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1 **Theorising Women's Health and health inequalities: shaping processes of the 'gender-**
2 **biology nexus'**

3

4 Short running title: gender, biology and health

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18 **Keywords:** biology, female genital mutilation/cutting, inequality, feminism, theoretical

19

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21 **Theorising Women's Health and health inequalities: shaping processes of the 'gender-**
22 **biology nexus'**

23
24 **Abstract**

25
26 Since the theoretical frameworks and conceptual tools we employ shape research outcomes
27 by guiding research pathways, it is important that we subject them to ongoing critical
28 reflection. A thoroughgoing analysis of the global production of women's health inequality
29 calls for a comprehensive theorization of how social relations of gender and the biological
30 body mutually interact in local contexts in a nexus with women's health. However, to date,
31 the predominant concern of research has been to identify the biological effects of social
32 relations of gender on the body, to the relative neglect of the co-constitutive role that these
33 biological changes *themselves* may play in ongoing cycles of gendered health oppressions.
34 Drawing on feminist and gender theoretical approaches, and with the health of women and
35 girls as our focus, we seek to extend our understanding of this recursive process by
36 discussing what we call the 'shaping processes' of the 'gender-biology nexus' which call
37 attention to not only the 'gender-shaping of biology' but also the 'biologic-shaping of
38 gender'. We consider female genital mutilation/cutting as an illustration of this process and
39 conclude by proposing that a framework which attends to *both* the 'gender-shaping of
40 biology' *and* the 'biologic-shaping of gender' as interweaving processes provides a fruitful
41 approach to theorising the wider health inequalities experienced by women and girls.

42
43 **Introduction**

44 As Raewyn Connell recently explains, 'in an ontological sense, gender is the way human
45 reproductive bodies enter history, and the way that social process, unfolding through time,
46 deals with biological continuity' [1, p.341]. Social relations of gender interact with the

47 biological body to shape the experiences of health of men and women, boys and girls, in
48 numerous ways in manifold geographic contexts worldwide. The aim of this theoretical
49 exposition is to analyse how, within this context, feminist and gender theorists have made
50 biological 'sex' and social 'gender' legible, with the specific object of identifying lacunae in
51 their expression in a nexus with health. We begin by suggesting that the principal theoretical
52 contribution to date has been to identify how the biological body is shaped by social
53 relations of gender, or what we conceptualise here as 'the gender-shaping of biology'. We
54 then propose that, notwithstanding calls to re-examine biology in feminist terms [e.g. 2, 3,
55 4, 5, 6], the matter of how the biological body may, by its turn, express and contribute to
56 social gender dynamics in a nexus with health—or what we term the 'biologic-shaping of
57 gender'—is underexplored. Taking the 'gender-biology nexus' as our object, we put forward a
58 theoretical approach which emphasises two co-constitutive 'shaping processes': the
59 'gender-shaping of biology' and the 'biologic-shaping of gender' as they operate with
60 respect to the health and health inequalities of girls and women. To explore and illustrate
61 this in a preliminary way, we take the example of female genital mutilation/cutting. In what
62 follows we acknowledge the various meanings given to the terms 'health' and 'illness', but,
63 given our expository purpose, we generally use the term 'health' inclusively to cover both
64 positive and negative dimensions of experience.

65

66 **The 'gender-shaping of biology'**

67 As extensively rehearsed, the sex/gender distinction introduced into feminism in the 1970s
68 [7] had a strong and timely purpose; to challenge the pejoration of the binary script which
69 has fashioned woman's being as analogous to the biological body, itself conceived as
70 inferior to that of man. This roused the compelling argument that the causes of health/ill-

71 health globally are predominantly social and an effect of women's inequality within the
72 dominion of men. Of course the argument has never been that 'biological sex' and 'social
73 gender' bear no relationship, but rather that 'the aura of naturalness and inevitability that
74 surrounds gender-differentiation' comes [...] from the beliefs people hold about it', rather
75 than from presumed biological characteristics [7, p.189]. Even so, research has been, and
76 generally still is, targeted above all towards an examination of the influence of gender as a
77 social factor on women's bodies and their health [8]. From the 1970s onwards, ground-
78 breaking social science and public health research raised two far-reaching concerns: the
79 generally higher prevalence of ill-health globally of women and girls (compared to men and
80 boys) at the individual and collective levels, and their adverse access to, and treatment in,
81 healthcare settings [e.g., 9, 10]. Anthropologists Nancy Scheper-Hughes and Margaret Lock
82 [11] have encouraged researchers to consider not only the individually experienced 'body-
83 self', but also the representational symbolic power of the 'social body' to define how nature
84 and culture are thought about in a society—for our interest here, in gendered terms—and the
85 'body politic' which, through healthcare (including lay healing) and other systems such as
86 kinship, regulates both the social body and individual bodies. Stressing that gender itself is
87 global, sociologist Connell [12,1], referred to earlier, has sought to capture the relations of
88 power, production, emotion, and representation that establish the 'gender order' and the
89 institutions (e.g., healthcare) that constitute the 'gender regime' of a society. She contends
90 that as both agents and objects in reflexive practices, bodies cannot be conceived as *either*
91 biologically *or* socially determined. Here 'gendered social embodiment' occurs in a
92 structured interplay with the 'reproductive arena' where 'the reproductive possibilities of
93 human bodies are historicized; that is, given specific social forms' [13] as both '*objects of*
94 social practice and *agents in social practice*' in a 'loop, a circuit, linking bodily processes and

95 social structures' [12, p. 67, emphasis original]. These theoretical contributions, amongst
96 others, have been effective and influential broad steers for a wealth of powerful empirical
97 research on 'gender and health' internationally [see, for example, 14, 15, 16, 17]. However,
98 while the biological body is clearly a point of reference in these and other theoretical
99 contributions, it is mostly tacit. In Connell's work, for instance, bodily capacities primarily
100 appear to be 'a site where something *social* happens', such as the creation of the categories
101 'women' and 'men' [12, p 68, emphasis added]. Her illustrations of anorexia and HIV
102 transmission [13], for example, address the transformation of bodies in social embodiment,
103 but she does not intend to take up the associated biological processes *in* the body. Recently
104 intersectionality has gained theoretical traction as a counter to universal depictions of the
105 experiences of social groups (such as women), pointing to matrices of domination that arise
106 from complex interactions of other social structures such as age, race, class, and citizenship
107 with gender [18]. For example, with reference to global health, Anuj Kapilashrmai and Olena
108 Hankivsky [19, p.2589] have recently argued that an intersectional approach goes beyond
109 the examination of what they identify as individual factors, such as biology, socioeconomic
110 status, sex, and gender, to explore the impact that interactions among these factors have
111 upon health in a specific context. As they argue, this advances understanding of health
112 inequalities by drawing attention to differences amongst what tend to be seen as relatively
113 homogenous population groups, such as 'women', and by highlighting the interacting
114 influence of different 'multiple sites and levels of power', such as laws, institutions, and
115 structures of discrimination like sexism on health [19, p.2589]. Yet, significant though their
116 points are, and although referring to the interacting role of biology, their attention in
117 illustrations of cardiovascular disease and migration is on the influence of interacting *social*
118 factors with the body. Also taking an intersectional approach, but with a thoroughgoing

119 focus on gender, Kristen Springer and colleagues justly question the positing of sex and
120 gender as distinct domains, explaining instead that ‘the vast majority of male-female health
121 differences are due to the effects of the irreducibility of entangled phenomena of
122 “sex/gender” and therefore that this entanglement should be theorized, modeled, and
123 assumed until proven otherwise’ [20, p.1818]. Again, the foremost concern is with the
124 ‘material effects on the body’ of ‘gendered life experiences’ as they ‘*show up*’ in ‘biologically
125 based “sex differences”’ [20, p.1818, our emphasis]. They cite existing research on matters
126 such as the effects of social interaction and status differentials on neuroendocrine function
127 and psychosocial stress on cardiovascular disease, but they do not intend to detail the
128 biological processes that may be at work.

129

130 What we refer to as ‘gender-shaping’ also underlines psychosocial stress research. Often
131 taking its cue from endocrinologist Hans Selye’s [21, p.692] definition of stress as ‘the non-
132 specific response of the body to any demand made upon it’ (such as emotional upsets on
133 processes such as blood pressure and body temperature), research has addressed the
134 effects (implying stress arousal) of gendered life and working conditions in the biological
135 body. For example, Marianne Frankenhaeuser and colleagues [e.g., 22] have researched the
136 importance of gendered conditions in unpaid work for the differences in stress hormone
137 response between men and women in white-collar occupations. In her influential depiction
138 of ‘embodiment’, social epidemiologist Nancy Krieger [23, p.350] explores what bodies tell
139 us about lives by the marks left on them by the body politic through, for instance, food
140 insecurity, economic and social deprivation. To depict how biological sex and social gender
141 are, ‘inextricably woven’, she introduced (with Sally Zierler), the lexicon ‘biologic expression
142 of gender’ to characterise the incorporation of social expressions of gender into the body–

143 such as the effects of underfunding of girls' athletic programs on 'body build and exercise
144 patterns' [24, p.42, p.43] – and the companion concept, the 'gendered expression of
145 biology' 'to show 'how biologic processes influence gender roles, relations, and conditions'
146 (such as when the ability to get pregnant is used to restrict women's employment in
147 typically male and well-paid jobs, even when less well-paid jobs can be more hazardous to
148 health) [24, p.41]. Here the focus is on biological *expression*, or how our understandings of
149 the biological body are filtered through a gender lens. Subsequently Krieger [25] has drawn
150 attention to the potentially synergistic relationship between what she dubs 'sex-linked
151 biology' and 'gender relations' in health outcomes. The former depicts the reproductive
152 system, including chromosomal sex, secondary sex characteristics, pregnancy, and
153 menopause. Her proposition that 'sex-linked biological characteristics can, in some cases,
154 contribute to or amplify gender differentials in health' [25, p.653] is instructive. Her
155 examples, such as women's higher exposure to intimate partner violence—where 'sex-linked-
156 biology' is set out as a determinant of strength and stamina, in interaction with 'gender
157 relations', such as men's greater likelihood of using physical violence—are astute, but it is not
158 her goal to explore the actual biological processes at work.

159

160 This summary, which for reasons of space cannot do justice to the now sizeable body of
161 writing from gender and feminist thinkers on women's health within the social sciences, has
162 highlighted how enlightening research on what we refer to as the 'gender-shaping' of the
163 biological body has been. However, in this loosely grouped corpus of research, biology has
164 not so much been ignored as left tacit; more tacit, we would argue, than it should be if we
165 are to move towards a more comprehensive understanding of ongoing cycles of women's
166 health oppressions. In a somewhat separate body of writing, feminist biologists have (as we

167 would expect) given biology a more visible analytic presence. For example, Anne Fausto-
168 Sterling [26, 27] deftly explores the interweaving of bodies, disorder and culture under the
169 rubric of 'life course systems theory'/'dynamic systems theory'. She observes that since
170 social experience produces new biosocial formations, 'nothing in the body' is 'permanent
171 and unchanging' [28, p.63]. She rightly argues that temporal changes draw attention to
172 alterations both in individual biological bodies as they grow and age and the transformation
173 of social groups as experiences of earlier generations are embodied in offspring. For
174 example, in an analysis of the skeletal system and osteoporosis, she conjectures that a
175 complex of factors, including physical exercise, diet, drugs, hormones, and biomechanical
176 effects on bone formation interact through the lifecycle to influence bone density and
177 fractures, negatively affecting more women than men. She explicitly acknowledges that we
178 know relatively little scientifically about how these processes and mechanisms occur, but
179 emphasises that they transpire within 'the experiences of growing, living, and dying in
180 particular cultures and historical periods and under different regimens of social gender' [26,
181 p.1510]. She hypothesizes, for instance, that women's more frequent dieting to lose weight
182 during their lifetime may contribute to lower peak bone density in adulthood compared to
183 men and hence to fractures. As this indicates, her focus is squarely upon the 'gender-
184 shaping' of biology. This is further illustrated through her example [29] of the facility to
185 chose from amongst the social features of gender to embed new bodily habits, such as the
186 capacity, through practice, to alter voice register, tonality and cadence to correspond with
187 that of a typical man or woman and the embodiment of this new habit in the sensorimotor
188 (neuromuscular) system. In a landmark analysis, biologist Lynda Birke chastens fellow
189 feminists for conceptualising the body as 'the malleable surface of an internally stable
190 corporeality' [2, p.137]. Following neuroscientist Steven Rose [29], she argues that although

191 bodies are ‘self-organising and self-determining’ and sometimes ‘outside of our willed
192 control’ [2, p.169, p.85], we should conceptualize them not as ‘simply *being*, but rather as
193 *becoming*’ in two-way processes throughout our lives [30, p.45, emphasis in original]. She
194 guides us very effectively to the fleshy, material body, but, again, we are primarily led
195 towards what we call the ‘gender-shaping of biology’ through changes within the body
196 resulting from social engagement [6].

197

198 Clearly the work of feminist biologists is very important. But we still have some way to go if
199 we are to move beyond the analysis of gendered narratives and representations to grasp
200 empirical data *about* the body which, as Margaret Lock and Vinh-Kim Nguyen recently put it,
201 remain black-boxed, obscuring ‘the pernicious, embodied and long-term consequences of
202 social inequalities’ [32, p.329]. As argued more generally by Thomas Lemke [33, p. 87],
203 amongst others, there is hesitancy amongst many feminists to engage directly with
204 ‘biological data and corporeal materiality of the body’. This hesitancy is explained by the
205 understandable desire to shun the hoary and truculent patriarchal equation of women and
206 girls with a defective biology which has justified women’s inequality through time [8]. Thus
207 it to some extent understandable that, ‘feminist-biologists’ (as we conceptualise them) and
208 other researchers we have discussed seem to grapple primarily with how social processes
209 (variously conceptualised) become embodied and (potentially) generate change in the
210 biological body—itself a thorny, and certainly important, matter—to the relative neglect of
211 the even bristlier and challenging concern of the interacting role that biological changes
212 themselves might play in *shaping gender* in the nexus with health. But, as we now go on to
213 argue, further steps are needed to develop a theoretical framework that tightens up the
214 ‘gender-biology nexus’ in relation to health.

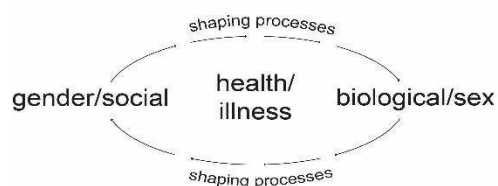
215

216 **The ‘biologic-shaping of gender’**

217 Though our conceptualization of the ‘gender-shaping of biology’ resonates with present
218 ways of thinking (as described above), the ‘biologic-shaping of gender’ is outwardly less
219 obvious in its meaning. It is therefore important to emphasise that we are not saying that
220 biology has a *determining* role, but rather that cyclical and highly complex ‘*shaping*
221 *processes*’ are likely to be in play whereby biological changes—which have themselves been
222 ‘gender-shaped’ (in the manner depicted by the existing research as discussed)—recursively
223 shape women’s gender-related experiences of health (‘the biologic-shaping of gender’).
224 Hence it should also be noted that we are not suggesting, or intending to identify, a linear
225 ‘input-output’ model whereby the ‘inputs’ of socially gendered experiences generate
226 biological changes which then ‘output’ to effect gendered health experiences anew, but
227 rather an imbricated and recursive process. This process is represented diagrammatically in
228 the Figure.

229

230 *Figure: Shaping processes of the ‘gender-biology nexus’*



231

232 With the advent of ‘new materialist’ feminism [e.g., 6, 34, 35] over roughly the last decade,
233 attention has turned more directly to the materiality of the body as ‘itself an active,
234 sometimes recalcitrant, force’ [34, p.4]. Samantha Frost [36, p.71], for example, argues that
235 if feminists wish to grasp the interaction of culture and biology as ‘complex, recursive, and

236 multi-linear' they must 'acknowledge that matter and biology are active in their own right'.
237 Humans, as Frost [38] relates, are 'biocultural' beings, or, as Karen Barad [35] puts it,
238 formed by 'naturalcultural' practices. The living human body comprises a multitude of
239 complex biological processes which bridge the inner body systems with the outer social and
240 gendered context, for example, through perception and cognition. As Frost [38: p. 75-6]
241 argues, bodies are responsive to their environments and 'quite literally rebuild themselves,
242 constantly, in response to the molecular constituents of their habitats'. But they are not
243 identical to their habitats since each body has been formed by its earlier biological and
244 cultural (biocultural) interchanges as well as those of previous generations. For instance,
245 research suggests that epigenetic processes may act as a channel through which social
246 environmental influences affect the body by changing gene expressions (the phenotype)
247 without changing the underlying DNA sequence (the genotype). Epigenetic changes may
248 thus alter gene expressions and modify disease susceptibility in various ways through
249 changes in the epigenome [39] which manifest in material physical form. Thus
250 environmental epigenetics highlights not only the making and remaking of bodies by their
251 environments, but also that bodies are, as Julie Guthman and Becky Mansfield argue,
252 'always active in their own remaking' [40, p.499]. Recognising that bodies and
253 social/material environments develop in relation to each other destabilises the
254 conventionally conceived social/biology border and draws attention to biological plasticity
255 [41]. Thus the body's external environments do not sit beyond it, but 'are themselves partly
256 a consequence of the organism itself as it produces and consumes the conditions of its own
257 existence' [42, p.108].
258

259 Although this way of thinking is gaining recognition, as Jörg Niewöhner and Margaret Lock
260 [43] instruct, there is a dearth of empirically-informed research in the health field to
261 illustrate just how the biological body may be actively involved in this process. This is
262 notably the case with regard to feminist work on health. As an illustration of how the
263 processes by which the biological body might not only be *shaped by* gender but may itself,
264 by turn, have a role in *shaping* women's experience of health/ill-health, we take female
265 genital mutilation/cutting (FGM/C) as a case example to begin to examine the body's
266 biological systems and health inequality. Given the state of current scientific knowledge, this
267 case is offered in a preliminary and tentative fashion.

268

269 **The case of FGM/C**

270 Identified by the United Nations as a human rights violation affecting girls and women
271 worldwide, FGM/C is especially concentrated in a swath of countries from the Atlantic coast
272 to the Horn of Africa, in areas of the Middle East, and in some countries of Asia. The WHO
273 defines the practice as comprising 'all procedures that involve partial or total removal of the
274 external female genitalia, or other injury to the female genital organs for non-medical
275 reasons' [44]. By recognising that 'FGM is an act that cuts away equality' [45], the most
276 recent UN-sponsored International Day of Zero Tolerance 2018 underscored the association
277 of FGM and gender inequality. Worldwide, in countries where it is prevalent, 200 million
278 girls and women alive today have been cut, with 3.2 million cut annually [45, 46, 47, 48].
279 Prevalence varies considerably across countries. Secular trend analysis shows some
280 significant shifts downwards in prevalence over the last twenty to thirty years in some
281 regions, such as East Africa, which according to Demographic Health Survey (DHS) data, saw
282 a reduction in prevalence from 71.4% in 1995 to 8.0% in 2016 [49]. However, UNFPA [47]

283 predicts (also based on DHS data) that due to underlying population growth in girls under
284 age 25, the number of women affected will increase significantly by 2030 in countries where
285 FGM/C is prevalent.

286 FGM/C is not only a practice, traceable back thousands of years, but also an object of
287 political debate within contemporary feminism and beyond [e.g., 50], making it in Hilary
288 Burrage's [51] words, a moral maze. UNICEF, for example, has employed both the more
289 politically neutral FGM/C (female genital cutting) and FGM [46, 52]. Since we cannot do
290 justice to political debates here, which, although important, are not essential to our
291 purpose, we opt to use the broader term FGM/C. FGM/C is an expression of gender
292 inequality and a form of violent abuse within patriarchal societies past and present[see e.g.,
293 51, 53]. FGM/C's persistence is often associated with entrenched socio-cultural norms. As a
294 cultural and political marker of inside/outsider status for girls and women, it often
295 symbolises cleanliness, purity, an appropriate embodied femininity and entry into
296 womanhood and is seen to improve fertility and marriageability [51, 54, 55]. Social
297 exclusion, shame and stigma often result if a girl is not cut [50, 52, 56]. Associations are
298 often drawn between FGM/C and the Islam since it is well-established in many
299 predominantly Islamic societies (such as in sub-Saharan Africa), yet not all Islamic groups
300 engage in the practice while many non Islamic groups do (it is practised amongst the
301 Christian and Jewish faiths, for example). As Burrage [51] relates, FGM/C is axiomatic to no
302 world religion, yet in various times and place various religious faiths have practised it and
303 patriarchal religions arguably create the milieu which allow the practice to continue.

304

305 Although the genito-urinary effects of FGM/C, such as effects on sensibility and sexual
306 pleasure, painful neuromas, micturition difficulties, menstrual, and obstetric complications

307 are fairly well-documented [e.g., 57, 58], in-depth studies of how these complications are
308 embodied and experienced throughout the lives of women are few in number, undoubtedly
309 because of the not inconsiderable practical challenge of conducting research on the matter.
310 Long-term bodily consequences of FGM/C may extend beyond the reproductive system,
311 involving, for instance, intestine and urinary bladder dysfunction and long-term pain and
312 complications [59], as well as somatic complaints; that is, symptoms with no identifiable
313 organic cause, such as aches and pains, and also significant mental health problems,
314 including depression, anxiety, and PTSD [60, 61, 62].

315

316 To refer back to our Figure, throughout our discussion thus far we have focused primarily on
317 one facet of the 'shaping process' within the 'gender-biology nexus'; namely, the 'gender-
318 shaping of biology'. In the reciprocal process of 'biologic-shaping of gender' we attend to
319 how the experience of women and girls may *alter* in complex embodied interactions with
320 biological changes in the body. By definition, when referring to *female* genital
321 mutilation/cutting, it is important that we include 'sex' because only the biological sex
322 organs of girls and women i.e., the vulva (clitoris, labia majora, labia minora are exposed to
323 trauma. While it can be noted that male circumcision (cutting of the prepuce, or foreskin)
324 and can also carry health risks (though these are not high) such as haemorrhage and
325 bleeding and erectile dysfunction [63], and that some argue that we should problematise
326 male circumcisions as a routine practice and its association with understandings of the male
327 body and masculinity [64], this is not addressed here as our focus is on women and girls.
328 Though not referring to FGM/C, Jörg Niewöhner and Margaret Lock argue that bodily
329 sensation and experience is 'in part *formed by* the material body, itself *contingent on*
330 evolutionary, environmental, social and individual variables' [43, p.684, our emphases]. The

331 consequences of these ‘variables’, as Niewöhner and Lock express it, are illustrated in
332 research by Anke Köbach and colleagues [60] with women in Jijiga, the capital of the Somali
333 region of Ethiopia where FGM/C has been widespread. Their analysis is based on a
334 convenience sample (without a control group) and comprises self-reported information
335 gleaned from women in interview (with clinical psychologists) about FGM/C, including
336 experience of the cutting, subsequent short and long-term physical complications, and
337 validated measures of PTSD and other mental health problems. From their analysis the
338 authors identified associations between the most severe kinds of cutting (types II and III)
339 and psychopathological symptoms in adulthood, especially vulnerability to PTSD and
340 shutdown dissociation. They also found higher hair cortisol concentrations (an indicator of
341 hormone response to stress) in women who experienced FGM/C before their first year of
342 age or had more severe forms of FGM compared to rest of the women, which indicates
343 long-term neuroendocrinological consequences of FGM and trauma in general on the
344 central stress system (the hypothalamic-pituitary-adrenal axis, or HPA). Since the HPA axis
345 genes play an important role in regulating the impact of social and environmental stress,
346 Köbach et al. draw attention to the possibility that the trauma from experiencing cutting
347 may have epigenetic effects. That traumas during a critical age period of epigenetic
348 plasticity in early life (as Köbach et al.’s [60] respondents’ experienced) may lead to
349 epigenetic processes is suggested by animal studies [65] and has been proposed as a
350 framework for epigenetic modifications in the biological integration of socioeconomic
351 factors during life. Research indicates that early egregious trauma (such as abuse in
352 childhood and other sorts of early-life stress among humans) may lead to dysregulation of
353 the HPA axis and later life mental ill health [66] as well as other health problems, such as
354 cancer and cardiovascular disease [e.g., 67, 68, 69]. Thus we can situate, albeit tentatively

355 (since, as noted, research is very limited at present), findings about FGM/C within the
356 hypothesized associations between stress-induced epigenetic modifications located in early
357 stressful life events during childhood and later life health inequalities in the manner
358 suggested as possible for socio-economic differentials [see e.g., 68, 70]. In our case
359 illustration, possible epigenetic effects reveal that the 'gender-shaping of biology' (taking
360 FGM/C to be the effect of women's environmental and social inequality) appears to
361 entangle with neuroendocrinological changes which 'biologically-shape' (but do not
362 determine) the health of girls and women exposed to FGM/C, which can be conceptualised
363 as a form of gendered health inequality. To explore this 'biologic-shaping of gender' in
364 relation to FGM/C further, we draw now on the work of Gillian Einstein [71, 72], a biologist
365 with a doctorate in neuroanatomy, who explores the neurobiological repercussions of
366 FGM/C from a feminist perspective.

367

368 Focusing on FGM/C type III (infibulation, excision of the external genitalia with closure of
369 the introitus) [62], Einstein proposes that cutting of the efferents and afferents (nerve
370 circuits) carried in the pudental, pelvic and hypogastric regions may affect the rest of the
371 body via the central nervous system (CNS) which, along with others [e.g., 73], she describes
372 as 'sensitive and malleable' [72, p.171]. She takes FGM/C's effects not in isolation and as
373 affecting one part of the body (the reproductive system), but as 'owned by the entire body,
374 or embodied through the interconnections of all body systems and the environment' [72,
375 p.158]. In an expressly speculative analysis she suggests that since the tissue of the vulva is
376 highly innervated, cutting the nerves which supply the skin and muscle will affect the feed-
377 back processes of the central nervous system and rouse long-lasting, body-wide effects such
378 as referred sensations, including pain (referred sensation means a sensation perceived at

379 another location than the site of the stimuli causing the sensation).The spinal cord and brain
380 may respond to cutting with reorganization ('rewiring') of neural circuits by referred
381 sensations (The neurological tissues can react to bodily losses akin to the way in which,
382 upon the amputation of a leg, a person may still feel the sensation of parts of the lost leg or
383 feelings of pain in the lost leg—a phenomenon called phantom sensation or phantom pain.
384 Einstein [71] suggests similarly that women exposed to FGM/C may experience phantom
385 sensations or clitoral pain.

386

387 Extrapolating from Einstein's arguments, while the (new) biological changes to the body
388 may *shape* physical sensations after having been cut, we would not expect them to
389 *determine* sensate experience in any simple or universal way because women's
390 interpretations of and responses to biological change are situated in time and place and
391 therefore formed by local expectations and practices. To deploy anthropologist Margaret
392 Lock's [74] well-known concept of 'local biologies', the shaping processes that we highlight
393 here are contingent and experienced in specific gendered environments. According to
394 Einstein [71, 72], it is reasonable to argue that as it is affected by other bodily modifications,
395 the CNS itself 'plays a role in the embodiment of culture' [72, p.155] with potential
396 gendered consequences for both the bodies and minds of women and girls. Thus she
397 proposes that cutting not only makes girls and women resemble their community physically
398 (which is likely to be normatively valued), 'through its actions on the CNS it inscribes values
399 of comportment and aesthetics' [71, p.94]. Thus she relates that FGM/C 'configures the
400 ways in which a woman carries herself, walks, and experiences the world' [71, p.94]. By this
401 we may infer that a new collective and individual mind-body is produced. First-person
402 experiential accounts provide support for this. Waris Dirie [75] and Hibo Wardere [56], for

403 instance, explain how their physical bodies changed after cutting and the horrific pain when
404 urinating and the nightmare of menstrual periods after being cut as young girls. Reflecting
405 back on the impact of biological change on her life as a girl, Wardere laments, ‘no more
406 running, skipping or jumping rope for me’ [56, p.223]. Similarly, in research by Morison and
407 colleagues [76], Somalis living in London spoke of direct effects of cutting which involved
408 walking and behaving differently to avoid opening up scars. This conjures political scientist
409 Iris Marion Young’s [77] classic discussion of female comportment. Less open than men in
410 gait and stride, Young argues that ‘modalities of female bodily existence’ are rooted in
411 experience of the body as a ‘fragile thing, which must be picked up and coaxed into
412 existence’ [77, p.39]. Perforce, women who have been cut may realise pain, distress, and
413 constricted physicality, but as this usually is all they and those around them know, over time
414 and through generations, as Einstein explains, experiential changes may become
415 ‘instantiated as the “normal” (and perhaps, desirable) body’ [72, p. 151; see also, 78] and
416 hence part of the experience of womanhood [56, 75]. Research with Somali-Canadian
417 women, for example, has shown that wide-scale bodily pain and discomfort can be brushed-
418 aside as normal-natural as women exhibit resilience through the desire not to let pain attain
419 power over their lives [71, 72, 78]. Nevertheless, as Johansen [79] explores, the pain of
420 infibulation has lasting effects, which Somali refugee women in her Norwegian study spoke
421 of as ‘embodied memory’ carried with them as a burden and sense of loss. This then points
422 to how shaping processes; the intertwined ‘gender-shaping of biology’ and consequent
423 ‘biologic-shaping of gender’ through time, may produce a new collective and individual
424 mind-body, as noted earlier.

425

426 To return explicitly to our Figure, while the origins of FGM/C are indisputably social and
427 seated in localised social relations of gender ('gender-shaping of biology'), they may effect
428 complex and perhaps far-reaching changes in the material biological body. The body
429 becomes other than what it once was (or could have been); it is altered. Through our
430 illustration, we have sought to open up black-boxed data about the body which obscures
431 the harmful embodied and long-term consequences of social inequalities [43] by bringing to
432 light the epigenetic and neurobiological processes through which changes may occur. These
433 bodily changes by *their* turn entwine with (but do not determine) women's individual and
434 collectively gendered bodily expressions and experiences (the 'biologic-shaping of gender')
435 which are unlikely to be universal, but rather to vary by time and place. It is important to
436 stress that by this argument we do not intend to say that the biological and the social are
437 one and the same, collapsed into one another or, as noted earlier, that a linear 'input-
438 output' process is in play, but rather that gender-suffused social milieu—which encompass,
439 for example, the health, life and experiences of our illustration—become sedimented (but
440 not ineludibly fixed) in bodily practices which concern women's health as individual and
441 collective lives evolve in time.

442

443 **Implications for policy**

444 As remarked upon at the start, it is important that theoretical frameworks and conceptual
445 tools are subject to ongoing critical analysis because they shape research outcomes by
446 guiding research pathways. A thoroughgoing analysis of the global production of women's
447 health inequality depends on a comprehensive theorization of how social relations of
448 gender and the biological body mutually inform each other in local contexts. To pick up on
449 the recent statement referred to earlier from UN Women [45] that 'FGM is an act that cuts

450 away equality', we argue that a comprehensive understanding of what this means for
451 women's health calls for us to go beyond the common concern with how social and cultural
452 practices shape the biological body—important though this, of course, is – to also attend to
453 the recursive effects of the biological changes themselves on women's social lives and lived
454 bodily experiences. Yet we very quickly reach the limits of our empirical knowledge when
455 we try to develop this more comprehensive approach. A primary reason for this is the
456 distinct lack of interdisciplinary research. While feminist and gender theorists have begun to
457 explore the biological substance of the body as active, rather than passive, matter (such as
458 in materialist feminism e.g., 35, 38], they have not directly engaged with health experiences
459 associated with inequality for women and girls. Even in the field of FGM/C, for example,
460 there is a paucity of in-depth qualitative research exploring embodied experience. Thus a
461 recommendation made here, which accords more generally with those made in the wider
462 context of women's health [e.g., 80, 81], is that research funding bodies and institutions
463 recognise the value of interdisciplinary theoretical and empirical research in the field
464 commonly known as 'gender and health' that addresses not only the 'gender-shaping of
465 biology' but also the 'biologic-shaping of gender' and which avoids essentialist and
466 reductivist thinking.

467

468 **Conclusion**

469 In this theoretical paper we have sought to explore how social relations of gender
470 interrelate with the biological body to shape the experience of health in ways that may
471 generate inequality for women and girls. Specifically we have analysed how feminist and
472 gender theorists have made biological 'sex' and social 'gender' legible, with the specific
473 object of identifying gaps in their expression in a nexus with health. We have argued that, to

474 date, most attention has been directed to what we call the ‘gender-shaping of biology’ to
475 the relative neglect of the co-constitutive role that biological changes *themselves*—what we
476 dub the ‘biologic-shaping of gender’—may play in ongoing cycles of gendered health
477 inequality. FGM/C has been taken to explore in a preliminary way how these ‘shaping
478 processes’ may occur. It is recognised, however, that we are limited in our capacity to fully
479 substantiate what we conceptualise as the shaping processes of the ‘gender-biology nexus’
480 (focusing on health and illness) at the present due to lack of research. In order for this to
481 progress, we suggest that far more interdisciplinary research between social scientists,
482 including gender theorists, and biological and health scientists is needed.

483

484 **End Materials**

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493 **Paper context:** Analyses of the relationship between social and biological factors in the
494 production of women’s health inequality have focused predominantly on how social factors
495 become embodied to the relative neglect of the reciprocal role played by the biological body
496 in shaping its social world. Drawing on feminist and gender theory we develop a novel

497 theoretical approach which attends not only to the 'gender-shaping of biology' but also to
498 the 'biologic-shaping of gender' as interweaving processes.

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502 **References**

503 [1] Connell R. Conclusion: reckoning with gender. In: Messerschmidt JW, Martin PY, Messner
504 MA, Connell R, editors. Gender reckonings. New York (NY): New York University Press; 2018.
505 p. 331-346.

506 [2] Birke L. Feminism and the biological body. New Brunswick: Rutgers University Press;
507 1999.

508 [3] Fausto-Sterling A. Sexing the body. New York (NY): Basic Books; 2000.

509 [4] Pitts-Taylor V. Mattering: feminism, science, and corporeal politics. In: Pitts-Taylor V,
510 editor. Mattering New York (NY): New York University Press; 2016a. p.1-20.

511 [5] Pitts-Taylor V. The Brain's body. Neuroscience and corporeal politics. Durham:Duke
512 University Press; 2016b.

513 [6] Wilson E. Gut Feminism. Durham: Duke University Press; 2015.

514 [7] Oakley A. Sex, gender and society. London:Temple Smith; 1972.

515 [8] Annandale E. Women's health and social change. London: Routledge; 2009.

516 [9] Roberts H, editor. Women, health and reproduction. London: Routledge, Kegan Paul;
517 1981.

518 [10] Doyal L. What makes women sick. London: Macmillan; 1995.

519 [11] Scheper-Hughes N, Lock, M. The mindful body: a prolegomenon to future work in
520 medical anthropology. Med Anthropol Q. 1987;1(1):6-41.

- 521 [12] Connell R. Gender. Cambridge: Polity; 2009.
- 522 [13] Connell, R. Gender, health and theory: conceptualizing the issue, in local and world
523 perspective. Soc Sci Med. 2012;74(11):1675-1683.
- 524 [14] Bird CE, Rieker PP. Gender and health: The effects of constrained choices and social
525 policies. New York (NY): Cambridge University Press; 2008.
- 526 [15] Wiklund M, Bengs C, Malmgren-Olsson EB, et al. Young women facing multiple and
527 intersecting stressors of modernity, gender orders and youth. Soc Sci Med. 2010;71(9):1567-
528 1575.
- 529 [16] Herrett M, Schofield T. Raewyn Connell: gender, health and healthcare. In: Collyer F,
530 editor. The Palgrave handbook of social theory in health, illness and medicine. London:
531 Palgrave; 2015. p. 550-566.
- 532 [17] Wiklund M, Ahlgren C, Hammarström, A. Constructing respectability from disfavoured
533 social positions: exploring young femininities and health as shaped by marginalisation and
534 social context. A qualitative study in Northern Sweden. Glob Health Action. 2018;
535 11(sup3):1519960.
- 536 [18] Misra J. Categories, structures and intersectional theory. In: Messerschmidt JW, Martin
537 PY, Messner MA, Connel R. editors. Gender reckonings. New York (NY): New York University
538 Press; 2018. p 111-130.
- 539 [19] Kapilashrami A, Hankivsky O. Intersectionality and why it matters to global health. The
540 Lancet.. 2018; 391:2589-2591.
- 541 [20] Springer K, Mager Stellman J, Jordan-Young R. Beyond a catalogue of differences: a
542 theoretical frame and good practice guidelines for researching sex/gender in human health.
543 Soc Sci Med. 2012;74(11):1817-1824.
- 544 [21] Selye H. The evolution of the stress concept. Am Sci. 1973;61(6):692-699.

545 [22] Frankenhaeuser M, Lundberg U, Fredrickson M, et al. Stress on and off the job as
546 related to sex and occupational status in white-collar workers. *J Organ Behav.*
547 1989;10(4):321-346.

548 [23] Krieger N. Embodiment: a conceptual glossary for epidemiology. *J Epidemiol Commun*
549 *H.* 2005; 59(5):350-355.

550 [24] Krieger N, Zierler H. Accounting for the health and women. *Crit Public Health.* 1997;7(1-
551 2):38-49.

552 [25] Krieger N. Gender, sexes, and health: what are the connections – and why does it
553 matter? *Int J Epidemiol.* 2003; 32:652-657.

554 [26] Fausto-Sterling A. The bare bones of sex: part 1 – sex and gender. *Signs.*
555 2005;30(2):1491-1528.

556 [27] Fausto-Sterling A. *Sex/gender: biology in a social world.* London: Routledge; 2012.

557 [28] Fausto-Sterling A. Against dichotomy. *Evolutionary Studies in Imaginative Culture.*
558 2017; 1(1):63-66.

559 [29] Fausto-Sterling A. Gender/sex, sexual orientation, and identity are in the body: how did
560 they get there. *J Sex Res.* 2019;56(5-6):529-555.

561 [30] Rose S. *Lifelines: biology, freedom, determinism.* Harmondsworth: Penguin; 1997.

562 [31] Birke L. Shaping biology. In: Williams S, Birke L, Bendelow G, editors. *Debating biology.*
563 London: Routledge; 2000. p.39-52.

564 [32] Lock M, Nguyen V-K. *An anthropology of biomedicine.* 2nd ed. Oxford: Wiley-Blackwell;
565 2018.

566 [33] Lemke T. Mater and matter: a primary cartography of material feminisms. *Soft Power.*
567 2017;5(1):83-100.

568 [34] Alaimo S, and Hekman S, editors. Material feminisms. Bloomington Indiana: University
569 of Indiana Press; 2008.

570 [35] Barad K. Meeting the universe halfway. Durham: Duke University Press; 2007.

571 [36] Frost S. The implications of the new materialisms for feminist epistemology. In:
572 Grasswick HE, editor. Feminist epistemology and philosophy of science: power in
573 knowledge. Springer: Switzerland AG; 2011. p. 69-83.

574 [37] Coole D, Frost S, editors. New materialisms. Durham: Duke University Press; 2010.

575 [38] Frost S. Biocultural creatures. London: Duke University Press; 2016.

576 [39] Skinner MK. Environmental epigenomics and disease susceptibility. EMBO Rep. 2011;
577 12(7):620-2.

578 [40] Guthman J, Mansfield B. The implications of environmental epigenetics: A new
579 direction for geographic inquiry on health, space, and nature-society relations. Prog Hum
580 Geog. 2012;37(4): 486-504.

581 [41] Meloni M, Testa G. Scrutinising the epigenetics revolution. In: Meloni M, Cromby J,
582 Fitzgerald D, Lloyd S, editors. The Palgrave handbook of biology and society. London:
583 Palgrave; 2017. p.191-226.

584 [42] Weasel L. Embodying intersectionality: the promise (and peril) of epigenetics for
585 feminist studies of science. In: Pitts-Taylor V, editor. Mattering. New York (NY):New York
586 University Press; 2016. p.104-121.

587 [43] Niewöhner J, Lock M. Situating local biologies: anthropological perspectives on
588 environment/human entanglements. BioSocieties. 2018;13(4):681-697.

589 [44] WHO. Female Genital Mutilation. Key Facts. 2018 [cited 2019 Aug 30]. Available from:
590 <https://www.who.int/news-room/fact-sheets/detail/female-genital-mutilation>.

591 [45] UN Women. International Day of Zero Tolerance to Female Genital Mutilation. 2018.
592 [cited 2018 Nov 24]. Available from:
593 [http://www.unwomen.org/en/news/stories/2018/2/statement-ed-phumzile-international-
594 day-of-zero-tolerance-for-fgm](http://www.unwomen.org/en/news/stories/2018/2/statement-ed-phumzile-international-
594 day-of-zero-tolerance-for-fgm).
595 [46] UNICEF. Female genital mutilation. 2018. [cited 2018 Dec 10]. Available from:
596 <https://data.unicef.org/topic/child-protection/female-genital-mutilation/>
597 [47] UNFPA. Bending the Curve: FGM trends we aim to change. 2018.
598 <https://www.unfpa.org/resources/bending-curve-fgm-trends-we-aim-change>
599 [48] WHO. Resolution adopted by the General Assembly on 18 December 2014. 69/150.
600 Intensifying global efforts for the elimination of female genital mutilations. 2014. [2018
601 cited Nov 4]. Available from:
602 http://www.un.org/en/ga/search/view_doc.asp?symbol=A/RES/69/150
603 [49] Kandala N-B, Ezejimofor MC, Uthman OA, Komba P. Secular trends in the prevalence
604 of female genital mutilation/cutting among girls: a systematic analysis BMJ Global
605 Health. 2018;**3**:e000549.
606 [50] Jordal M, Griffin G. Clitoral reconstruction: understanding changing gendered health
607 care needs in a globalized Europe. Eur J Womens Stud. 2018; 25(2):154-167.
608 [51] Burrage H. Eradicating FGM. London: Routledge; 2015.
609 [52] UNICEF. Female Genital Mutilation/Cutting: A statistical overview and exploration of
610 the dynamics of change. New York: UNICEF; 2013.
611 [53] Mwanri L, Gatwiri GJ. Injured bodies, damaged lives: experiences and narratives of
612 Kenyan women with obstetric fistula and female genital mutilation/cutting. Reprod Health.
613 2017;14:38. [https://reproductive-health-
614 journal.biomedcentral.com/track/pdf/10.1186/s12978-017-0300-y](https://reproductive-health-
614 journal.biomedcentral.com/track/pdf/10.1186/s12978-017-0300-y)

615 [54] Sagna M. Gender differences in the support for discontinuation of female genital
616 cutting in Sierra Leone. *Cult Health Sex.* 2014;16(6):603-619.

617 [55] O’Neill S. Purity, cleanliness, and smell: female circumcision, embodiment, and
618 discourses among midwives and excisers in Fouta Toro, Senegal. *Journal of the Royal*
619 *Anthropological Institute.* 2018;24(4):730-748.

620 [56] Wardere H. *Cut.* London: Simon & Schuster; 2016.

621 [57] Andro A, Cambois E, Lesclingand, M. Long-term consequences of female genital
622 mutilation in a European context: self perceived health of FGM women compared to non-
623 FGM women. *Soc Sci Med.* 2014;106:177-184.

624 [58] Klein E, Helzner E, Shayowitz M, et al. Female genital mutilation: health consequences
625 and complications—a short literature review. *Obstetrics and Gynecology International.*
626 2018; <https://www.hindawi.com/journals/ogi/2018/7365715/>

627 [59] Berg RC, Underland V, Odgaard-Jensen J, et al. Effects of female genital cutting on
628 physical health outcomes: a systematic review and meta-analysis. *BMJ Open.* 2014;
629 <https://bmjopen.bmj.com/content/4/11/e006316>

630 [60] Köbach A, Ruf-Leuschner R, Elbert T. Psychopathological sequelae of female
631 genital mutilation and their neuroendocrinological associations. *BMC Psychiatry.* 2018;
632 18:187 <https://doi.org/10.1186/s12888-018-1757-0>.

633 [61] WHO. WHO guidelines on the management of health complications from female
634 genital mutilation. Geneva, WHO; 2016.
635 <https://www.who.int/reproductivehealth/topics/fgm/management-health-complications->
636 [fgm/en/](https://www.who.int/reproductivehealth/topics/fgm/management-health-complications-fgm/en/)

637 [62] WHO. Care of Girls and Women Living with Female Genital Mutilation. A Clinical
638 Handbook. Geneva: WHO; 2018.

639 [63] Paakkanen, EK. Entitled, powered or victims-an analysis of discourses on male and
640 female circumcision, genital mutilation/cutting and genital cosmetic surgery. International
641 Human Rights. DOI: [10.1080/13642987.2019.1612375](https://doi.org/10.1080/13642987.2019.1612375); 2019

642 [64] Fox M, Thomson M. Foreskin is a feminist issue. *Aust Feminist Stud.* 2009; 25(60):195-
643 201.

644 [65] Lee RS, Sawa A. Environmental stressors and epigenetic control of the hypothalamic-
645 pituitary-adrenal axis. *Neuroendocrinology.* 2014;100(4):278-287.

646 [66] Van Voorhees E, Scarpa, A. The effects of child maltreatment on the hypothalamic-
647 pituitary-adrenal axis. *Trauma Violence Abus.* 2004; 5(4):333-52.

648 [67] Daskalakis NP, Yehuda R. Programming HPA-axis by early life experience: mechanisms
649 of stress. *Front Endocrinol.* 2015;
650 <https://www.frontiersin.org/articles/10.3389/fendo.2014.00244/full>

651 [68] Stringhini S, Vineis P. Epigenetic signatures of socioeconomic status across the
652 lifecourse. In: Meloni M, Cromby J, Fitzgerald D, Lloyd S, editors. *The Palgrave handbook*
653 *of biology and society.* London:Palgrave; 2017.p:541-589.

654 [69] Kelly-Irving M, Delpierre C. The embodiment dynamic over the life course: a case for
655 examining cancer aetiology. In: Meloni M, Cromby J, Fitzgerald D, Lloyd S, editors. *The*
656 *Palgrave handbook of biology and society.* London: Palgrave; 2017. p.519-540.

657 [70] Thayer ZM, Kuzawa CW. Biological memories of past environments: epigenetic
658 pathways to health disparities. *Epigenetics.* 2011;6(7):1-6.

659 [71] Einstein G. From body to brain: considering the neurobiological effects of female genital
660 cutting. *Perspect Biol Med.* 2008;51(1):84-97.

661 [72] Einstein G. Situated neuroscience: exploring biologies of diversity. In: Bluhm R, Jaap
662 Jacobson A, Mailbom HL, editors. *Neurofeminism.* London:Palgrave; 2012.p:145-174.

663 [73] Papadopoulos D. The imaginary of plasticity: neural embodiment, epigenetics and
664 ecomorphs. *Sociolog Rev* 2011;59(3):232-456.

665 [74] Lock M. The tempering of medical anthropology: troubling natural categories. *Med*
666 *Anthropol Q.* 2001;15(4):478-492.

667 [75] Dirie W. *Desert flower*. London: Virago; 2001.

668 [76] Morison L, Dirir A, Elmi S, et al. How experiences and attitudes relating to female
669 circumcision vary according to age on arrival in Britain. *Ethnic Health.* 2004;9(1):75-100.

670 [77] Young I. Throwing like a girl. In: Young IM, editor. *On female body experience*. Oxford:
671 Oxford University Press; 2005.p.27-45.

672 [78] Jacobson D, Glazer E, Mason R, et al. The lived experience of female genital cutting
673 (FGC) in Somali-Canadian women's daily lives. *PLoS one.* 2018; 13(11).
674 <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0206886>

675 [79] Johansen REB. Pain as a counterpoint to culture: toward an analysis of pain associated
676 with infibulation among Somali immigrants in Norway. *Med Anthropol Q.* 2002; 16(3):312-
677 340.

678 [80] Rieker P, Bird C. Rethinking gender differences in health: why we need to integrate
679 social and biological perspectives. *The Journals of Gerontology.* 2005; Series B. 60 (special
680 issue 2):S40-S4.

681 [81] Sharman Z, Johnson J. Towards the inclusion of gender and sex in health research and
682 funding: An institutional perspective. *Soc Sci Med.* 2012;74:1812-1816.