

1 **The influence of individual provider characteristics and attitudes on**  
2 **caesarean section decision-making**

3

4 Caesarean section (CS) rates ~~have been~~ have risen ~~rising~~ worldwide in the past two  
5 decades, particularly in middle and high-income countries. In addition to changing  
6 maternal and health system factors, there is growing evidence that provider factors may  
7 contribute to rising unnecessary caesareans. The aim of this review ~~aimed was~~ to assess  
8 the evidence for the associations between individual provider characteristics, attitudes  
9 towards CS and decision-making for CS. A search was conducted in May 2018 in  
10 PubMed and Web of Science with 23 papers included in our final review. Our results  
11 show that higher anxiety scores and more favourable opinions of CS were associated with  
12 increased likelihood of performing CS. ~~Our~~ These results ~~findings~~ highlight a need for  
13 appropriate interventions to target provider attitudes towards CS to reduce unnecessary  
14 procedures.

15           Keywords: caesarean delivery; provider; obstetrician; midwife; attitudes

16

## 17 Introduction

18

19 Caesarean section (CS) rates have risen are rising worldwide in all global regions in the  
20 past two decades, particularly in middle and high-income countries (Betrán *et al.*, 2007,  
21 2016; Vogel *et al.*, 2015). When medically indicated, this procedure can be life-saving  
22 for both the mother and unborn child. However, rapidly rising CS rates indicate the  
23 procedure is ~~often increasingly~~ used in the absence of medical indications (Gibbons *et*  
24 *al.*, 2010; Kabore *et al.*, 2016), increasing the risk of obstetric complications when  
25 compared to vaginal birth, such as infection, bladder injury, and deep-vein thrombosis  
26 (Souza *et al.*, 2010; Ye *et al.*, 2016). Unnecessary CS may also place increased pressure  
27 and financial burden in health systems with limited resources, and act as a barrier to  
28 achieving universal health coverage for emergency obstetric care (Gibbons *et al.*, 2010).

29

30 Studies have attempted to identify the major factors driving the rise in CS ~~procedures~~,  
31 with the aim of providing guidance on reducing unnecessary CS (Khunpradit *et al.*, 2011;  
32 Mascarello, Horta and Silveira, 2017; Mumtaz, Bahk and Khang, 2017; Shabila, 2017).

33 The evidence has shown that, in addition to changing clinical practices and demographic  
34 maternal factors such as increases in BMI and maternal age leading to higher-risk  
35 deliveries (Khan *et al.*, 2017), economic, organisational and legal factors higher  
36 ~~socioeconomic status and private healthcare systems service level factors~~ may also  
37 contribute to the observed rise (Linton, Peterson and Williams, 2004; Kamal *et al.*, 2005;  
38 Soto-Vega *et al.*, 2015). In addition, maternal request was often thought to contribute to  
39 rising CS rates, but a systematic review ~~by Mazzone *et al.* (2011)~~ (Mazzone *et al.*, 2011)  
40 showed only a minority of women express a preference for caesarean delivery (Mazzone  
41 *et al.*, 2011). There is some suggestion that preference for CS is higher later in pregnancy,

42 implying that interactions with providers during pregnancy may contribute to shaping  
43 maternal requests for CS\_(Domingues, 2014).

44

45 In addition to maternal and health system factors, it is increasingly recognised that  
46 individual provider factors ~~– including individual-level characteristics such as gender and~~  
47 ~~occupation, as well as perceptions, attitudes and opinions of CS –~~ may have a  
48 ~~significant~~ influence on CS rates\_(Panda, Begley and Daly, 2018). ~~Provider factors~~  
49 ~~include individual-level characteristics (such as age, gender, occupation) as well as their~~  
50 ~~perceptions, attitudes and opinions of CS.~~ Previous studies have identified wide variation  
51 in individual providers' CS rates\_(Poma *et al.*, 1999; Grant, 2005). A recent systematic  
52 review ~~of clinicians' opinions of factors influencing decision-making for CS~~ by Panda  
53 and colleagues\_(Panda, Begley and Daly, 2018) ~~suggests~~ found that clinicians' report that  
54 personal beliefs about CS are a major factor influencing decision-making for CS,  
55 alongside health system factors and individual characteristics. However, no reviews to  
56 date have assessed how providers' characteristics and attitudes to CS are associated with  
57 their CS decision-making in practice.

58

59 The aim of ~~our study~~this review is to ~~review~~synthesise the evidence on individual  
60 provider characteristics, attitudes and CS decision-making by examining the association  
61 between: (1) individual provider characteristics and provider attitudes towards CS; (2)  
62 individual provider characteristics and CS decision-making; and (3) provider attitudes  
63 towards CS and CS decision-making.

## 64 **Materials and Methods**

65

66 A conceptual framework was developed to describe the inter-related factors influencing  
67 CS decision-making, including individual-level provider characteristics and attitudes  
68 (Figure 1). Provider attitudes to CS, defined in this study as providers' evaluation of the  
69 risks and benefits of performing a CS compared to vaginal delivery, are thought to  
70 influence how likely they are to perform a CS. Provider attitudes are likely to be shaped  
71 by individual-level characteristics, such as age and years of practice, as well as their  
72 facility and health system culture, including insurance systems, financial incentives, and  
73 resource availability. In daily practice, providers' attitudes to CS may interact with  
74 maternal and health system factors in shaping their decision-making on mode of delivery:  
75 for example, a provider ~~believing that CS carries very little risk to the mother~~ is more  
76 likely to accept a maternal request for CS in the absence of medical indications if they  
77 believe that CS carries very little risk to the mother, especially or if they practice in a  
78 health system context where they receive a higher payment for CS than vaginal delivery.

79

80 We carried out a literature review in May 2018 to identify papers assessing the association  
81 between (1) individual provider characteristics and attitudes towards CS, (2) individual  
82 provider characteristics and CS decision-making, and (3) provider attitudes towards CS  
83 and CS decision-making. We searched PubMed and Web of Science using keyword  
84 search terms related to caesarean section, CS attitudes and decision-making, and  
85 providers (Supplementary Table 1 for search strategy).

86

87 A manual search of the reference lists of the most relevant articles was also performed to  
88 identify any further literature eligible for inclusion. Only English publications ~~in English~~

89 from the last 10 years reporting quantitative findings were included in this review, but  
90 ~~there was no discrimination~~no studies were excluded based on geographic location. ~~Only~~  
91 ~~quantitative research was considered, and e~~Evidence on all providers caring for women  
92 during labour or influencing their mode of delivery was included (obstetricians-  
93 gynaecologists, nurses and midwives).

94  
95 We considered studies to assess providers' attitudes to CS if they measured agreement  
96 with statements on risks of CS (such as safety/risk to mother and/or baby), reported  
97 preferred mode of delivery for themselves or a relative, ~~or~~ opinions on optimal caesarean  
98 rates, or caesarean rates in their own health facility. We considered articles measuring  
99 both self-reported and observed CS decision-making, including self-reported agreement  
100 to CS on maternal request or vaginal birth after caesarean (VBAC); self-reported  
101 preferred mode of delivery for their patients; recommendation for mode of delivery based  
102 on clinical vignettes/scenarios, and individual provider CS rates. Non-CS specific indices  
103 measuring fear, anxiety, or risk-taking were considered as suitable proxies for overall  
104 provider attitudes affecting clinical CS decision-making.

105  
106 The identified publications were first screened on the basis of ~~abstract~~ title and  
107 ~~title~~ abstract. Retained articles were then assessed on the basis of full text to determine if  
108 they met the inclusion criteria (summarised in Table 12), ~~with~~ ~~S~~some articles  
109 ~~contributed~~ to several objectives. We did not use a formal ranking system to assess the  
110 quality of evidence. A systematic review was not attempted for this topic due to the lack  
111 of established index terms and the diversity in measurement of attitudes to CS and CS  
112 decision-making in the literature.

113 **Results**

114

115 A total of 2642 individual papers were identified through our search strategy. 2619 were  
116 excluded (~~54~~ due to duplication, 2444 based on title/abstract, and the remaining 1210  
117 after full-text review due to lack of quantification for the association between provider  
118 characteristics, provider attitudes and/or CS decision-making) (Figure 2). A total of 23  
119 unique studies were included in our review. Table 2 summarizes the key findings for each  
120 objective; Table S2 Supplementary Table 2 describes full data extraction of all included  
121 papers, split by ~~sub~~-objective.

122

123 Of the 23 studies, one had a global scope, 12 (52%) were conducted in Europe, six (26%)  
124 in North America, ~~while and~~ the remaining four ~~were spread across the remaining~~  
125 ~~regions from~~ Australia, Russia, Nigeria and Japan. ~~One study had a global scope,~~  
126 ~~while~~ Notably, no studies were conducted in China or South Asia. Twenty-one studies had  
127 providers as study respondents, while in two ~~had~~ women who had given birth ~~as study~~  
128 ~~respondents (who were asked about~~ reported provider characteristics and mode of  
129 delivery).

130

131 *Association between individual provider characteristics and provider attitudes*  
132 *towards CS*

133

134 Nine studies investigated the association between provider characteristics and attitudes  
135 towards CS. Of the 5 studies that investigated differing attitudes to CS by provider gender,  
136 one study in Italy (Monari et al., 2008) observed no difference in attitudes on CS rate in  
137 their own hospital or risk/benefits of the procedure (Monari et al., 2008) and one study in

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138 ~~Sweden (Josefsson et al., 2011) found male and female providers' reported similar~~  
139 ~~"reasonable" CS rates for their hospital (13.7% vs 13.1%, p=0.028) (Josefsson et al.,~~  
140 ~~2011) or risk/benefits of the procedure.~~ One study in Sweden found no difference in  
141 percentage of male and female providers reporting a preference for vaginal delivery for  
142 themselves, a partner or their daughter (p=0.642) (Gunnervik et al., 2008) although more  
143 female than male providers felt that the current CS rate in their own department was too  
144 high (43.5% vs 34.1%, p=0.025) (Gunnervik et al., 2008). One global survey of obstetric  
145 care providers (Cavallaro, Cresswell and Ronsmans, 2016) found males reported a higher  
146 optimal CS rate than females (25% vs 20%, p=0.008) (Cavallaro, Cresswell and  
147 Ronsmans, 2016). ~~although in Sweden (Josefsson et al., 2011) male and female providers'~~  
148 ~~report similar "reasonable" CS rates for their hospital (13.7% vs 13.1%, p=0.028).~~ In the  
149 United Kingdom, male providers were more likely to opt for a CS "for themselves or their  
150 partners" than female providers (13% vs 9%, no p-value reported) (Lightly et al., 2014).  
151  
152 Of the 34 studies that investigated differing attitudes to CS by provider age, 3-2 studies  
153 conducted in Sweden reported that older providers were more likely to agree that CS is  
154 as safe as vaginal birth for mother and baby, and the best mode of delivery for a woman  
155 with fear of delivery (Gunnervik et al., 2008; Josefsson et al., 2011) (Josefsson et al.,  
156 2011) (Sahlin et al., 2017). However, one global survey (Cavallaro, Cresswell and  
157 Ronsmans, 2016) found no difference in reported optimal CS rate by age of providers  
158 (p>0.05) (Cavallaro, Cresswell and Ronsmans, 2016).  
159  
160 Two studies assessed the differing attitudes to CS by years of practice experience: one  
161 paper showed no difference between provider responses to questions on safety/risk of CS  
162 procedure (Josefsson et al., 2011). In Sweden, providers with longer work experience

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163 were less likely to agree that vaginal birth increases the risk of incontinence (p=0.005)  
164 and prolapse (p=0.001) than providers with shorter work experience, however there was  
165 only weak evidence of a difference in agreement that elective CS is as safe for mother as  
166 vaginal birth (p=0.056)(Gunnervik et al., 2008).

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168 Six studies examined differences in attitudes to CS by provider occupation. Three studies

169 ~~(Sahlin et al., 2017) (Kisa, Kisa and Younis, 2017) (Monari et al., 2008)~~ in Sweden,

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170 Turkey and Italy found that midwives were more likely than obstetricians to report that  
171 the CS rates in their own hospitals were too high (p=0.033; no p-value reported; p<0.001,

172 respectively) (Monari et al., 2008; Kisa, Kisa and Younis, 2017; Sahlin et al.,

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173 2017)(~~Sahlin et al., 2017) (Kisa, Kisa and Younis, 2017) (Monari et al., 2008)~~, and in

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174 Sweden researchers found midwives reported slightly lower reasonable CS rates than

175 obstetricians (11.5% vs 13.8%, p<0.001)(Josefsson et al., 2011). Midwives in Italy were

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176 less likely than obstetricians to believe that CS provides benefits to the mother (p=0.02)

177 and reported more risks associated with elective CS, including foetal distress and

178 emotional stress (Monari et al., 2008). One study in the United States reported attitude

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179 scores more favourable to CS among obstetricians than midwives (~~no scores or p values~~

180 ~~were reported~~)(White VanGompel et al., 2018), while ~~researchers in Australian~~ found

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181 midwives were less likely to opt for elective CS in future pregnancies (11% vs 21%, no

182 p value)(Turner et al., 2008). Only one study, conducted in Sweden, found no difference

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183 between midwives and obstetricians in agreement to vaginal birth being preferable to CS  
184 (p=0.809)but did find obstetricians were more likely to agree that CS is as safe as vaginal

185 birth (p<0.001) (Josefsson et al., 2011).

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186 *Association between individual provider characteristics and CS decision-*  
187 *making*

188

189 A total of 16 studies investigated the association between provider characteristics and CS  
190 decision-making. Of the nine studies examining the association between provider gender  
191 and CS decision-making, Four-four studies observed no difference by gender in  
192 providers' willingness to offer VBAC in women with two prior CS (Doret *et al.*,  
193 2010)(~~M. et al., 2010~~),<sup>27</sup> acceptance of CS on maternal request (Chigbu, Ezenyeaku and  
194 Ezenkwele, 2010), or obstetrician CS rates (Dweik *et al.*, 2014; Ito *et al.*, 2014)(~~Dweik et~~  
195 ~~al., 2014~~). In clinical scenarios, the odds of male providers were more likely to  
196 recommending CS were 1.50 to 2.74 times higher than for female providers (OR= 1.50;  
197 95% CI 1.05— 2.13) in the United States (~~Cheng et al., 2014~~) and Russia (Danishevski *et*  
198 *al.*, 2008; Cheng *et al.*, 2014) (~~OR=2.74, p=0.015~~)(~~Cheng, Snowden, Handler, Tager,~~  
199 ~~Hubbard, Caughey, et al., 2014~~); male providers were also more likely to accept CS on  
200 maternal request with previous complicated deliveries (OR=-1.92; p<0.001) in Norway  
201 (Fuglenes, Øian and Kristiansen, 2009) and to agree with CS on maternal request in  
202 Sweden (p<0.001) (Gunnervik *et al.*, 2008). One study in the United States found male  
203 providers had higher mean CS rates when compared to their female colleagues, although  
204 the absolute difference was small (33.6% vs 29.9%, p=0.002) (McClelland *et al.*, 2017).

205

206 Of the ~~seven~~<sup>4</sup> studies investigating the association between provider age and CS  
207 decision-making, ~~four~~<sup>4</sup> studies observed little or no difference in age as a determinant  
208 for higher CS rates in Hungary (~~p=0.061~~)(Dweik *et al.*, 2014), in preferred delivery mode  
209 for their patients in Norway (Fuglenes, Øian and Kristiansen, 2009), willingness to offer  
210 VBAC (Doret *et al.*, 2010) —and for acceptance of CS on women's request in Sweden

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211 ~~(p=0.052)~~(Gunnervik et al., 2008) and Nigeria ~~(p=0.17)~~(Chigbu, Ezenyeaku and  
212 Ezenkwele, 2010). The remaining two studies ~~observed-reported~~ older providers were  
213 more likely than their younger counterparts to recommend CS (OR 1.84, p<0.001) in the  
214 United States and to perform CS in Russia (OR 1.04 with each additional year, p=0.033)  
215 ~~(Danishevski et al., 2008)~~. (Danishevski et al., 2008; Cheng et al., 2014).

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216  
217 Of the six studies assessing the association between years of provider practice experience  
218 and CS decision-making, three studies found no difference in obstetricians' willingness  
219 to offer VBAC in France ~~(p>0.05)~~(Doret et al., 2010), accept maternal requests for CS in  
220 Nigeria ~~(p=0.56)~~(Chigbu, Ezenyeaku and Ezenkwele, 2010), or recommend CS in the  
221 United States ~~(p>0.05)~~(Cheng et al., 2014). One Swedish study observed that providers  
222 with ≥10 years' work experience were more likely to agree with a woman's right to  
223 elective CS than those with less work experience (p=0.022)(Gunnervik et al., 2008).  
224 ~~conversely, while a~~An American-British study also found physicians practicing obstetrics  
225 for >10 years were significantly more likely to offer VBAC than those practising for less  
226 (52% vs 36%, p<0.001)(Wells, 2010). ~~Conversely, in t~~Two and in one studies from  
227 ~~(Saudi Arabia, United States), conversely, found that more less~~ experienced staff had up  
228 ~~to 2.5-fold lower higher~~ CS rates —one study found that less experienced staff (board  
229 ~~certified) had 2.5 fold higher CS rate than consultants~~(Al-Kadri et al., 2015). ~~(Wells,~~  
230 ~~2010).~~

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231  
232 Of the ~~seven-six~~ studies analysing the association between provider occupation and CS  
233 decision-making, one study in Sweden found no difference by provider occupation in  
234 their agreement to women's request for CS (p=0.952) (Sahlin et al., 2017). In Poland,  
235 midwives were less likely to approve of maternal request for CS than obstetricians (14.8%

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236 vs 35.9%, p<0.001), while no difference was observed between Ukrainian midwives and  
237 obstetricians (p=0.1419) (Skreć-Magierło et al., 2016). One Argentine study found  
238 obstetricians ~~were had~~ 4.4 times ~~higher the odds more likely than midwives~~ to perform  
239 CS on maternal request ~~than midwives~~ (95% CI 1.58—12.09, no p value) (Rivo et al.,  
240 2018). Three papers directly examined differences in CS rates by occupation: in the  
241 United States, care by obstetricians compared to midwives was associated with an  
242 increased risk of unplanned CS in two studies - (~~adjusted OR: -1.43, 95% CI: 1.04—~~  
243 ~~2.12~~) (Carlson et al., 2018) and (41.8% vs 29.9%, p<0.0001) (McClelland et al., 2017).  
244 ~~while in~~ Canada, ~~the relative risk of CS delivery was 0.48 when~~ women cared for by  
245 family physicians ~~had half the caesarean rate~~ compared to obstetricians after  
246 ~~adjustments~~ for age, income, hospital type and a number of clinical risk factors.  
247 However, after adjusting for unmeasured confounders using instrumental variable  
248 analysis, the caesarean rate was 27% higher in family physicians compared to  
249 obstetricians (Dawe et al., 2017).

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### 250 *Association between provider attitudes towards CS and CS decision-making*

251  
252 Three studies examined the association between provider attitudes and their CS decision-  
253 making, using quantitative indices to measure attitudes. Two of ~~the studies~~ these  
254 calculated a score based on general provider attitudes/traits (not specific to CS), ~~while~~  
255 ~~one study calculated a score specific to provider attitudes towards CS. One~~ The first  
256 ~~paper~~ from Norway calculated a fear index, measuring providers' fear of complaints and  
257 litigation ~~(rather than of the CS itself)~~, and a risk attitude index, measuring general  
258 decision-making under uncertainty, using a previously validated tool ~~measuring general~~  
259 ~~decision-making under uncertainty~~ (Fuglenes, Øian and Kristiansen, 2009). Providers  
260 with a higher fear score were more likely to recommend CS in all five ambiguous clinical

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261 scenarios (OR range: 1.05-1.10), however risk attitude was not associated with CS  
262 recommendation in any of the scenarios. The second study in Wales calculated a general  
263 anxiety trait score among attending registrars using a validated psychometric  
264 questionnaire, and found a strong correlation between higher anxiety trait levels and  
265 registrars' emergency CS rate (Pearson's correlate 0.722, p<0.001) (Allcock, Griffiths  
266 and Penketh, 2008).

267  
268  
269  
270 ~~Another~~ The second ~~third~~ study conducted in the United States calculated a score specific  
271 to provider attitudes toward CS, using ~~ed~~ a previously validated questionnaire survey  
272 instrument of provider birth attitudes (including benefits of caesarean section and fear of  
273 vaginal birth) to calculate an attitude score out of 5, with higher scores indicating more  
274 favourable attitude to CS. Providers' CS rates were significantly associated with their  
275 attitude scores, with each 1-point increase in attitude score associated with a 21% increase  
276 in CS rates (incidence rate ratio: 1.21, 95% CI: 1.002—1.45) (White VanGompel et al.,  
277 2018). ~~One~~

278 ~~second study in Wales calculated a general anxiety trait score among of attending~~  
279 ~~registrars using a validated general psychometric questionnaire, and found a strong~~  
280 ~~correlation between higher anxiety trait levels and registrars' emergency CS rate~~  
281 ~~(Pearson's correlate 0.722, p<0.001) (Allcock, Griffiths and Penketh, 2008).~~

282  
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284 **Discussion**

285

286 Results from this review show that attitudes towards CS (including anxiety trait scores  
287 and fear of litigation) were associated with ~~the a higher~~ propensity to perform caesareans.  
288 In contrast, the evidence regarding individual provider characteristics, such as gender,  
289 age and years of practice experience showed varied results. Around half of studies found  
290 that male providers ~~were~~ more likely to have favourable attitudes towards caesareans,  
291 although these were all conducted in ~~Western EuropeSweden~~, limiting their  
292 generalisability; ~~and~~ half of studies found that male providers were more likely to perform  
293 CS, most of which were conducted in Scandinavia and North America. There was mixed  
294 evidence that older providers had ~~ve~~ more favourable attitudes and are more likely to  
295 perform caesareans; while years of practice ~~showed showed little evidence of a difference~~  
296 ~~in attitudes with half of studies reporting no association, the remaining evidence presents~~  
297 ~~inconsistencies in the direction of CS decision-makingno or inconsistent associations~~  
298 ~~with CS decision-making~~. Midwives consistently had ~~ve~~ a less favourable opinion of CS  
299 than obstetricians, although birth attendant occupation ~~was~~ not consistently associated  
300 with CS rates.

301

302 Roter et al. (2002) and Janssen et al. (2012) ~~have commented~~suggested that male  
303 providers often have poorer communication with patients when compared to their female  
304 counterparts, where female providers often engage in more positive and informative  
305 dialogue with a more patient-centred approach, which may ~~influence the likelihood~~  
306 ~~of reduce~~ maternal request for CS ~~due to their patients being more educated by their~~  
307 ~~attending physician due to improved patient education and confidence~~ (Roter, Hall and  
308 Aoki, 2002; Janssen and Lagro-Janssen, 2012). ~~Another possible explanation for the~~

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309 ~~gender differences in attitudes towards CS could be the choice of obstetrician;~~  
310 ~~Furthermore, Liu et al noticed-observed~~ that patients in Taiwan would often ~~specifically~~  
311 request a female obstetrician, which could lead to reduced clinical experience for male  
312 providers, potentially accentuating their anxiety of vaginal birth and distorting risk  
313 perceptions of the CS procedure (Liu et al., 2008).

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314  
315 It is unclear why older providers were found to have a ~~different-lower~~ risk perception than  
316 their younger colleagues, although in Gunnervik (2008)'s study, ~~the~~ older physicians  
317 reported feeling a higher pressure and demand from midwives to end an ongoing delivery  
318 with CS, compared to their younger ~~and less-experienced~~ colleagues (Gunnervik et al.,  
319 2008). This may lead to obstetricians becoming desensitised to the risks of ~~caesareans~~ CS,  
320 increasing their likelihood of ~~recommendation-performing or recommending a CS~~ over  
321 time. Alternatively, Sahlin (2017)'s review of old and new medical textbooks showed  
322 that listed indications of CS had increased over time, which may explain why older  
323 providers relate differently to CS than their younger counterparts (Sahlin et al., 2017).

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324  
325 One possible explanation for midwives consistently having less favourable attitudes  
326 towards CS could be related to their training and healthcare approach. One study in the  
327 Netherlands suggested that the differing attitudes by occupation may be due to traditional  
328 care models in Western European countries where midwives have a less medicalised  
329 attitude to childbirth compared to obstetricians, who often take a more biomedical  
330 approach; ~~they-the authors state-suggest rising that their~~ CS rates ~~rising~~ may be a  
331 consequence of ~~their-the~~ primarily midwife-led care model becoming increasingly  
332 obstetrician-led in the Netherlands (Offerhaus *et al.*, 2015). ~~Another explanation may be~~  
333 ~~that~~ In addition, obstetricians ~~are-may be~~ more comfortable and involved with surgical

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334 procedures and tend to see more complicated pregnancies than midwives, ~~which~~  
335 ~~may potentially~~ leading to a biased perspective of the risks of vaginal delivery overall.  
336 One study observed midwives were less risk-averse than obstetricians, and would accept  
337 higher levels of risk before opting for a CS (Cox, 2011), while another found ~~midwives~~  
338 ~~were willing to accept significantly higher risks of potential complications of vaginal birth~~  
339 ~~than clinicians~~ ~~physicians~~ ~~significant differences in attitudes of risk associated with~~  
340 ~~vaginal birth~~ (Turner et al., 2008), suggesting differences in risk attitude could also  
341 contribute to explaining the difference in acceptance of CS between midwives and  
342 obstetricians. The observed higher CS rates among deliveries assisted by obstetricians  
343 and family medicine physicians compared to midwives likely reflects both more  
344 favourable attitudes towards the procedure as well as differences in risk of deliveries of  
345 their patient populations, in settings where deliveries without complications are managed  
346 by midwives and physicians are responsible for the final decision to perform a CS.

347  
348 Our findings echo the conclusions of the review by Panda ~~and colleagues (2018)~~ (Panda,  
349 Begley and Daly, 2018), which identified that clinicians' personal beliefs are the main  
350 factor identified by providers as influencing their decision to perform CS, alongside  
351 individual ~~provider~~ characteristics and health system factors. Our review confirms that  
352 attitudes to CS and anxiety/fear can be associated with clinician's decision, although the  
353 evidence base is currently limited. In addition, the quantitative scores used ~~in included~~  
354 ~~studies~~ had not all been validated. The one paper identified that calculated an attitude  
355 score towards CS did not include a number of important factors that emerged from  
356 Panda's review, such as provider's responses regarding convenience of CS or confidence  
357 levels in performing CS, and therefore may not have captured all relevant attitudes (White  
358 VanGompel et al., 2018).

359  
360 General risk scores were not associated with CS in one study\_(Fuglenes, Øian and  
361 Kristiansen, 2009), although higher general anxiety trait and higher composite attitude  
362 score (i.e. more favourable attitudes towards CS) provider attitudes regarding “fear of  
363 vaginal birth” and “safety by mode or place of birth” were associated predictive of  
364 higherwith provider’s CS rates in other studies\_(Allcock, Griffiths and Penketh, 2008;  
365 White VanGompel *et al.*, 2018) (~~Allcock, Griffiths and Penketh, 2008~~); for the former  
366 study, the results observed may be due to a lack of proximity how closely related theof  
367 the general risk score was to how clinical ns make CS decision-makings about caesareans  
368 rather than a true lack of effect. Gawande (~~2006~~) argues that the increased use of CS is  
369 partly due to a desire to manage the risks of vaginal deliveries: scheduled CS are less  
370 risky than emergency CS, and the reliability of caesareans in producing better Apgar  
371 scores may encourages providers to choose them, despite the increased risk to mothers  
372 (Gawande, 2006), suggesting a possible explanation for that risk-adverse providers may  
373 indeed haveinge higher CS rates.

374  
375 Most of the evidence concerning providers and CS decision-making concerns the link  
376 between individual characteristics and decision-making. There is scarce evidence on  
377 provider attitudes towards CS, and we only identified three studies that calculated a  
378 quantitative attitude index score, highlighting the need to further understand the specific  
379 psychological traits or opinions of CS leading to more interventionist practice. This  
380 scarcity of evidence is problematic because providers’ attitudes are a more proximal risk  
381 factor for CS decision-making than provider characteristics; furthermore, characteristics  
382 such as age and gender are non-modifiable, offering little opportunity for intervention to  
383 limit unnecessary caesareans. Based on the three identified studies, the association

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384 between providers' favourable CS-attitudes towards CS and higher practice of CS seems  
385 strong, suggesting ~~efforts to prevent unnecessary CS should~~that interventions targeting  
386 provider attitudes to CS should be explored as an avenue for preventing unnecessary CS.

387  
388 Our study has some limitations. We only considered articles published in English,  
389 although only 4 publications were excluded due to language. The diversity in  
390 measurement of provider attitudes and CS decision-making across studies was a  
391 challenge for synthesising results. The majority of studies used Likert scales to measure  
392 agreement with statements on risks related to caesareans, while others used questionnaires  
393 and clinical scenarios to capture views and opinions. ~~T~~hese proxies may not represent  
394 provider's true CS rates, however vignettes have been shown to be valid in other contexts,  
395 and similar patterns were observed with studies examining the association with CS rates  
396 (Mohan et al., 2013; Evans et al., 2015)-. There is a lack of consensus in the literature on  
397 how to calculate ~~attitudes~~ indices measuring attitudes towards CS among providers. ~~;~~

398 ~~w~~We suggest adapting and validating a version of the birth attitudes score adapted used  
399 by White VanGompel (2018) (White VanGompel et al., 2018), to ensure all important  
400 factors influencing propensity to perform CS are captured. This score comprised Likert-  
401 style items on factors likely to affect primary caesarean among low-risk women  
402 (including fear of vaginal birth for themselves or partner and safety of caesarean section  
403 compared to vaginal delivery for women and babies);- we suggest ~~by~~ including additional  
404 factors such as opinions on convenience ~~of CS~~ and confidence ~~of performing a vaginal~~  
405 birth (as identified ~~as to possibly~~ influencing decision-making by Panda et al (Panda,  
406 Begley and Daly, 2018) and Savage et al (Savage, 2007)), ~~to ensure all important factors~~  
407 influencing propensity to perform CS are captured.

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409 The key strength of our paper was the conceptual framework we developed to describe  
410 the relationship between individual provider characteristics, provider attitudes towards  
411 CS, and CS decision-making. This study reviewed the association between these three  
412 groups of factors separately, identifying stronger evidence for the association of the more  
413 proximal risk factor (attitudes to CS) than distal risk factors (individual characteristics)  
414 with clinical practice, supporting our conceptualisation of the relationship between these  
415 variables.

416  
417 Our results suggest that interventions targeting providers' attitudes towards CS may help  
418 reduce unnecessary interventions. A meta-analysis by Chaillet (2007) (Chaillet and  
419 Dumont, 2007) of evidence-based strategies for reducing CS rates only found one study  
420 incorporating physician education of maternal and foetal benefits of vaginal birth  
421 ( $p < 0.001$  for reduction of CS rates post-intervention). To our knowledge, no studies have  
422 attempted to change provider risk perceptions towards CS, however previous work on  
423 providers' attitudes towards evidence-based guidelines may help inform any future  
424 interventions. From Grimshaw (2001) (Grimshaw et al., 2001) it is known that passive  
425 interventions alone such as posters in the workplace are unlikely to elicit change in  
426 practice, and multifaceted approaches incorporating both active and passive components  
427 at regular intervals are more effective at changing attitudes (Grimshaw et al., 2001). For  
428 CS, regular audits and feedback on CS rates in each clinical practice, and regular training  
429 on indications for CS may help remind providers of the risks of CS and support them in  
430 assisting complicated vaginal deliveries; it may also be useful to provide support after  
431 experiencing a traumatic delivery to mitigate fear attitudes. Implementation of evidence-  
432 based guidelines combined with a mandatory second-opinion policy may also curtail  
433 the influence of personal attitude on decision-making and reduce unnecessary procedures.

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434 ~~and has been shown to slightly reduce CS use (sites in health facilities in Argentina,~~  
435 ~~Brazil, Cuba, Guatemala, and Mexico) and in Taiwan~~ (Althabe *et al.*, 2004; Liang *et al.*,  
436 2004). Additionally, recently one hospital programme in the United States found a  
437 significantly decreased primary CS rate when residents were supervised by a senior  
438 obstetrician (Bardos *et al.*, 2017). Further research is needed to understand in which  
439 policy and healthcare organisation contexts mandatory second opinions could help  
440 prevent unnecessary CS, and what other interventions may be effective. The WHO  
441 recently reviewed the evidence on non-clinical interventions to reduce unnecessary CS  
442 (World Health Organization (WHO), 2018) , however, based on the evidence available  
443 recommendations focus on educating women about the risks of CS and improving  
444 provider adherence to protocols (through audits and feedback, and mandatory second  
445 opinion). No guidance exists on interventions directly challenging provider beliefs or  
446 attitudes regarding CS, which our results suggest are worth exploring. ~~within existing~~  
447 ~~policies of decision-making to understand in which contexts mandatory second opinion~~  
448 ~~could help prevent unnecessary CS. regarding~~The need for further research to guide the  
449 ~~development of non-clinical interventions to reduce unnecessary caesarean sections led~~  
450 ~~the WHO to establish a working group and publish specific guidance on the issue.~~

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451  
452 Finally, in our review we identified a lack of studies from certain geographical areas  
453 where CS rates are known to be exceptionally high, such as East and South Asia, Eastern  
454 Europe, the Middle East and Latin America and therefore it would be important to  
455 conduct further studies to understand the influence of provider characteristics and  
456 attitudes in these regions.

## 457 **Conclusion**

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459 As key decision-makers for CS, obstetricians drive the overall CS rates within their  
460 countries. However, the factors that influence their decision are multiple and difficult to  
461 quantify. To our knowledge, this was the first review of ~~the quantitative~~ evidence ~~for on~~  
462 ~~the~~ association between provider characteristics, attitudes, and decision-making for CS,  
463 ~~aiming to synthesise what is known about how the former two domains affect the latter~~ CS  
464 ~~decision-making in practice~~. Our results indicate that provider attitudes ~~appear to be an~~  
465 ~~important~~ ~~are a~~ determinant of CS decision-making – ~~confirming obstetricians’ opinions~~  
466 ~~synthesised in a prior review~~ (Panda, Begley and Daly, 2018) – ~~and that interventions~~  
467 aiming to change provider attitudes may help to prevent unnecessary CS. Heterogeneity  
468 was observed in our findings related to individual provider characteristics, suggesting that  
469 associations with CS attitudes and decision-making are context-specific and therefore any  
470 interventions to prevent unnecessary CS must be tailored to the setting. Provider gender,  
471 age and occupation are not modifiable through intervention, but they may be helpful in  
472 targeting interventions to change ~~provider~~ attitudes ~~and ensure women receive the safest~~  
473 ~~and most appropriate care at birth~~.

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476

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481

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484

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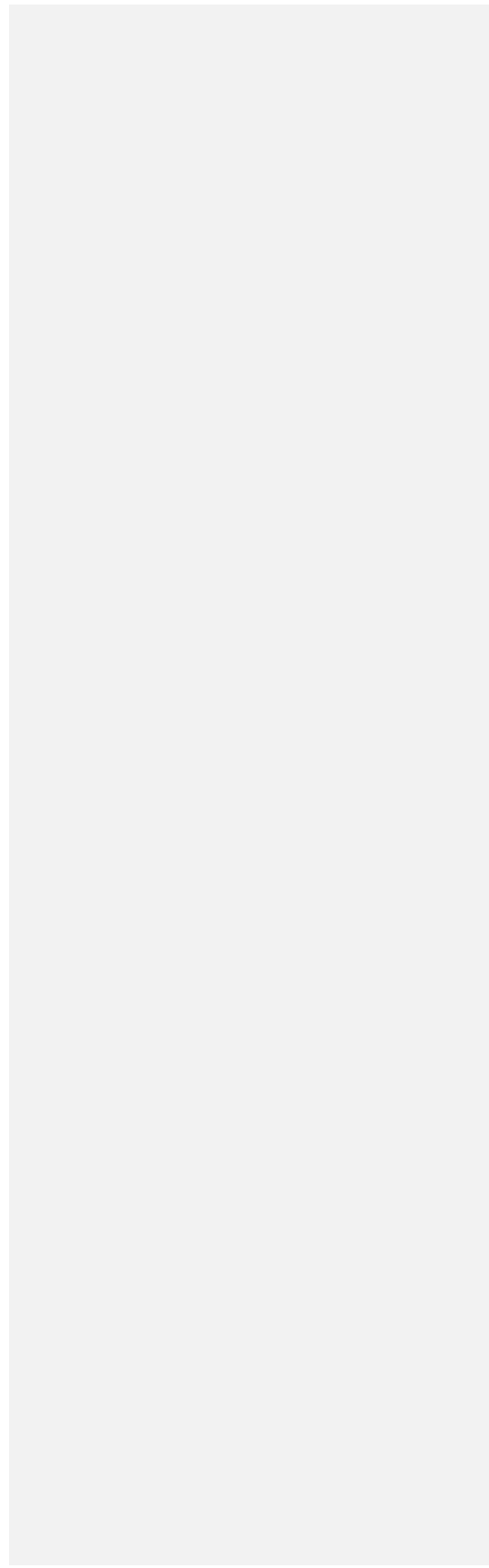
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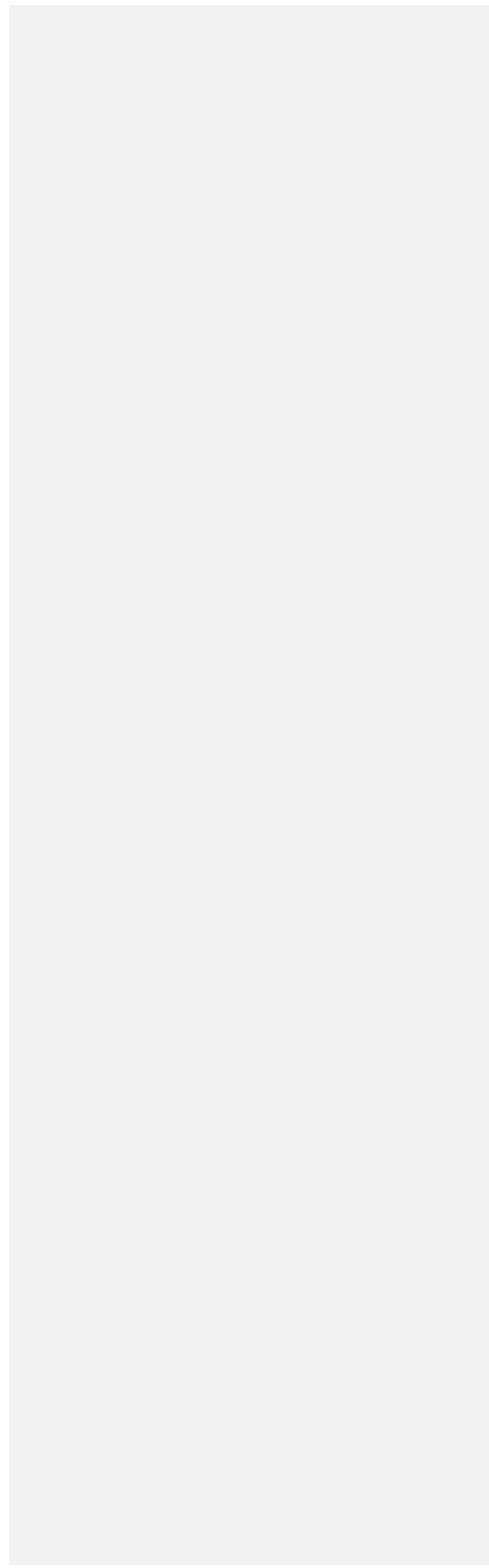
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683 **Appendices**

684

685 **Figure captions**

686

687 Table 1. Inclusion and exclusion criteria

688 [Table 2: Summary of key findings for each objective](#)

689

690 Figure 1. Conceptual framework of individual provider factors influencing CS rates.

691

692 Figure 2. Identification of studies

693 Supplementary Table 1. Example search strategy (PubMed)

694 Supplementary Table 2. Data extraction table.