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1 **PROTOCOL**

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2 **Effects of pollution on adolescent mental**  
3 **health: a systematic review protocol**

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14 **Abstract**

15 **Background:** Whilst there is little uncertainty about the deleterious impact of pollution on human and planetary  
16 health, pollution's impact on adolescent mental health is less well understood. This is particularly true for young  
17 people in underdeveloped and developing world contexts, about whom research is generally lacking. Furthermore,  
18 although adolescent resilience continues to be a research priority, little attention has been paid to adolescent  
19 pathways of resilience in the face or aftermath of pollution exposure. The objective of this study will be to examine  
20 the associations between pollution and mental health in 10- to 24-year-olds (i.e. adolescents).

21 **Methods:** We designed and registered a study protocol for a systematic review of studies which link pollution and  
22 mental health in adolescents. We will include observational studies (e.g. cohort, case-control, time series analyses)  
23 that assess the associations between exposure to any form of pollution and the mental health of 10- to 24-year-  
24 olds. The primary outcome will be symptoms associated with neurodevelopmental disorders; disruptive, impulse-  
25 control, and conduct disorders; depressive disorders; anxiety disorders; substance disorders; and schizophrenia. No  
26 secondary outcomes will be considered. Literature searches will be conducted in multiple electronic databases  
27 (from inception onwards), including PubMed, MEDLINE, SCOPUS, Web of Science, CINAHL, PsycINFO, SciELO, ERIC,  
28 and Africa-Wide. Two investigators will independently screen all citations, full-text articles, and abstract data. The  
29 methodological quality (or bias) of included studies will be appraised using appropriate tools. We will provide a  
30 narrative synthesis of the evidence.

31 **Discussion:** This systematic review will evaluate the evidence on the associations between pollution and the  
32 mental health of 10- to 24-year-olds. Our findings will be of potential interest to multiple audiences (including  
33 adolescent patients/clients, their families, caregivers, healthcare professionals, scientists, and policy makers) and  
34 could be used to develop prevention and intervention strategies as well as focus future research. Results will be  
35 published in a peer-reviewed journal.

36 **Systematic review registration:** PROSPERO CRD42020176664

37 **Keywords:** Narrative synthesis, Mental disorder, Pollutants, Pollution-associated risks, Resilience, Systematic review  
38 protocol, Adolescent, Mental health

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**Q3** 39 **Background**

40 Across the globe, human activity has resulted in wide-  
41 spread emissions that are harmful to the earth and its in-  
42 habitants [1]. Harmful emissions pollute the air, water,  
43 and/or soil [2] via substances—including plastics, heavy  
44 metals, pesticides, building materials, antibiotics, and  
45 synthetic hormones—heat, vibrations, or noise [3, 4].  
46 Pollution's harmful physical health sequelae are well-  
47 recognized [5–7].

48 In comparison, understanding of the mental health ef-  
49 fects of pollution is less robust [8–10], particularly when  
50 it comes to impacts on young people [11, 12]. Even  
51 when studies have included young people's mental  
52 health, there is almost no focus on adolescents (i.e.  
53 young people aged 10 to 24 [13]) and mental health is  
54 restricted to neurodevelopmental challenges (i.e. autism  
55 spectrum disorder [ASD], attention deficit hyperactivity  
56 disorder [ADHD], impaired cognitive functioning/learn-  
57 ing capacity). For instance, a systematic review of 63 ar-  
58 ticles published between 2000 and 2018 investigated six  
59 physical and neurodevelopmental outcomes among in-  
60 fants and children exposed to air-borne pollutants asso-  
61 ciated with fossil fuel combustion [14]. The review  
62 provided unequivocal evidence that exposure to air pol-  
63 lution is deleterious to the physical and neurodevelop-  
64 mental health of infants and children (mostly < 10 years).  
65 In comparison, only one of the articles included in the  
66 review specified neurodevelopmental outcomes for ado-  
67 lescents (i.e. hyperactivity and/or inattention at age 15).  
68 A subsequent narrative review of 134 articles relating to  
69 pollution and mental health by Ventriglio and colleagues  
70 [15] similarly included little on adolescent mental health.  
71 The review, which was not systematic, reported neuro-  
72 developmental disorders (including ADHD and ASD)  
73 and cognitive deficits among children (generally younger  
74 than 10) exposed to air, light, or noise pollution; heavy  
75 metals; and/or pesticides. This review made little refer-  
76 ence to mental illness that was not neurodevelopmental  
77 (such as depression or anxiety) [15]. There was a single  
78 mention of increased 'psychiatric conditions' following  
79 children's exposure to ultrafine particles and one of 'a  
80 mental disorder' following a 16-year-old female's expo-  
81 sure to mercury. Another example of the limited atten-  
82 tion to pollution effects on adolescent mental health is  
83 the review by Freire and Koifman [16]. These authors  
84 conducted a systematic review of 25 studies that investi-  
85 gated pesticide exposure and depression/suicide. Eight of  
86 the 25 reviewed studies reported samples that included  
87 adolescents (10- to 24-year-olds [13]). Even so, there  
88 were no adolescent-specific conclusions relating to the  
89 overall finding that there was a limited evidence base  
90 linking pesticide exposure and depression or suicide.

91 The under-attention to pollution's potential mental  
92 health effects in adolescence is problematic, not least

because much of the global burden of disease is attribut- 93  
able to mental illness [17]. Half of all mental disorders 94  
are thought to have commenced by early adolescence 95  
[18]. Such early onset is associated with 10 times the ex- 96  
penditure of disorders with later onset [19]. Moreover, poor 97  
adolescent mental health predicts constrained develop- 98  
ment along with long-term diminished cognitive, psy- 99  
chological, and behavioural capacities [20, 21]. 100  
Furthermore, adolescence is a time of substantial per- 101  
sonal change that impacts how adolescents interact with 102  
the world (and, therefore, pollutants). These concerns 103  
beg systematic attention to the mental health of adoles- 104  
cents, with specific consideration of those who are ex- 105  
posed to any form of pollution (i.e. air, water, and/or 106  
soil—including plastics, heavy metals, pesticides, build- 107  
ing materials, antibiotics, and synthetic hormones —and 108  
heat, vibrations, or noise). This attention must be inclu- 109  
sive of adolescents in low- and middle-income countries 110  
(LMICs), given that 85% of the world's young people 111  
reside in LMICs [22] and the understanding that they 112  
may be disproportionately impacted by exposure to pol- 113  
lution [1]. 114

115 Consideration of adolescent mental health should not  
116 omit the factors and processes that enable or sustain men-  
117 tal health [23, 24]. Whilst young people's capacity to  
118 maintain positive mental health despite exposure to risk is  
119 well-researched [25], there is limited understanding of the  
120 resilience processes that protect adolescent mental health  
121 specifically during and/or following exposure to environ-  
122 mental pollution [26]. Given the paucity of mental health  
123 services and adequately trained staff, particularly in LMICs  
124 [17, 27], leveraging the factors and processes that support  
125 mental health resilience could forestall the need for men-  
126 tal health services. Because resilience processes are multi-  
127 systemic and sensitive to developmental, situational, and  
128 cultural determinants [28], it will be important to ascer-  
129 tain what facilitates adolescent resilience to pollution ex-  
130 posure across diverse contexts and highlight contextually  
131 relevant resilience-enablers.

132 Taken together, the abovementioned concerns prompt  
133 our interest in what is currently known about the associ-  
134 ations between pollution and adolescent mental health  
135 worldwide. This interest is framed by a social-ecological  
136 perspective of resilience, i.e. the understanding that posi-  
137 tive human adaptation to significant risk, such as pollu-  
138 tion, is a dynamic and contextually responsive process  
139 [29]. Accordingly, the aim of this study will be to evalu-  
140 ate the associations between pollution and adolescent  
141 mental health across diverse contexts and throughout  
142 their development. To this end, the proposed systematic  
143 review will answer the following questions:

- 144 1. What is the association between pollution exposure  
145 (type/level) and symptoms of adolescent mental

- 146 illness (e.g. symptoms associated with  
147 neurodevelopmental disorders like autism, attention  
148 deficit, and/or hyperactivity disorder; conduct  
149 disorders; depression, anxiety, and substance  
150 disorders)?
- 151 2. In what ways, if any, are these associations different  
152 across adolescent development and diverse  
153 geographical contexts?
- 154 3. In instances where minimal symptoms of  
155 adolescent mental illness are reported, which  
156 protective factors, if any, are/could be associated  
157 with adolescent mental-health resilience to pollu-  
158 tion exposure?
- 159 4. What clinical and/or study methodological  
160 characteristics might explain any heterogeneity in  
161 results?

## 162 **Methods**

163 The present study protocol is being reported in accord-  
164 ance with the reporting guidance provided in the Pre-  
165 ferred Reporting Items for Systematic Reviews and  
166 Meta-Analyses Protocols (PRISMA-P) statement [30, 31]  
167 (see PRISMA-P checklist in Supplemental File 1). This  
168 protocol has been registered within the International  
169 Prospective Register of Systematic Reviews (PROSPERO)  
170 database (registration ID: CRD42020176664).

### 171 **Eligibility criteria**

172 Studies will be selected based on the following criteria.

#### 173 **Study design**

174 Only original, human studies will be included. Any ob-  
175 servational study (i.e. study in which outcomes are not  
176 manipulated) is eligible, except for qualitative, in silico  
177 (i.e. computer-simulated), or intervention ones (e.g. in-  
178 terventions to limit adolescent exposure to pollution or  
179 improve adolescent mental health). The previously men-  
180 tioned studies are unlikely to provide evidence that ad-  
181 dresses the proposed review's purpose and thus we have  
182 limited our scope to observational studies.

#### 183 **Participants**

184 We will include studies of people aged 10 to 24 years  
185 from any country. According to Sawyer et al. [13], this  
186 age range constitutes adolescence. Traditionally, adoles-  
187 cence spanned 10 to 19 years [18]. The decision to fur-  
188 ther include 20- to 24-year-olds in the definition of  
189 adolescence reflects recent arguments for adolescence to  
190 include those who would traditionally have been consid-  
191 ered emerging adults [13], given how dependence on  
192 parents has been extended by modern societies' valuing  
193 of post-school education/training and global trends of  
194 youth unemployment. Our exclusive focus on adoles-  
195 cents relates to adolescence being a sensitive

developmental period when half of all mental health 196  
problems develop and manifest [18]. Furthermore, ado- 197  
lescence is a time of substantial personal change that im- 198  
pacts how adolescents interact with the world (and, 199  
therefore, pollutants). 200

#### 201 **Exposures**

202 To be included, studies must investigate adolescent ex- 202  
posure to pollution. Following the European Union's 203  
definition [4], pollution is understood as 'the direct or 204  
indirect introduction, as a result of human activity, of 205  
substances, vibrations, heat or noise into air, water or 206  
land which may be harmful to human health or the 207  
quality of the environment' (p. 6). Studies that make tan- 208  
gential reference to pollution (e.g. only in the introduc- 209  
tion or recommendations) and do not measure it in 210  
some way will be excluded. The same applies to studies 211  
in which solvents or pesticides are purposefully used to 212  
self-harm (e.g. substance abuse or suicide). Studies 213  
reporting exposure to natural (rather than anthropo- 214  
genic) sources of heat will also be excluded. 215

#### 216 **Outcomes**

217 To be included, studies must investigate the mental 217  
health of adolescents exposed to pollution. For adoles- 218  
cents, mental health implies no or limited indication of 219  
(i) neurodevelopmental disorders; (ii) disruptive, 220  
impulse-control, and conduct disorders; (iii) depressive 221  
disorders; (iv) anxiety disorders; or (v) substance disor- 222  
ders [32]. Lee et al. [19] also include schizophrenia in 223  
typical adolescent-onset disorders. All these disorder 224  
groupings are recognized by the 5th edition of the Diag- 225  
nostic and Statistical Manual of Mental Disorders 226  
(DSM-5<sup>TR</sup>) [33]. The DSM-5<sup>TR</sup> guides practitioner sup- 227  
port of mental health. Studies that did not measure 228  
mental health outcomes (e.g. through a clinical inter- 229  
view, scale/checklist, self- or adult-report) will be 230  
excluded. 231

#### 232 **Report characteristics**

233 Peer-reviewed, indexed journal articles (published and 233  
pre-print, online) will be included. Reports could be 234  
published in any language and at any time. In instances 235  
where the same data set is reported in multiple articles, 236  
the article that provides the clearest evidence of pollu- 237  
tion associations with adolescent mental health will be 238  
included. 239

#### 240 **Information sources**

241 Peer-reviewed articles, published on or before 10 April 241  
2020, will be retrieved using the following databases: 242  
Africa-Wide, CINAHL, ERIC, PsycARTICLES, and Psy- 243  
cINFO (all via EBSCOhost platform); MEDLINE (via 244  
Web of Science Clarivate Analytics); PubMed; Scopus 245

246	(which includes contents of Embase); Web of Science	eligible article. In instances of reviewer disagreement	296
247	Core Collection; and SciELO Citation Index. The data-	about extracted data, LT and KH will arbitrate. If neces-	297
248	base search will be supplemented by a manual search of	sary, study authors will be approached to clarify	298
249	the reference lists of well-cited articles identified in the	uncertainties.	299
250	database search and by contact with included study au-		
251	thors. The reviewer team (of which researchers from the		
252	Global South comprise the majority) will be sensitive to		
253	the inclusion of indexed Global South studies given their		
254	historic under-representation in scholarly literature [34].		
255	Following Bellefontaine and Lee [35], grey literature will		
256	only be included should the aforementioned information		
257	sources show that the published literature is limited.		
258	<b>Search strategy</b>		
259	The search strategy (see Supplemental File 2) was devel-		
260	oped by author LS1, a librarian working in South Africa,		
261	and tested by LS2, a research assistant working in the		
262	UK. No date or language limits will be imposed, but the		
263	search will be limited to scholarly/peer-reviewed journal		
264	publications. The terms listed in the search strategy will		
265	be searched for in the title, abstract, and topic fields (for		
266	the databases that allow such delimiters).		
267	<b>Study records</b>		
268	<b>Data management</b>		
269	Articles meeting the search strategy will be populated		
270	into EndNote and screened for duplicates. Once dupli-		
271	cates have been removed, the records will be exported to		
272	Zotero, a software programme that allows citations to be		
273	formulated as title and abstract.		
274	<b>Selection process</b>		
275	The first 50 citations (title and/or abstract) will be inde-		
276	pendently screened by 11 of the review authors (LT,		
277	YAV, CB, MECL, GPA, MAO, LG, LL, IM, AT, KH) and		
278	results compared via consensus discussion (see Saldana		
279	[36]). This will support reviewer familiarity with the in-		
280	clusion/exclusion criteria and calibrate application of the		
281	criteria. Thereafter, the remaining citations will be di-		
282	vided into five sets. Each set will be independently		
283	screened by at least 2 reviewers. Titles/abstracts that		
284	meet the inclusion criteria—as well as those where there		
285	is uncertainty—will be selected for a full-text review by		
286	LL and KH. Consensus discussions (see Saldana [36])		
287	will again be used to resolve any disagreements. Should		
288	consensus not be reached, LT will arbitrate.		
289	<b>Data collection process</b>		
290	Data extraction will be guided by a data-charting form		
291	that will be developed by LT and KH and calibrated by		
292	all reviewers (using 10 of the eligible articles). The data-		
293	charting form will correspond to the items for which		
294	data will be sought (see the 'Data items' section). At least		
295	2 reviewers will independently extract data from each		
		<b>Data items</b>	300
		Data will be extracted as follows.	301
		<b>Study design</b>	302
		We will extract the type of design and methods, sample	303
		size and type (e.g. random or purposive), population	304
		sampled from, data collection instruments (including	305
		those to assess pollutant exposure or measure mental	306
		health), study duration, data collection dates, ethical pro-	307
		cedures, and study funding (if any).	308
		<b>Participants</b>	309
		We will extract detail about age (e.g. age range, average	310
		age) and, where possible, other demographic detail (e.g.	311
		sex/gender, race/ethnicity, nationality, urban/rural/other	312
		location, education, socio-economic status).	313
		<b>Exposures</b>	314
		We will extract data relating to direct exposure to air-,	315
		water-, or land-based substances, vibrations, heat, or	316
		noise, as well as duration and frequency of direct expo-	317
		sure. We will also extract data relating to indirect expo-	318
		sure to air-, water-, or land-based substances, vibrations,	319
		heat, or noise, as well as duration and frequency of the	320
		indirect exposure.	321
		<b>Mental health impacts</b>	322
		We will extract data relating to symptoms of (i) neuro-	323
		developmental disorders; (ii) disruptive, impulse-control,	324
		and conduct disorders; (iii) depressive disorders; (iv)	325
		anxiety disorders; (v) substance disorders; or (vi) schizo-	326
		phrenia spectrum disorders. Where possible, we will dis-	327
		tinguish between acute (i.e. requiring institutionalization	328
		or hospitalization) and other impacts (i.e. any non-in-	329
		patient treatment, such as medication or counselling). In	330
		instances where journal articles specify related DSM-	331
		5 <sup>TM</sup> or ICD codes, these will be recorded. Should publi-	332
		cations report evidence of causal mechanisms for pollut-	333
		ants' mental health impacts, then we will extract these	334
		too.	335
		<b>Factors or processes that protect mental health</b>	336
		Following Ungar and Theron [28], we will extract data	337
		relating to biological, psychological, social, structural, or	338
		ecological factors or processes that are reported to be as-	339
		sociated with mental health resilience.	340

### 341 **Publication details**

342 We will extract detail about whether the article is open  
343 or closed access, the existence of a study protocol, and  
344 the language(s) of publication.

### 345 **Outcomes and prioritization**

346 The primary outcomes will be evidence (or not) of  
347 symptoms of (i) neurodevelopmental disorders; (ii) dis-  
348 ruptive, impulse-control, and conduct disorders; (iii) de-  
349 pressive disorders; (iv) anxiety or post-traumatic stress  
350 disorders; (v) substance disorders; or (vi) schizophrenia  
351 spectrum disorders. Each of the aforementioned consti-  
352 tutes a cluster of disorders. For example, as per the  
353 DSM-5<sup>TM</sup>, depressive disorders comprise 8 disorders  
354 (e.g. disruptive mood dysregulation disorder, major de-  
355 pressive disorder, persistent depressive disorder) [33].  
356 Using DSM-5<sup>TM</sup> diagnostic criteria, each of these can be  
357 further specified and assigned a specific DSM-5<sup>TM</sup> code.  
358 For example, major depressive disorders can present as a  
359 single or recurrent episode that is mild, moderate, se-  
360 vere, with psychotic features, in partial remission, in full  
361 remission, or unspecified [33]. Given that articles that  
362 report mental health outcomes are not necessarily  
363 authored by mental health practitioners trained to use  
364 the DSM to diagnose specific mental health disorders,  
365 we anticipate that journal articles will use broad classifi-  
366 cations (e.g. depression or anxiety) when reporting men-  
367 tal health impacts. So long as these impacts were  
368 measured, we will accept broad or DSM-5<sup>TM</sup>-detailed  
369 classifications. Where possible, the impact of the dis-  
370 order on adolescents' daily functioning (e.g. school at-  
371 tendance or capacity to be socially engaged) will be  
372 noted too. No secondary outcomes will be considered.

### 373 **Risk of bias in individual studies**

374 Two review authors will independently assess the risk of  
375 bias in the included quantitative studies using the Scot-  
376 tish Intercollegiate Guidelines Network (SIGN) method-  
377 ology checklist [37]. This checklist includes 14 items, of  
378 which 12 assess research biases, including in selection,  
379 performance, attrition, and detection. The two review  
380 authors will evaluate these 12 items on all included stud-  
381 ies and will use the Cochrane Collaboration Review  
382 Manager (RevMan) [38] risk-of-bias graph to present  
383 this information.

384 Disagreements between review authors over the risk of  
385 bias in individual studies will be resolved by discussion,  
386 with involvement of two additional review authors where  
387 necessary. Following Hughes-Morley et al. [39], we will  
388 not omit any studies that demonstrate bias or limited  
389 quality. Instead, we will clearly identify the biases of  
390 these studies using the RevMan risk-of-bias graph [38]  
391 and will de-emphasize the results in our synthesis.

### Data synthesis 392

393 Because we anticipate that studies will not be sufficiently  
394 homogenous to accommodate meta-analyses, the results  
395 will be tabulated and narratively synthesized. We will  
396 conduct our data synthesis according to the Synthesis  
397 Without Meta-analysis (SWiM) guidelines from Camp-  
398 bell et al. [40]. In line with SWiM guidelines, we will in-  
399 clude a table explaining and outlining the reporting of  
400 our data synthesis. An advantage of narrative syntheses  
401 is their capacity to provide a detailed response to the  
402 question directing the review [41]. This should yield a  
403 detailed account of what is currently known about how  
404 pollution relates to adolescent mental health worldwide,  
405 as well as what facilitates adolescent mental health resi-  
406 lience in the face or aftermath of pollution exposure. This  
407 account will be useful to signpost limitations and si-  
408 lences in current understandings of adolescent mental  
409 health during/following exposure to pollution and to ad-  
410 vocate for specific research and practice agendas. To en-  
411 sure replicability of the narrative synthesis, we will make  
412 public the completed data-charting forms that informed  
413 the synthesis (e.g. as supplemental, online files when the  
414 review is published). LT and KH will lead the synthesis,  
415 with input from the remaining reviewers.

### 416 **Meta-biases**

417 Meta-bias includes both the selective reporting of out-  
418 comes due to their significance, magnitude, or direction  
419 and publication bias [31]. To assess meta-biases due to  
420 selective outcome reporting, we will (1) evaluate whether  
421 studies have associated protocols and whether those pro-  
422 tocols were published prior to the recruitment of partici-  
423 pants; (2) look for discrepancies between the published  
424 article and protocol (for those studies with a protocol);  
425 and (3) contact authors of the study, where additional  
426 information is needed. We do not plan any assessment  
427 of meta-biases due to publication bias.

### 428 **Confidence in cumulative evidence**

429 To assess confidence, we will apply the Grading of Rec-  
430 ommendations Assessment, Development and Evalu-  
431 ation (GRADE [42]), which is a widely used and  
432 transparent framework for summarizing confidence in  
433 evidence presented. GRADE involves a separation be-  
434 tween judgements of quality of the evidence of the  
435 strength of the recommendations. Quality of evidence is  
436 classified into high, moderate, low, and very low, with  
437 these evaluations based on the type of study conducted,  
438 limitations of the study, inconsistencies in results, indir-  
439 ectness of evidence, imprecision, and potential reporting  
440 bias. Strength of the recommendation is classified into  
441 strong and weak, based on the quality of the evidence,  
442 uncertainty about the effects, variability in values, and

443 uncertainty about resource use (in the case of  
444 interventions).

#### 445 Discussion

446 If changes are needed during the course of conducting  
447 the systematic review, we will make a dated amendment  
448 to our published PROSPERO review protocol  
449 (CRD42020176664). Although we will not limit the lan-  
450 guage of publications, we anticipate that publications in  
451 languages other than Afrikaans, Cantonese, English,  
452 Hebrew, Mandarin, Portuguese, or Spanish will require  
453 the use of professional translation services as the re-  
454 viewer team is familiar with the aforementioned lan-  
455 guages only. Accurate reporting of the original content  
456 will hinge on the accuracy of such translation. Another  
457 potential limitation relates to the level of publication de-  
458 tail, particularly regarding exposures and mental health  
459 impacts. A lack of detail is likely to limit the usefulness  
460 of the review to policy makers and mental health practi-  
461 tioners. We intend to make these stakeholders (and  
462 others, including adolescent clients/patients, their fam-  
463 ilies, caregivers, and scientists) aware of review findings  
464 through social media posts, presentations at inter-  
465 national meetings, and an academic publication in a  
466 peer-reviewed journal.

467 Despite these possible limitations, we believe that the  
468 proposed review is overdue. Adolescents comprise at  
469 least 16% of the world's population [43]. Pollution effects  
470 are threatening the wellbeing of this sizeable population  
471 [1]. To better ensure the transition to healthy adulthood  
472 and protect the wellbeing of the world's current and fu-  
473 ture adolescents, a thorough understanding is needed of  
474 how adolescent mental health is affected by pollution  
475 and what might enable resilience to pollution effects.  
476 The review that we propose is a first step in gaining that  
477 thorough understanding.

#### 478 Abbreviations

479 DSM-5<sup>TR</sup>: Diagnostic and Statistical Manual of Mental Disorders;  
480 GRADE: Grading of Recommendations Assessment, Development and  
481 Evaluation; LMICs: Low- and middle-income countries

#### 482 Supplementary Information

483 The online version contains supplementary material available at <https://doi.org/10.1186/s13643-021-01639-z>.

[Q6]

487 **Additional file 1:** PRISMA-P 2015 Checklist. This checklist has been  
488 adapted for use with protocol submissions to *Systematic Reviews* from  
489 Table 3 in Moher D et al: Preferred reporting items for systematic review  
490 and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic Re-*  
491 *views* 2015 4:1

492 **Additional file 2:** APA PsycArticles search strategy, modified as needed  
493 for other electronic databases  
494

[Q4]

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502

#### 503 Authors' contributions

504 LT led the conceptualization of the protocol with input from all authors. LT  
505 and KH wrote the first and final protocol drafts. All other authors provided  
506 valuable editorial input to the drafts. The authors read and approved the  
507 final manuscript. [Q5]

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#### 514 Availability of data and materials

515 Data sharing is not applicable—no new data were generated for the  
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#### 517 Declarations

#### 518 Ethics approval and consent to participate

519 Not applicable to this protocol.

#### 520 Consent for publication

521 All co-authors have consented to publication.

#### 522 Competing interests

523 The authors declare that they have no competing interests.

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