

Climate change and women's health: A scoping review

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Abstract

Climate change is a significant global health threat that is underpinned by the existing issue of gender inequality. A scoping review was conducted to better understand the relationship between climate change and women's health. We found a notably higher proportion of existing studies focused on low- and middle-income countries (LMIC). Most of the studies included were published after 2010, with predominantly qualitative study designs. Four key themes were identified, including women's exposure to climate change risks, the impacts on women's health, factors contributing to the vulnerability, and responding strategies in addressing climate change. The scoping review indicates that women's health is at higher risks due to the vulnerable to climate change, especially in LMIC. Meanwhile, it is beneficial to have insights from women in terms of adaptation and mitigation strategies to build stronger resilience. Mixed methods are strongly recommended to support evidence-based policy making in responding to climate change.

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Climate change and women’s health: A scoping review

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Key points:

- Women’s health is at higher risks due to the vulnerable to climate change, especially in LMIC.
- The societal, cultural, and economic factors could contribute to the vulnerability. It is beneficial to have a gender aspect in responses.
- Mixed methods incorporating quantitative and qualitative assessments are needed.

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21 **ABSTRACT**

22 Climate change is a significant global health threat that is underpinned by the existing issue of
23 gender inequality. A scoping review was conducted to better understand the relationship between
24 climate change and women’s health. We found a notably higher proportion of existing studies
25 focused on low- and middle-income countries (LMIC). Most of the studies included were published
26 after 2010, with predominantly qualitative study designs. Four key themes were identified,
27 including women’s exposure to climate change risks, the impacts on women’s health, factors
28 contributing to the vulnerability, and responding strategies in addressing climate change. The
29 scoping review indicates that women’s health is at higher risks due to the vulnerable to climate
30 change, especially in LMIC. Meanwhile, it is beneficial to have insights from women in terms of
31 adaptation and mitigation strategies to build stronger resilience. Mixed methods are strongly
32 recommended to support evidence-based policy making in responding to climate change.

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37 1 INTRODUCTION

38 Climate change is a significant global health issue that has rapidly and urgently become a priority on
39 the global health agenda (Duncan 2006, Levy 2015). It's detrimental effects to Earth's ecosystem
40 has led to increases in natural disasters, vector borne diseases, poor air quality and extreme
41 variance in climatic temperatures, all of which directly and indirectly affect human health (Duncan
42 2006, Rylander, Odland et al. 2013). Abundant research has confirmed its relationship with
43 endangering human health, highlighting poverty, food insecurity, geographic isolation and
44 degrading societal norms as key factors which accelerate the negative effect of climate change
45 (Langer, Meleis et al. 2015, Jerneck 2018).

46 Globally, approximately 1.3 billion people in low-and middle-income countries (LMICs) live below
47 the poverty line, with 70% of those being female (Sorensen 2018). Climate change exacerbates
48 women's distinct health needs, particularly during pregnancy where maternal health and nutrition
49 is vital to the developing foetus and infant (Rao 2011, Watt 2011, Rylander, Odland et al. 2013,
50 Franco-Orozco 2018, Sorensen 2018). In addition to this, women in LMICs generally have a
51 domestic role in the household, exposing them to poor air quality through inappropriate gases used
52 during cooking and poor ventilation of the cooking area (Duncan 2006, Pinkerton 2013, Tirado
53 2013, Rosenthal 2018, Bhallamudi and Lingam 2019, Mazorra 2020). In terms of social and cultural
54 issues, women often have less access to ownership of land, education and paid labour, all of which
55 increases their vulnerability to climate change (Langer, Meleis et al. 2015, Jerneck 2018). Women
56 are often faced with unequal access to economic and technical resources after natural disasters and
57 climate-change related extreme weather events (Langer, Meleis et al. 2015, Jerneck 2018). There
58 exists a complex relationship between climate change and women's health that is underpinned by
59 the existing issue of gender inequality (World Health Organization. 2014, Sorensen 2018, United
60 Nations 2020).

61 The role of women in tackling climate change in general has been made a priority as part of many
62 recent global goals, such as the Sustainable Development Goals (SDGs), Paris Agreement on Climate
63 Change and the United Nations Framework Convention on Climate Change, which acknowledge the
64 relationship between climate change and women's health (Haque 2011, Langer, Meleis et al. 2015,
65 Maurice 2015, United Nations 2015, Amoroso 2018, Collantes 2018, Manandhar, Hawkes et al.
66 2018, Sorensen 2018, United Nations 2020). The World Health Organization (WHO) has also
67 highlighted the importance of gender, health and climate change and offered mitigation strategies
68 to address the issues present (World Health Organization 2014). In addition to these, there has
69 been an increase in the number of published literatures that identify this relationship and highlight
70 the need for sustainable solutions to address this issue (Watts, Amann et al. 2018). These solutions
71 are based on themes of women empowerment and advocacy for gender equality, through
72 community-led strategies, national policies and global resilience (Paavola 2008, Dulal 2009,
73 Engelman 2010, Page 2010, The Lancet. 2015, Sen Roy 2018).

74 Despite this issue being identified as an increasing global concern, no single study has been able to
75 identify the breadth of literature available around this topic and explore all aspects of the
76 relationship between climate change and women's health. The study aims to fill in the gap in

77 literature by conducting a scoping review to better understand climate change and women’s health
 78 to support the development of climate change strategies and actions.

79 **2 METHODS**

80 As defined by Arksey and O’Malley, a scoping review aims to map the key concepts that underpin a
 81 research topic and highlight main sources and various types of evidence available (Arksey and
 82 O’Malley 2005). A scoping review was preferred over a systematic review as we wanted to assess
 83 the current breadth of available evidence that explores the relationship between climate change
 84 and women’s health. The methodological framework by Arksey and O’Malley was adopted for the
 85 review.

86 A systematic search of literature was undertaken using four databases, including MEDLINE,
 87 EMBASE, CINHAI and SCOPUS. Key words and search strategies were developed and are outlined in
 88 Table 1. The set search strategy was developed after initial search on each database to identify
 89 relevant topics and MeSH terms. The same search strategy was adopted for each of the four
 90 databases to identify literature present and exported to EndNote for further analysis. Citation
 91 chaining was also utilised to identify further literature that was not indexed in the databases
 92 selected.

93 **TABLE 1 – Key words and search strategy***

Keywords	Terms Used
Climate change/variability/extremes	(Climate w/1 change* OR variab* OR extrem*) OR “global warming” OR “greenhouse effect”
Gender/women	Gender OR wom?n OR “wom?n’s health” OR female* OR (gender w/1 role* OR perspective* OR perception* OR disparit* OR equalit*)
Health	Health* OR “health outcome*” OR wellbeing OR wellness OR “quality of life” OR “health effect*”
Maternal Health	(Maternal w/1 health OR mortality OR morbidity OR welfare OR wellbeing) OR “maternal health outcome*” OR “maternal health impact*”
Mitigation and Adaptation	Sustain* OR mitigat* OR adapt*

94 * The above search strategy is modified for the SCOPUS database.

95 Database search was conducted between the months of March and May in 2020, with the last
 96 search being conducted on 10/05/2020. The studies retrieved from the databases were exported
 97 onto EndNote program for further analysis. Duplicates were removed and the initial title and
 98 abstract screening was completed by one reviewer (ZD). After this initial screening, the references
 99 selected for full text screening were exported onto a Microsoft Excel spreadsheet. The spreadsheet
 100 was organised to extract data from each article including the authors, publication year, publication
 101 title, location, population demographics, study design, findings, and limitations. Both reviewers (ZD

102 and YZ) independently performed the full text analysis and extracted relevant data. Discrepancies
103 were resolved by discussion amongst the reviewers.

104 The set inclusion and exclusion criteria aided in selecting relevant studies for the scoping review.
105 Studies were included if the full text was available, in English language, and published before
106 31/03/2020. Research that focused solely on air pollution and women's health was not included
107 due to abundance evidence on this topic unless the relationship between air pollution and climate
108 change was also discussed. Moreover, although children's health is closely related to maternal
109 health and women's health in general, studies that only focused on children's health were not
110 included as they were beyond the scope of this review.

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112 **3 RESULTS**

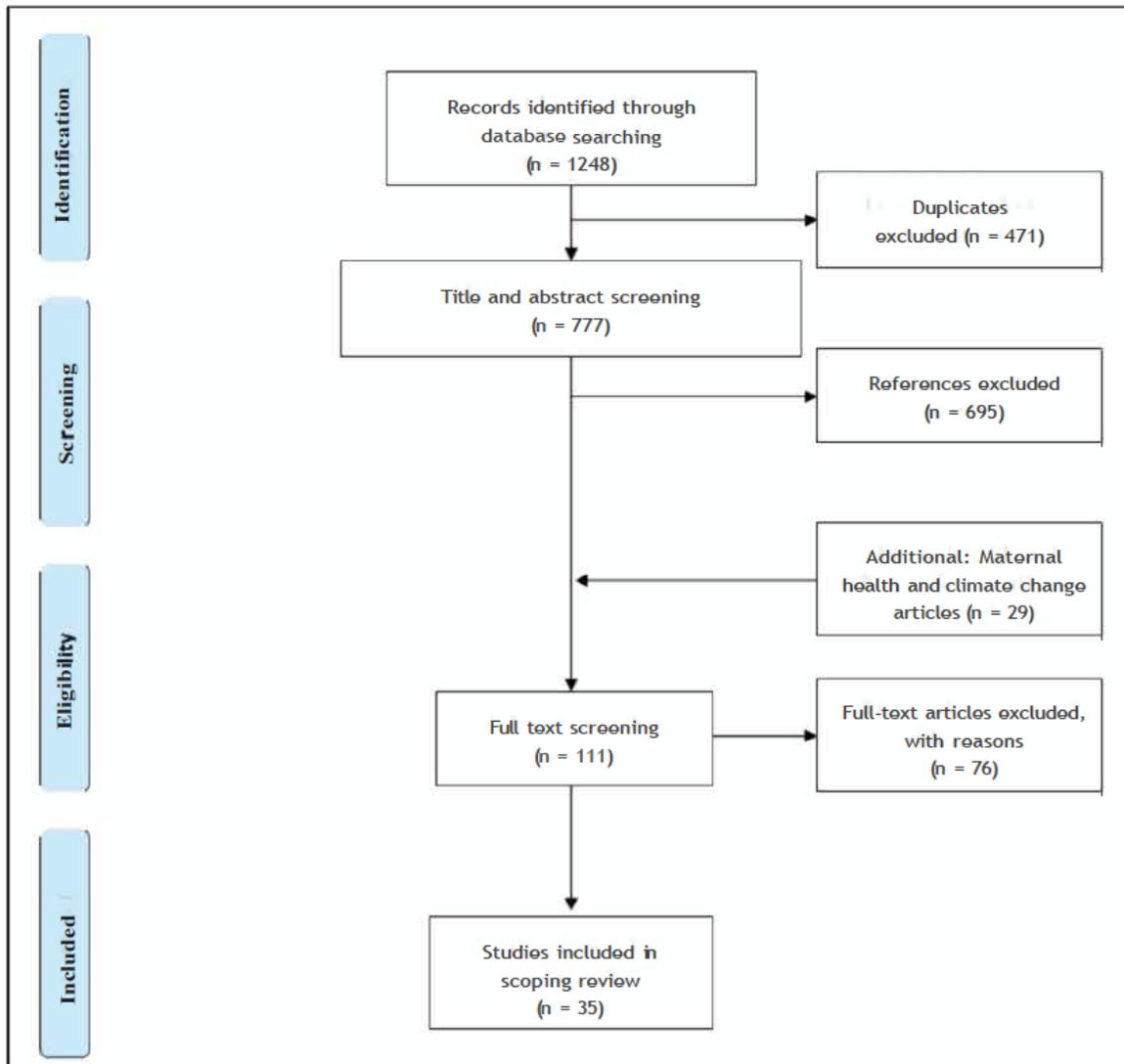
113 Initial searches on the databases yielded a total of 1,248 citations (see figure 1), which were
114 exported to EndNote for further analysis. After the removal of duplicates (n=471), title and abstract
115 screening was performed on the remaining unique articles (n=777). The majority of these
116 publications (n=695) were irrelevant to the topic of the scoping review and were excluded at this
117 stage. Full-text analysis was performed for the remaining publications (n=82). It was during this
118 process that 'maternal health' was identified as a relevant topic to 'women's health' and search
119 incorporating 'maternal health' and 'climate change' was performed again on the databases to
120 identify further publications relevant to the topic. After removal of duplicates and title and abstract
121 screening for articles relevant to climate change and maternal health, a total of 29 articles were
122 further identified for full text analysis. Further publications were identified through citation
123 chaining of reference lists and these were again reviewed independently by the two researchers for
124 inclusion in the scoping review. In all, a total of 35 articles were included in the scoping review.

125 **3.1 Literature characteristics**

126 Of all the articles included in the scoping review (n=35), the studies mainly explored the
127 relationship between climate change and women's health in LMICs (n=27). Most of the studies
128 included were published after 2010 (n=32), with only a few being published before this time period
129 (n=3). Most of the articles employed a qualitative study design (n=18). There were a smaller
130 number of quantitative studies (n=11) and even fewer studies which utilised a mixed-methods
131 study design (n=6). The qualitative study designs obtained responses through individual in-depth,
132 semi-structured and structured interviews, focus group discussions, observations, case scenario
133 analyses or a combination of these methods. Quantitative studies utilised cross-sectional surveys,
134 regression modelling and time-series study designs to report relevant data. Studies that
135 incorporated a mixed-methods approach combined a survey or randomised and non-randomised
136 controlled design with qualitative methods such as use of in-depth interviews and focus group
137 discussions to further explore research issues. The studies included in the analysis were based in
138 different countries and regions, with notably higher proportion exploring LMICs (n=22). Broadly, the
139 studies focused on topics of climate change exposures and risks, health outcomes, risk factors to
140 vulnerability and mitigation and adaptation strategies that addressed the relationship between
141 climate change and women's health. Most articles had findings across two or more of these

142 themes, however, only three articles were identified to have findings across all four
143 themes.(Denton 2002, Beaumier 2010, Bunce 2016) A summary of the articles included in the
144 analysis and their literature characteristics is outlined in Table 2.

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147 **Figure 1 PRISMA Flow Diagram**

148 **TABLE 2 – Summary of literature included in the scoping review**

Author, Year	Region	Study Design	Findings			
			Climate change exposures and risks	Health outcomes	Risk factors to vulnerability	Mitigation or adaptation strategies
Abdullah et al., 2019	Rural Bangladesh	Qualitative	X	X		
Alhassan et al., 2019	Ghana	Mixed methods	X	X	X	
Asamoah et al., 2018	Ghana	Quantitative	X	X		
Balehey et al., 2018	Afar, Ethiopia	Qualitative		X	X	
Beaumier et al., 2010	Canada: Igloolik, Nunavut	Qualitative	X	X	X	X
Bunce et al., 2016	Canada: Iqaluit, Nunavut	Qualitative	X	X	X	X
Carranza et al., 2019	Kenya, Uganda and Senegal	Qualitative			X	
Cil et al., 2017	Unites States of America	Quantitative	X	X		
Denton, 2002	Global	Quantitative	X	X	X	X
Drolet, 2012	British Columbia, Canada	Mixed methods	X			X
Granderson, 2017	Tonga Island, Vanuatu	Mixed methods				X
Khan et al., 2011	Bangladesh	Mixed methods	X	X		
Khapung, 2016	Western Nepal	Qualitative		X	X	X
Koehler, 2018	Global	Qualitative		X	X	X
Larson et al., 2018	Brazil, Cameroon, Indonesia, Peru, Tanzania and Vietnam	Quantitative			X	X
Leipert et al., 2005	Northern British	Qualitative	X		X	X

	Columbia, Canada					
MacVicar et al., 2017	Uganda	Qualitative	X	X	X	
Marí-Dell'Olmo et al., 2019	Barcelona	Quantitative	X		X	
Mason et al., 2015	Baguio City, Philippines	Quantitative	X		X	X
Masson et al., 2019	Chad	Quantitative			X	X
Mazorra et al., 2020	Casamance Natural Subregion, West Africa	Qualitative		X	X	X
McCall et al., 2019	Leipzig, Germany	Quantitative	X			X
Ortega-Egea et al., 2014	Europe	Mixed methods			X	X
Patrick e al., 2011	Victoria, Australia	Qualitative				X
Poudel et al., 2020	Lamjung district, Nepal	Qualitative	X	X	X	
Powers et al., 2012	Australia	Quantitative				X
Roy et al., 2002	India	Qualitative			X	X
Sanchez et al., 2012	Benin, West Africa	Qualitative	X			
Seidel et al., 2014	Global	Qualitative			X	X
Shanthi et al., 2017	Tamil Nadu, India	Qualitative			X	X
Scheelbeek et al., 2016	Coastal Bangladesh	Quantitative	X	X		
Shodieva et al., 2014	Uzbekistan	Qualitative			X	X
Singh et al., 2018	Karnataka, South India	Mixed methods	X		X	X
Tirado et al., 2013	Nigeria	Qualitative	X	X		X
Zhang et al., 2018	Australia	Quantitative	X			

149 *Note: 'X' indicates that the finding was observed in the article.*

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153 **3.2 Findings**

154 *3.2.1 Women's exposures to climate change risks*

155 Weather changes as a result of climate change and/or natural disasters, such as floods, hurricanes,
156 increases in heat waves, droughts, poor air quality and increased salinity of water, were by reported
157 twenty articles in relation to women's health (Denton 2002, Leipert 2005, Beaumier 2010, Khan,
158 Ireson et al. 2011, Drolet 2012, Sanchez 2012, Tirado 2013, Mason 2015, Bunce 2016, Scheelbeek,
159 Khan et al. 2016, Cil and Cameron 2017, MacVicar, Berrang-Ford et al. 2017, Asamoah, Kjellstrom et
160 al. 2018, Singh 2018, Zhang 2018, Abdullah, Dalal et al. 2019, Alhassan 2019, Mari-Dell'Olmo 2019,
161 McCall 2019, Poudel 2020). Floods, hurricanes, heat waves and droughts were found to impact the
162 agricultural industry where women worked as primary labourers, retrieved food for daily
163 consumption and relied upon heavily for household incomes (Denton 2002, Drolet 2012, Alhassan
164 2019, Poudel 2020). Women were found to be more affected by temperature extremes such as
165 heat waves which put them at a higher risk of poor maternal health, hypertension and heat
166 exhaustion (Cil and Cameron 2017, MacVicar, Berrang-Ford et al. 2017, Asamoah, Kjellstrom et al.
167 2018, Singh 2018, Mari-Dell'Olmo 2019, McCall 2019). Decreases in temperatures in the most
168 northern parts of the world increased likelihood of heavy snowfall and blizzards, which affected
169 women's ability to find and collect food for their family, as part of their primary caretaker roles in
170 the communities (Leipert 2005, Beaumier 2010, Bunce 2016). Melting of ice glaciers due to climate
171 change decreased seafood available in the northern regions, which resulted in food insecurity for
172 women in those communities (Bunce 2016). The rise in sea-level due to climate change has also
173 increased salinity of water in surrounding sources whereby some communities collect water and
174 has been found to be linked with maternal health in terms of complicating pregnancy by higher risk
175 of hypertension and gestational diabetes (Khan, Ireson et al. 2011, Scheelbeek, Khan et al. 2016).
176 Only one identified study reported that there was no difference found between the impact of
177 climate change on women and men (Sanchez 2012). Another study that examined suicide as a
178 health outcome of climate change found that male suicides increased with higher temperatures
179 (Zhang 2018).

180 *3.2.2 Impacts on women's health*

181 The relationship between climate change and women's health outcomes was analysed by sixteen
182 studies included in the review (Denton 2002, Beaumier 2010, Khan, Ireson et al. 2011, Tirado 2013,
183 Bunce 2016, Khapung 2016, Koehler 2016, Scheelbeek, Khan et al. 2016, Cil and Cameron 2017,
184 MacVicar, Berrang-Ford et al. 2017, Asamoah, Kjellstrom et al. 2018, Balehey 2018, Abdullah, Dalal
185 et al. 2019, Alhassan 2019, Mazonra 2020, Poudel 2020). Women were more affected by nutritional
186 deficiencies, such as malnutrition and anaemia, due to food insecurity reasons (Denton 2002,
187 Beaumier 2010, Tirado 2013, Koehler 2016). This was found to be more common in female-headed
188 households compared to male-headed households (Alhassan 2019). Women in rural areas were
189 also more likely to be at risk of vector-borne diseases because they are likely to be in close
190 proximity to wells, rivers and ponds when they collect water supplies (Denton 2002, Bunce 2016,
191 Poudel 2020). A strong relationship was also identified between climate change and maternal
192 health (Denton 2002, Khan, Ireson et al. 2011, Tirado 2013, Khapung 2016, Koehler 2016,
193 Scheelbeek, Khan et al. 2016, Cil and Cameron 2017, MacVicar, Berrang-Ford et al. 2017, Asamoah,
194 Kjellstrom et al. 2018, Abdullah, Dalal et al. 2019). Pregnant women were more likely to experience

195 hypertension, exhaustion, miscarriages and stillbirths with higher temperatures and food insecurity
196 (Khan, Ireson et al. 2011, Tirado 2013, Scheelbeek, Khan et al. 2016, Cil and Cameron 2017,
197 MacVicar, Berrang-Ford et al. 2017, Asamoah, Kjellstrom et al. 2018). This was more common in
198 women who worked as manual labourers in the agricultural industry (MacVicar, Berrang-Ford et al.
199 2017, Abdullah, Dalal et al. 2019). Women developed more respiratory conditions, particularly in
200 rural areas where renewable energy was not available, and women used hazardous gases to cook
201 foods leading to inhalation of toxic pollutants (Mazorra 2020).

202 *3.2.3 Factors contributing to the vulnerability*

203 Twenty-two articles explored the risk factors to vulnerability in relation to women's health and
204 climate change (Denton 2002, Roy 2002, Leipert 2005, Beaumier 2010, Ortega-Egea 2014, Seidel
205 2014, Shodieva 2014, Mason 2015, Bunce 2016, Khapung 2016, Koehler 2016, MacVicar, Berrang-
206 Ford et al. 2017, Shanthi 2017, Balehey 2018, Larson 2018, Singh 2018, Alhassan 2019, Carranza
207 2019, Mari-Dell'Olmo 2019, Masson 2019, Mazorra 2020, Poudel 2020). Climate change
208 exacerbated existing gender and social inequalities faced by women, especially in rural and remote
209 communities (Beaumier 2010, Bunce 2016, Khapung 2016, Balehey 2018, Alhassan 2019). Women
210 in rural areas were found to have decreased social networking and employment opportunities in
211 order to increase their income (Leipert 2005, Beaumier 2010, Mason 2015, Khapung 2016, Alhassan
212 2019, Masson 2019, Poudel 2020). In very remote areas, patriarchal nature of the communities
213 enhanced gender discrimination and violence against women when natural disasters destroyed
214 agricultural crops and decreased household income (Roy 2002, Leipert 2005, Masson 2019). They
215 were identified as often being the last members to eat in the household, allowing the males in the
216 family and the children to eat first (Leipert 2005, Ortega-Egea 2014, Bunce 2016, Masson 2019).
217 The studies overall reported that women in general had very limited rights in owning land, wealth
218 and were often excluded from inheritance (Denton 2002, Roy 2002, Leipert 2005, Beaumier 2010,
219 Shodieva 2014, Mason 2015, Koehler 2016, MacVicar, Berrang-Ford et al. 2017, Shanthi 2017,
220 Balehey 2018, Singh 2018, Carranza 2019, Masson 2019). Women's health and their role as
221 caregivers are significantly affected by their lack of human rights, exclusion from decision making in
222 society, and financial dependence on males who earn income in their households (Roy 2002,
223 Ortega-Egea 2014, Singh 2018, Masson 2019, Poudel 2020). Accessing education is considered a
224 superior privilege for women in rural communities, who are not given opportunities to build careers
225 which may enable them to improve their current socio-economic status (Beaumier 2010, Seidel
226 2014, Shodieva 2014, Shanthi 2017, Larson 2018, Mari-Dell'Olmo 2019).

227 *3.2.4 Responding strategies*

228 Twenty-two articles included in the review discussed mitigation and adaptation strategies to
229 address the negative effects of climate change on women's health (Denton 2002, Roy 2002, Leipert
230 2005, Beaumier 2010, Patrick 2011, Drolet 2012, Powers 2012, Tirado 2013, Ortega-Egea 2014,
231 Seidel 2014, Shodieva 2014, Mason 2015, Bunce 2016, Khapung 2016, Koehler 2016, Granderson
232 2017, Shanthi 2017, Larson 2018, Singh 2018, Masson 2019, McCall 2019, Mazorra 2020).
233 Community-based strategies to increase women empowerment were reported as mitigation
234 strategies to address women's lack of access to education, health care and employment
235 opportunities (Beaumier 2010, Tirado 2013, Mason 2015, Larson 2018, Mazorra 2020). Strategies to
236 enhance local adaptive capacity to climate change were also mentioned, with more input from

237 women's perspectives regarding management at household levels (Roy 2002, Patrick 2011, Drolet
238 2012, Mason 2015, Larson 2018, Masson 2019). Utilising humanitarian resources to provide women
239 with education around using renewable resources was noted as a solution to decreasing women's
240 exposure to hazardous air pollutants during cooking times (Mazorra 2020). Encouraging women to
241 develop resilience, advocate for their rights, freedom of speech and equal involvement in decision
242 making at a national level was also a reported mitigation strategy (Denton 2002, Drolet 2012, Seidel
243 2014, Khapung 2016, Koehler 2016, Granderson 2017, Shanthi 2017, Singh 2018). Policy initiatives,
244 taking into consideration the existing gender disparity, were highly recommended to improve
245 societal conditions and women's access to health care services, especially maternal health care
246 (Masson 2019). Government assistance to women living in areas prone to extreme climatic effects,
247 such as droughts, was found to mitigate health impacts of climate change on women in high-
248 income countries (HICs) (Powers 2012). Women were noted to have higher resilience during times
249 of distress, which was also reported as an adaptive strategy to address implications of climate
250 change on women's health (Leipert 2005, Powers 2012, Bunce 2016, Masson 2019).

251

252 **4 DISCUSSION**

253 The scoping review has identified a strong but complex relationship between climate change and
254 women's health. Most of the studies included in the review report findings from LMICs through
255 qualitative study designs. The results identify robust evidence of the impact of climate change on
256 women's health in LMICs, where currently most gender disparities exist (Powers 2012, Bunce 2016,
257 Khapung 2016). It is even more interesting to note that the small number of studies which were
258 conducted in HICs were done so in rural and remote areas. This general finding indicates that
259 gender inequality varies from rural to urban areas, but also highlights the need for more studies to
260 analyse how women living in urban areas are affected by climate change.

261 Of the studies conducted in LMICs, it has been well established that climate change has triggered
262 natural disasters and weather extremes that directly and indirectly affect women's health (Denton
263 2002, Leipert 2005, Beaumier 2010, Khan, Ireson et al. 2011, Drolet 2012, Sanchez 2012, Tirado
264 2013, Mason 2015, Bunce 2016, Scheelbeek, Khan et al. 2016, Cil and Cameron 2017, MacVicar,
265 Berrang-Ford et al. 2017, Asamoah, Kjellstrom et al. 2018, Singh 2018, Zhang 2018, Abdullah, Dalal
266 et al. 2019, Alhassan 2019, Mari-Dell'Olmo 2019, McCall 2019, Poudel 2020). Directly, women are
267 more negatively affected by droughts and heat waves due to their roles in society and nutritional
268 and physiological requirements during periods of menstruation and pregnancy (Denton 2002,
269 Beaumier 2010, Tirado 2013, Koehler 2016). Women are already considered vulnerable populations
270 globally due to societal conditions and the results from the scoping review indicate that this
271 vulnerability also extends to the effects of climate change. Their role as manual labourers in the
272 agricultural industry, being responsible for performing domestic housework duties and be primary
273 carers for children present a scenario where women are mostly homebound and unable to deal
274 with the effects of natural disasters socially and physically. This indicates that there is potential for
275 employment of capacity building strategies to help women in these settings to overcome barriers to
276 vulnerability.

277 The impact of climate change on maternal health has also been reported in the articles included in
278 the scoping review. This relationship is very important because it is very closely related with
279 paediatric health, and therefore overall population outcomes. Whilst pregnancy makes women
280 physically vulnerable, they are also more sensitive to changes in temperature and likely to have a
281 weaker immune system, making them physiologically more vulnerable to acquiring infectious
282 diseases, especially vector-borne diseases which has been well reported in the review (Denton
283 2002, Bunce 2016, Poudel 2020). Complications in maternal health result in infants that are also
284 more vulnerable, compromised in terms of health and have higher medical resource requirements.
285 This has the potential to implicate negative health outcomes in the overall population in terms of
286 utilising already scarce medical resources and decreases sustainability of medical health resources.
287 This effect is likely to have a greater impact on population health in LMICs compared to HICs, where
288 health care services and resources are more readily available. Women in HICs have more access to
289 health care services, employment and education opportunities, that enables them to be
290 independent financially and possibly mitigate effects of climate change on their health. Mixed
291 methods that incorporate both quantitative and qualitative assessments are strongly
292 recommended to support evidence-based policy making in responding to climate change.

293 The review also identified factors which make women more vulnerable to climate change than men
294 in terms of social, economic and cultural issues. Gender inequality is present in both HICs and in
295 LMICs (Powers 2012, Khapung 2016). Women's lack of access to education, limited employment
296 opportunities and minimal involvement in economic decision making further intensifies their
297 vulnerability. These basic human rights allow distribution of equal power in the society; if women
298 are not presented with these opportunities, they have little power in advocating for change. If
299 women do not have access to education, they may not have access to information that may
300 increase their awareness and understanding of climate change effects, which is an important
301 enabling factor for change at an individual and even societal level. This is especially important for
302 women living in rural and remote areas where they already have limited access to resources and
303 information. Globally, women predominantly face inequity in health care access due to societal and
304 cultural factors (Masson 2019, Mazorra 2020). This calls for health care initiatives to identify and
305 address these barriers as part of providing holistic health care for women to ensure that this gap is
306 reduced.

307 Adaptation and mitigation strategies have been discussed in majority of the included articles.
308 Current societal conditions are identified as being the root cause of the vulnerability and negative
309 health impacts that women face (Roy 2002, Beaumier 2010, Alhassan 2019, Masson 2019).
310 Strategies are outlined at an individual, community, national and global level in order to address
311 the issue. At an individual level, building resilience to climate change effects is outlined as a strong
312 approach that has the potential to underpin strategies at a national and global level (Leipert 2005,
313 Mason 2015). Community-led strategies are also found to be effective and involved having women-
314 only focus groups in order to share innovate ideas and management strategies at the household
315 level (Roy 2002, Beaumier 2010, Bunce 2016). Due to their primary role as caretakers, women tend
316 to care more about environmental change and adverse effects of climate change on future
317 generation (Denton 2002, Ortega-Egea 2014, Mason 2015, Granderson 2017, McCall 2019). Building
318 on this, it is beneficial to have insights from women in terms of adaptation strategies because they

319 are more likely to provide perspectives on long-term sustainable solutions. Women need to be
320 empowered to participate in policy making process, especially when concerning use of natural
321 resources such as energy and water. Policy makers need to have a gendered approach to climate
322 change policy making and acknowledge that the needs of men and women differ, and therefore
323 need to adapt policies to ensure that those needs are met. HICs that have made progress in
324 achieving this outcome need to share their knowledge and perspectives in helping reduce the
325 gender inequality present in LMICs, where they may not have resources to support women to
326 achieve change. Complex interactions of social, cultural and economic factors that exist in today's
327 society make climate change a gendered issue, by disproportionately impacting women's health. It
328 is also noted that whilst adaptation and mitigation strategies were addressed in the studies, there is
329 limited insights into barriers of implementing such policies and strategies, or assessment of
330 community acceptance, feasibility of policies or cost implications.

331 There are a number of limitations present in the current scoping review. Firstly, the scoping review
332 excluded dissertations, theses, and books that may have provided further insights into the evidence
333 in literature. Most studies have employed a qualitative study design which allowed insights into
334 perspectives of different communities. However, there is always the potential risk of bias when
335 analysing qualitative data. There is scope for more quantitative and mixed methods approaches to
336 help fill in the gaps present in literature. The scoping review also did not assess the quality and
337 strength of evidence presented in the articles included. Of the articles included, they were mainly
338 based on data from LMICs, which may limit generalisability to HICs. This indicates that a gap in
339 literature exists when assessing the impact of climate change on women's health in HICs.

340

341 **5 CONCLUSION**

342 The scoping review conducted on climate change and women's health indicates that the
343 relationship between the two concepts is complex due to the nature of environmental, societal,
344 cultural, and economic factors. Whilst most of the studies reported this relationship in the context
345 of LMICs, it highlights the need for further research to be conducted in HICs setting to allow a more
346 comprehensive understanding of the scenario. Broadly, the themes of women's exposure to climate
347 change risks, impacts on women's health, vulnerability and responding strategies are heavily
348 underpinned by gender inequity issues. Identification of these may have provided the effectiveness
349 and feasibility of the suggested strategies from a societal perspective, which would have ensured
350 sustainability of the change being implemented. Mixed methods are strongly recommended in
351 future research to assist policy making in responding to climate change. When considering
352 implementation of climate change policies and strategies, it is important to acknowledge that the
353 existing issue of gender inequity exacerbates the effects of climate change on women's health.
354 Policies and strategies need to have a holistic approach and develop interventions according to
355 different gender aspects.

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357

358 **Acknowledgement**

359 This review paper did not analyse any new data. Only results published in identified previous
360 studies were used. The 35 included studies were listed in Table 2 in the paper and in the reference
361 list.

362

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