be important; 30% to 60%: may represent moderate
456 heterogeneity; 50% to 90%: may represent substantial heterogeneity; 75% to 100%: considerable
457 heterogeneity.[48] The level for statistical significance will be set to $\alpha < 0.05$.

458 The Bayesian approach to statistical inference will be applied for the MAs using random effects models.
459 The primary benefits of using Bayesian meta-analysis in addition to frequentist meta-analysis include
460 (a) the ability to include prior knowledge of the effect into a model, updating the existing knowledge
461 as evidence accumulates (b) the ability to make more nuanced conclusions that expand on a simple
462 presence or absence of support for the hypotheses based on a p-value, and (c) the ability to assess the
463 plausibility of the results and to make conclusions based on the probability that the results are within
464 a given range.[49,50] For the Bayesian meta-analysis, Gibbs sampling of the Markov Chain Monte Carlo
465 (MCMC) algorithm will be used in JASP.[45] The probability for publication bias will also be calculated
466 using the JASP extension Robust Bayesian Meta-analysis (RoBMA). We will apply RoBMA to conduct
467 state of the art publication bias-adjusted MA.[51,52] The Bayesian framework will allow for Bayesian
468 model averaging,[49] taking several plausible models into account and alleviating concerns about
469 selecting the right model from the variety of adjustment methods available.[53] In addition, RoBMA
470 has several other benefits – it allows researchers to (1) quantify evidence on a continuous scale,
471 including for the null, (2) avoid accumulation bias, and (3) ease estimation problems by using prior

472 distributions. We will use the prior specifications[51] and models with the modification of removing
473 the fixed-effects models.

474 Additionally, the mediation effects of determinants on PAB/SB will be investigated using frequentist
475 meta-analytical structural equation modelling (meta-SEM).[54] To conduct meta-SEM, the covariance
476 structure of the mediation is required. If this information is not presented in a primary study, the
477 authors will be contacted. We will conduct meta-SEM only when we can extract the required data.

478 **ETHICS AND DISSEMINATION**

479 The current protocol describes the process through which a series of SLRs and MAs will be performed,
480 with the aim to identify modifiable determinants that are (in)effective in influencing PAB and SB in
481 children and adolescents. The findings of the resultant studies will be disseminated in peer-reviewed
482 publications and academic conferences where possible. Modifiable determinants from studies with
483 different study designs and measured using self-report or device-based methods will be reported
484 separately in different publications. The BESt will also be shared with policy makers within the DE-PASS
485 consortium in the first instance. As no primary data will be collected, no ethical approval is required.

486 **Author contributions**

487 The current systematic review protocol was produced by members of the COST Action CA19101
488 Determinants of Physical Activities in Settings (DE-PASS). The protocol was conceived and designed
489 by C.M., F.C.M.L., M.K., A.M., G.D.T. and K.N. The methodology was planned and outlined by C.M.,
490 F.C.M.L., M.K., A.M., G.D.T., K.N., F.B., R.P. and M.M. The protocol was initially drafted by M.K., A.M.,
491 G.D.T. and F.C.M.L. Subsequent drafts were reviewed by the included members of DE-PASS: F.B.,
492 R.P., M.M., F.B., S.B., M.B., G.C., A.C., C.C., H.C., A.C., S.C., J.C.S., V.Č., C.C., C.C., E.D., A.D.B., A.D.C.,
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506 **Competing interests**

507 The authors declare no competing interests.

508 **Key dates**

509 The project commenced in June 2021. At the time of submission, the search was complete and data
510 extraction underway. The expected completion date is October 2022.

511

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