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Research

Keywords: Inequality, Exclusive breastfeeding practice, Social and behavioral change communication, Nigeria

Posted Date: March 10th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-287956/v1>

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Version of Record: A version of this preprint was published at International Journal for Equity in Health on July 27th, 2021. See the published version at <https://doi.org/10.1186/s12939-021-01504-4>.

Socioeconomic Inequality in exclusive breastfeeding behavior and Ideation factors for Social Behavioral Change in three North-western Nigerian States: A cross-sectional study.

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1 **Abstract**

2 **Background**

3 Socioeconomic inequalities could mitigate the impact of social and behavior change
4 (SBC) interventions aimed at improving positive ideation towards the practice of
5 exclusive breastfeeding. This study explores the empirical evidence of inequalities in
6 the practice of exclusive breastfeeding (EBF) and associated ideational domains of the
7 theory of Strategic Communication and Behavior Change in three north-western
8 Nigeria states.

9 **Methods**

10 We used cross-sectional data from 3,007 randomly selected women with under-two-
11 year-old children; the convenient regression method was applied to estimate the
12 concentration indexes of exclusive breastfeeding behavior, ranked by household
13 wealth index. Inequality was decomposed to associated ideational factors and
14 sociodemographic determinants. Avoidable inequalities and the proportion of linear
15 redistribution to achieve zero inequality were estimated.

16 **Results**

17 Women from wealthier households were more likely to practice exclusive
18 breastfeeding (CIx = 0.1236, p-value = 0.00). Attendance of at least four antenatal
19 clinic visits (ANC 4+) was the most significant contributor to the inequality,
20 contributing CIx = 0.0307 (p-value = 0.00) to the estimated inequality in exclusive
21 breastfeeding practice. The elasticity of exclusive breastfeeding behavior with respect
22 to partners influencing decision to breastfeed and ANC4+, were 0.1484 (p-value =
23 0.00) and 0.0825 (p-value = 0.00) respectively. Inequality in the regular attendance at
24 community meetings (CIx = 0.1887, p-value =0.00); ANC 4+) (CIx = 0.3722, p-value
25 = 0.00); and maternal age (CIx = 0.0161, p-value = 0.00) were pro-rich. A 10.7%

26 redistribution of exclusive breastfeeding behavior from the wealthier half to the
27 poorer half of the population could eliminate the inequality (line of zero inequality).
28 Inequalities were mainly in the cognitive and social norms domain and were all pro-
29 poor.

30 **Conclusion**

31 Socioeconomic inequalities exist in exclusive breastfeeding behaviour: the associated
32 ideations in the study states but are mostly avoidable. A 10.7% redistribution from
33 wealthier to the poorer half of the population will achieve elimination. Messaging for
34 SBC communication interventions to improve breastfeeding practices could be more
35 effective by targeting the mitigation of these inequalities.

36

37

38 Keywords: Inequality, Exclusive breastfeeding practice, Social and behavioral change
39 communication, Nigeria.

40

41 **Background**

42 Health inequities are significant determinants of population health, and interventions to
43 improve population health, which neglect the impact of inequality: the disproportionate
44 concentration of individuals with certain health behaviors/outcomes in some population
45 sub-groups, may, in the long run, aggravate inequitable access to health, healthcare, and
46 social injustice [1]. Health inequalities and the inequality in the delivery of healthcare
47 remain challenges to the health policy community. The unequal exposure to
48 interventions and access to health services generally give rise to inequitable and
49 avoidable differences in disease burden and response to interventions to mitigate the
50 burdens across groups in the population.

51

52 It is well recognized that social determinants shape individual interaction and play a
53 significant role in the wellbeing of the individual, family, and community [2-4]. Factors
54 such as knowledge, attitudes, social, mental, and cultural norms and conventions
55 influence individuals' and communities' health states, including healthcare-seeking
56 behaviors [5]. Globally, social and behavior change (SBC) interventions are being
57 increasingly implemented for modulating change toward generating appropriate
58 healthcare demand and reducing preventable maternal, newborn, and childhood
59 morbidities and mortalities [6-8]. For instance, the United States Agency for
60 International Development (USAID) is investing in SBC interventional research and
61 programming in Nigeria, aiming towards positively changing the norms that underpin
62 the health-seeking behaviors of individuals and communities [9-11]. There is limited
63 but growing evidence on the nature of the interactions between social and cultural
64 norms in modulating health-seeking behavior. Evidence is scarce on the inequities in
65 the population distribution of health-improving priority behaviors and their underlying

66 norms and ideations. The impact of interventions could be limited or skewed unfairly
67 towards the relatively socioeconomically endowed group in the population. The
68 existence of inequalities in health and health care, the priority behaviors that impact
69 population health, and the ideational determinants could regressively impact SBC for
70 demand creation programming. This situation could consequently result in suboptimal
71 impact from SBC interventions diminishing the expected program outcomes.

72

73 Despite decades of heightened advocacy for improving breastfeeding within Nigeria
74 Primary Health Care, breastfeeding practices remain low in Nigeria, with exclusive
75 breastfeeding rates as low as 29% at the national level and as low as 19% in the
76 country's north-western region [12]. Studies have explored the social determinants of
77 exclusive breastfeeding practices in diverse cultures. In northern Nigeria,
78 sociodemographic factors such as maternal education, maternal employment,
79 household wealth, antenatal care attendance, and facility delivery have been
80 associated with breastfeeding practices [13, 14]. Other studies have also shown that
81 cultural beliefs and perceptions about breastfeeding, including husband disapproval
82 [15], knowledge, norms, self-efficacy, and other psychosocial influences, have also
83 influenced breastfeeding practices [16, 17].

84 New strategies for improving breastfeeding practices and behavior have built on the
85 Ideation Model of Strategic Communication and Behavior Change [16] concepts,
86 linking individual ideation with behavior within cognitive, emotional, and social
87 domains as informed in behavioral theories and models [18]. These Social and
88 Behavioral Change intervention programs typically focus on modulating psychosocial
89 influences, or ideations, as intermediate determinants of health behaviors [16].

90 Notwithstanding the programming attention to the psychosocial determinants for
91 improving breastfeeding practices, critical explorations are also essential for
92 determining the extent to which inequalities in ideational norms shape behavior towards
93 demand creation for Maternal, Newborn and Child Health and Nutrition (MNCH+N),
94 Family Planning (FP), and Malaria care in the population. Evidence is scarce in the
95 published literature on the causal determinants (predictors) of observed inequalities in
96 a population's breastfeeding behavior and practices and how existing inequalities could
97 mitigate outcomes from SBC interventions and programming in communities. A study
98 in rural India has explored the Effects of health behavior change intervention through
99 women's self-help groups on maternal and newborn health practices and related
100 inequalities [19]. Another study from Norway explained the socioeconomic inequalities
101 in exclusive breastfeeding. It concluded that socioeconomic inequalities in exclusive
102 breastfeeding were "largely explained by sociodemographic factors, but also by
103 modifiable factors, such as smoking habits and breastfeeding difficulties, which can be
104 amenable to public health interventions" [20]. An appreciation of the drivers and
105 patterns of socioeconomic inequalities is vital in designing effective SBC intervention
106 strategies that target population sub-groups most at need, improves its relative impact
107 and in turn, the potential to reduce the inequality gaps. Estimating the avoidable
108 inequality (proportion of the inequality that is amenable to intervention) is vital in
109 designing SBC intervention strategies and goal setting. Typically, only a proportion of
110 inequalities is amenable to intervention (termed avoidable inequality). The proportion
111 of the estimated inequality uncorrectable by interventions (unavoidable inequalities)
112 arises from genetic factors and gender: determinants such that interventions cannot
113 modify. Decomposing inequality estimates into the relative contribution of the

114 associated determinants into the avoidable and unavoidable proportions potentially
115 provides evidence to support better targeting of intervention strategies with more
116 realistic program impact expectations. Although there is increasing worldwide interest
117 in SBC programming to modulate positive behavior and ideational norms, there has not
118 been significant research attention given to examining how inequalities can potentially
119 mitigate the impact of programs. There is limited evidence in the published literature
120 on inequality in the population distribution of priority behaviors and related health-
121 improving ideation factors to inform better targeting of SBC interventions to population
122 groups.

123

124 There is sufficient evidence from the published literature to suggest a regressive
125 socioeconomic status or educational level-related inequality in populations [21, 22].

126 The lower socioeconomic groups are less likely than, the higher socioeconomic
127 groups to acquire positive breastfeeding behavior [22], have limited access to
128 nutritional counseling, and have limited access to factors that generate positive
129 ideation that influence healthy breastfeeding behavior. Although an objective
130 estimation of inequalities in statistically verifiable metrics may provide critical
131 evidence to support the targeting intervention strategies towards better outcomes and
132 the objective evaluation of such programs and interventions. However, there has not
133 been sufficient evidence of such explorations in Nigerian populations or elsewhere.

134

135 Since 2017, the United States Agency for International Development (USAID) Nigeria
136 has invested in implementing SBC intervention programs through the Breakthrough
137 ACTION Nigeria (BA-N) consortium in 11 of Nigeria's 37 states. However,
138 Breakthrough RESEARCH Nigeria (BR-N) is USAID's flagship project for social and

139 behavior change (SBC) research, evaluation, and generating programmatic evidence to
140 inform and support BA-N's SBC programs interventions, including other SBC
141 programs in Nigeria in general.

142

143 **Objective**

144 This paper seeks to explore the empirical evidence of inequalities in the population
145 distribution of exclusive breastfeeding practice and the enabling ideation factors in
146 childbearing age women in three north-western Nigerian states of Sokoto Kebbi and
147 Zamfara. The main goal is to objectively estimate the degree of inequality in the
148 practice of exclusive breastfeeding and its association with ideating psychosocial
149 factors by employing the concentration index method [23]. By so doing, the inequality
150 estimate was decomposed to the contributions from the associated ideation factors and
151 sociodemographic determinants. The elasticity of the ideation and sociodemographic
152 determinants with respect to exclusive breastfeeding practices, the avoidable
153 inequality, and the proportion of linear population redistribution of exclusive
154 breastfeeding practices to eliminate the inequality (achieving zero inequality) were
155 estimated.

156 **Methods**

157

158 This exploration is based on the household data from a Breakthrough
159 RESEARCH (BR-N) Behavioral Sentinel Surveillance (BSS) baseline survey
160 wave conducted between September and October 2019 in Breakthrough ACTION
161 program areas in Kebbi, Sokoto, and Zamfara. BR-N aims to increase 17 priority
162 health behaviors in Maternal, Newborn, Child Health plus Nutrition (MNCH+N),
163 Family planning, and Malaria. Its goals are to improve individual and social

164 determinants of health, strengthen SBC coordination and collaboration among
165 partners, and strengthen the SBC capacity of national and sub-national public
166 sector entities. The BA-N SBC intervention program consists of three core
167 components: 1) advocacy outreach to opinion leaders and community influencers
168 at State and LGA levels; 2) direct engagement of community members through
169 household visits and community dialogues directed at target populations, with
170 referrals for services as needed; and 3) complementary integrated SBC messaging
171 through mass, mid-media, and mobile phones.

172

173 **Sampling and Data**

174 Data for this paper were obtained from a Behavioral Surveillance (BSS) Survey that
175 collected information on several health issues, including breastfeeding practices and
176 factors that might influence these practices. We used the data to explore the
177 socioeconomic status (SES) related inequalities in the population distribution of
178 exclusive breastfeeding ideation and exclusive breastfeeding practice at the household
179 level. The BSS data were obtained through a two-stage cluster-sample, a cross-
180 sectional population survey of over 3000 women with a child under two years in
181 wards from Kebbi, Sokoto, and Zamfara states. The survey sample size was based on
182 the BR-N evaluation design [24], allowing for a 10% non-response rate, a power
183 criterion of 0.80, an alpha coefficient of 0.05, and varying intra-cluster correlations
184 and minimal detectable differences for priority outcomes of the evaluation. At the first
185 stage, 108 enumeration areas (EA) (36 in each state) were selected from BR program
186 wards using digital maps and a grid sampling methodology. At the second sampling
187 stage, all households within each sampled Enumeration Areas (EA) were randomly
188 sampled to select households with a resident childbearing age (14-49-year-old)

189 woman who had a child under two years. Responses from the sampled women were
190 obtained through face-to-face interviews using the household and female pilot-tested
191 questionnaires by trained interviewers. Information was obtained on usual resident
192 household members and household assets and characteristics. The female
193 questionnaire was used to collect data on respondents' demographics, reproductive
194 history, contraceptive use, media exposure, gender norms, exclusive breastfeeding
195 and ideations related to breastfeeding while conducting the interviews in the local
196 (Hausa) language. A currently breastfeeding infant aged 0-5 months, who was neither
197 offered any liquids during the first three days after birth nor any soft or semi-solid
198 foods in the 24 hours prior to administering the questionnaire was coded as being
199 exclusively breastfed - the outcome variable. A five-item Likert scale response
200 (strongly disagree, somewhat disagree, don't know, somewhat agree, and strongly
201 agree) was obtained for the ideation questions probing for the respondents' knowledge
202 and beliefs domain of breastfeeding ideation and norms. Responses were: very
203 uncertain, somewhat uncertain, don't know, somewhat confident, and very confident
204 for probes into self-efficacy. The overall response rate was 99%.

205

206 **Analysis**

207 The concentration index (CI_x) [25, 26] method, which is arguably more appropriate
208 than inequality indices derived from social welfare function (defining equity with the
209 social justice approach) [1] was adopted for the estimation. This method allows for
210 objectively computing the inequality metric as it conveniently subjects to statistical
211 examination for precision, allowing for the examination of changes in inequality in a
212 population over time. The Lorenz (concentration) curve, which visually complements
213 the CI_x, was used for the visual descriptive examination of the inequalities in

214 exclusive breastfeeding behavior across the three states. Ranking the exclusive
215 breastfeeding practice by household living standard proxied by the household
216 socioeconomic status, beginning from the lowest, the Lorenz (14) curve plots the
217 cumulative proportion of the population against the cumulative proportion of
218 exclusive breastfeeding behavior. The concentration index (CIx) is computed as
219 twice the area between the concentration curve and the diagonal, taking a value of
220 zero if the curve coincides with the diagonal and positive (negative) values when it
221 lies above (below) the diagonal. [27] and is represented in the formula below [28-30]:

222

$$223 \quad C = \frac{2}{n\mu} \sum_{i=1}^n h_i R_i - 1 \quad (1)$$

224 Where h_i is the health sector variable, (exclusive breastfeeding) for person i ; μ is the
225 mean of h , and R_i is the fractional rank in the household wealth index distribution of
226 the i^{th} person (distribution from most disadvantaged (i.e., poorest) to the least
227 disadvantaged (i.e. richest)) [28-30]. With a negative CIx, inequality is interpreted as
228 pro-poor (favoring the population's socioeconomic disadvantaged), indicating that
229 individuals with exclusive health practice are disproportionately concentrated among
230 the socioeconomically disadvantaged groups. A positive concentration index implies
231 that the inequality is pro-rich. All the socioeconomic groups enjoy the same
232 distribution of positive breastfeeding behavior, ideational norms, and the enabling
233 factors if the plot coincides with the diagonal (zero inequality). If the inequality
234 estimates favor the population's socioeconomically advantaged (wealthier) group,
235 multiplying the estimated concentration index by 75 gives the percentage of exclusive
236 breastfeeding behavior that would be needed to be (linearly) redistributed from the
237 wealthier half to the poorer half in the population to arrive at a zero concentration
238 index. [31] The concentration index ranges from -1 (inequality fully favoring poorer

239 households): all individuals that are exclusively breastfeeding their children are from
240 poorer households to 0 (line of equality) and +1 (inequality favoring wealthier
241 households), all individuals that are exclusively breastfeeding are in the wealthier
242 households [27-30].

243

244 **Decomposition of inequality**

245 We followed Wagstaff et al. (2003) [32] to estimate the overall inequality in the
246 practice of exclusive breastfeeding (y_i), decomposing the inequality to the
247 contribution of ideation and sociodemographic determinants (x_k) using the convenient
248 linear regression model [28, 30, 32]:

$$249 \quad y_i = \alpha + \sum_k \beta_k x_{ki} + \varepsilon_i \quad (2)$$

250 The concentration index is computed following [26, 28], C can be computed
251 alternatively as:

$$252 \quad C = \sum_k (\beta_k \bar{x}_k / \mu) C_k + GC_\varepsilon / \mu \quad (3)$$

253 Where μ is the mean of y_i as previously defined (eq 1), \bar{x}_k the mean of x_k , C_k is the
254 concentration index for x_k , k is the vector of variables and GC_ε is the generalized
255 concentration index for ε_i . The deterministic or explained component (the first
256 component in equation (2)) is equal to the weighted sum of the concentration indexes
257 of the regressors where weights are the elasticities of y_i with respect to x_k . The second
258 component (computed as a residual) is the unexplained component, reflecting the
259 inequality in ideation that cannot be explained by systematic variation in x_k across
260 socioeconomic groups. This decomposition allows further decomposition of each
261 factor's contribution to the elasticities of the breastfeeding practices ($\beta_k \bar{x}_k / \mu$) and
262 SES-related inequity (C_k) [30]. Standardization was done to control for possible

263 confounding effects from sociodemographic variables [28, 33-36], and to estimate the
264 difference between the observed and actual inequality, including the degree of
265 inequality that should be observed if the standardizing variables were uniformly
266 distributed across the population (which by extension, purges the effects of confounders
267 revealing the potentially avoidable inequality). Avoidable inequality is defined as the
268 level of inequality that can be ameliorated through interventions [27, 33, 35, 36].
269 Inequalities arising from genetic, regional, and temporal factors may be impossible to
270 change. We used this convenient (multivariate) regression method to decompose the
271 estimated inequality into 1) the contribution from ideational and normative
272 determinants, 2) the innate inequality in these determinants, and 3) the elasticities of
273 the determinants on the inequality in exclusive breastfeeding behavior [27, 28, 32].
274 Also, estimates of the avoidable inequality (the proportion of the inequality that is
275 amenable to intervention or programming) and unavoidable (not amenable to
276 programming and interventions) components of the total decomposed inequality were
277 obtained. The relative contribution of the sociodemographic determinants of
278 inequality, such as respondents' age, educational status, household size (measured in
279 adult equivalence), and other determinants of interest, were estimated. Each household
280 size was standardized using the household adult equivalence (an equivalent number of
281 all household members). The household adult equivalence estimated using the formula
282 - $AE = (A + \alpha K)^\theta$ [37, 38] (AE = adult equivalence, K = number of under 18 years old
283 in a household). Deaton and Zaidi (2002) propose values in the region of 0.3 to 0.5 for
284 α (higher in developed countries) and 0.75 to 1.0 for θ , given that food accounts for a
285 large proportion of total consumption and economies of scale are relatively limited [38,
286 39]. The unit of analysis was the household or individuals within the households ranked
287 by the socioeconomic status (SES) or household living standard. Socioeconomic status

288 was proxied by household wealth index estimated through principal component
289 analysis of household possessions (assets) [27, 40-43]. The analysis was based on the
290 bivariate approach to measuring inequalities [23, 44]. This approach looks at the subset
291 of breastfeeding behavior and ideation factors inequality occurring across the
292 distribution of households or individuals (ranked by SES) by typically comparing the
293 cumulative proportion of households or individuals ranked by ideation or SBC behavior
294 against the cumulative proportion of SES [25, 45-48]. The five-scale Likert responses
295 were dichotomized to fit the bivariate regression model for estimating the Lorenz curve
296 and the CIx index. The Lorenz estimate, Lorenz curve, and the Foter-Greer-Thorbecke
297 (FGT_CI) routines of STATA 16 © (STATA Corporation, College Station, TX, USA)
298 statistical software were used for all analyses. Also, Microsoft® Excel spreadsheet was
299 used to construct the diverging bar graph (Figure 1). We used a two-part (Probit and
300 generalized linear model) multiple regression model to adjust for the excess zeros in
301 the exclusive breastfeeding outcome variable in the data. Aikaike Information Criteria
302 (AIC) was used for diagnostics and selecting the best model.

303

304

305 **Results**

306 **Descriptive statistics for the sample**

307

308 Table 1 shows the summary description of the full sample. A total of 3007

309 childbearing age women were included in the analysis. Among the study participants,

310 about 10% had practiced exclusive breastfeeding after birth. About 30% of the

311 women were in the modal 20-24 years age bracket, 23.6% had at least four antenatal

312 care visits during her last pregnancy, and only 6.2% regularly attended community

313 meetings in the past year. The mean number of equivalent adults per household was

314 about 3. Regarding the ideation factors in the cognitive dimension, half (49.2%) of the

315 women spontaneously mentioned any benefit from exclusive breastfeeding in the first

316 six months of a child's life (knowledge domain). About 63% spontaneously

317 mentioned immediate breastfeeding after birth as a method to protect the newborn's

318 health (in the knowledge domain), and 70.9% did not agree with the belief that the

319 mothers' breastmilk after birth (*colostrum*) is bad milk (in the belief domain). On the

320 social ideational dimension, 58.5% of the participants agreed that it is important for

321 mothers to give their child only breastmilk in the first six months of infant's life

322 (Injunctive norm); 39.1% agreed that most women in the community give infants

323 only breastmilk in the first six months of life (descriptive norm); and 48% mentioned

324 their partners as influencing their decision to breastfeed (social influence). For the

325 emotional dimension, 49.9% of the participants stated their confidence in exclusively

326 breastfeeding a child in the first six months after birth (self-efficacy).

327 **(Table 1 here)**

328

329 The diverging bars in Figure 1 describe the Likert scale responses to the probes on

330 exclusive breastfeeding behavior and the associated ideational factors. About 32.5%

331 and 18.5% strongly or somewhat agreed, respectively, regarding their likelihood to

332 breastfeed their next child for six months after birth, while 29.8% and 15.7% strongly
333 and somewhat disagreed, respectively. Approximately 44.9% and 18.2% strongly or
334 somewhat agreed, respectively, to have the confidence to start a breastfeeding
335 conversation with their husbands (self-efficiency in the decision-making domain in
336 the emotional dimension) and lower percentages, 16.7% and 14.0% respectively,
337 disagreed. Also, within this domain and dimension, 31.7% and 18.2% strongly or
338 somewhat agreed, respectively, to have the confidence to exclusively breastfeed the
339 child for the first six months of birth, 29.2% strongly disagree, and 17.5% somewhat
340 disagreed. Regarding the cognitive dimensions: 34.6% strongly agree, 23.9%
341 somewhat agree, while 18.1% strongly disagree, 17.8% somewhat disagree that it is
342 essential for mothers to exclusively breastfeed for six months (injunctive norm).
343 About 17.0% of the mothers strongly agree, and 22.1% somewhat agree that most
344 mothers in the community only give infants breastmilk (subjective norm) while 33.2%
345 and 18.9% strongly and somewhat agree, respectively. Approximately 10.2% strongly
346 agreed, and 14.4% somewhat agree that a mother's breastmilk after birth is bad (belief
347 domain) while 55.8% strongly disagree, 15.1% somewhat disagree. Finally, 60.5%
348 strongly agree, and 24.2% somewhat agree that breastmilk contains essential nutrients
349 for six months of life (beliefs), 8.7% strongly and 3.2% somewhat disagree.

350 **(Figure 1 here)**

351 **Lorenz (concentration) Curve.**

352 Figure 2 shows the Lorenz concentration index for exclusive breastfeeding behavior
353 in the three states combined data (panel a) and by state (panel b). Inequality in
354 exclusively breastfeeding generally favors the socioeconomically advantaged (pro-
355 rich) (CIx = 0.142 (95% CI; 0.08 – 0.20)). Women who practice exclusive
356 breastfeeding in all three states are disproportionately concentrated in

357 socioeconomically advantaged households, (Figure 2, panel a). Similarly, in Zamfara
358 and Kebbi states, inequality in exclusively breastfeeding favors the socioeconomically
359 advantaged (CIx = 0.159 (95% CI; 0.078 – 0.242) and 0.125 (95% CI; -0.009 – 0.260)
360 respectively), although CIx is not strongly statistically significant. The women who
361 practice exclusive breastfeeding are disproportionately concentrated in
362 socioeconomically advantaged households, (Figure 2, panel b). In contrast, the
363 inequality in exclusively breastfeeding children is pro-poor, favoring the
364 socioeconomically disadvantaged in Sokoto State (CIx = - 0.269 (95% CI: -0.390 – -
365 0.148)), statistically significant and significantly different from the estimates of Kebbi
366 and Zamfara states. Women who practice exclusive breastfeeding in Sokoto State are
367 disproportionately concentrated in socioeconomically disadvantaged households.

(Figure 2 here)

368 **Generalized linear model analyses.**

369 The two-part regression results examining the relationships between the exclusive
370 breastfeeding behavior and the ideation factors and sociodemographic determinants
371 are presented in Table 2. The findings suggest that four or more antenatal clinic
372 attendance during pregnancy significantly accounts for the variation in exclusive
373 breastfeeding. Ideation factors: influence of partners in the decision to breastfeed the
374 child and spontaneously mention any benefits of EBF practice (first six months of infants'
375 life) for the mother, also are significantly associated with the exclusive practice of
376 exclusive breastfeeding.

(Table 2 here)

377 **Concentration index and decomposition analysis for inequality of exclusive**
378 **breastfeeding practices**

379 Table 3 presents the CIx analysis results of the decomposition of the CIx into the
380 contribution of the ideation and sociodemographic variables in the fourth column;
381 the elasticities of the ideation and socioeconomic variables with respect to the
382 exclusive breastfeeding behavior (third column); and the independent inequalities
383 in these factors (second column). Inequality in exclusive breastfeeding in the
384 three states combined was pro-rich as mothers in wealthier households were more
385 likely to engage in exclusive breastfeeding (CIx = 0.1236; p-value = 0.00). ANC
386 attendance 4+ was the most significant contributor to the inequality (CIx =
387 0.0307; p-value = 0.00). The contributors to inequalities in exclusive
388 breastfeeding practices were mainly in the cognitive and emotional ideation
389 domains, although their contributions to the inequality were not statistically
390 significant (Table 3).

391 The elasticity estimates showed that a percentage change in the ideation factor in
392 partners influencing the decision to breastfeed and attending ANC 4 or more times
393 (ANC 4+) during the last pregnancy could significantly result in a 0.15% (p-value
394 = 0.00) and 0.08 % (p-value = 0.00) change in the exclusive breastfeeding
395 behavior respectively. The estimates of the elasticity of exclusive breastfeeding
396 relative to the other ideation factors were not statistically significant.

397 The results showed that inequalities in a few of the ideation determinants are pro-
398 rich while majority are pro-poor (Table 3). The inequality in the regular
399 attendance at community meetings (CIx = 0.189; p-value =0.00); an ANC4+ (CIx
400 = 0.372; p-value = 0.00); and maternal age (CIx = 0.016; p-value = 0.00) were

401 significantly pro-rich. Inequalities in the majority of the ideation determinants are
402 pro-poor, including spontaneously reporting any benefits in the first six months of
403 exclusive breastfeeding practice (CIx = -0.1986, p-value=0.00); Spontaneously
404 mentioning immediate breastfeeding as a method to protect the health of the new-
405 born after delivery (CIx = - 0.2443, p-value = 0.00); Mothers who agreed that
406 mothers breastmilk after birth (colostrium), is bad milk (CIx = - 0.3935, P-value =
407 0.00); Agreeing on the importance of mothers to give their child only breastmilk
408 in the first six months of infant's life (CIx= - 0.2507, p-value = 0.00); Confidence
409 in practicing EBF for first six months of infant's life (CIx = - 0.3463, p-value =
410 0.00); Agreeing (strongly or somewhat) that most women in the community give
411 infants only breastmilk in first six months of life (CIx = - 0.2365, p-value = 0.00)
412 were pro-poor, that is, the inequalities favor the poorer households.

413 The results showed that all (100%) the inequality in the distribution of exclusive
414 breastfeeding behavior is avoidable. Also, 11% linear population redistribution of
415 exclusive breastfeeding behavior from the wealthier half to the poorer half of the
416 population could eliminate the inequality in exclusive breastfeeding (CIx=0, the
417 inequality lying on the line of zero inequality).

418 **(Table 3 here)**

419 **Discussion**

420 This paper assesses the inequality of exclusive breastfeeding practice and the
421 contribution of ideational and sociodemographic determinants in three north-western
422 (Sokoto, Kebbi, and Zamfara) states of Nigeria. The analyses provide evidence of
423 inequality in exclusive breastfeeding practice and its SBC ideational determinants of
424 the practice of exclusive breastfeeding that interventions may target for optimal
425 program impact. For instance, we found that the inequality of exclusive breastfeeding
426 generally disfavors the socioeconomically disadvantaged – pro-rich. Women in
427 socioeconomically disadvantaged households were less likely than their counterparts
428 in socioeconomically advantaged households to practice exclusive breastfeeding. Four
429 or more antenatal visits during the last pregnancy, the influence of partners in the
430 decision to breastfeed the child in the social-influence communication domain, and
431 spontaneously reporting any benefits of EBF practice in the first six months of infants' life in
432 the knowledge domain are significantly associated with the practice of exclusive
433 breastfeeding. The women in the wealthiest households were more likely to
434 exclusively breastfeed the child than those in the lower socioeconomic (poorer)
435 households. Regular antenatal (at least four) visits during pregnancy, which is also
436 pro-rich, contributed significantly to breastfeeding practices' inequality. The findings
437 showed that changes in the population distribution of women who had at least four
438 antenatal visits during pregnancy, women whose partners influenced their decision to
439 breastfeed the child exclusively and knew benefits from exclusive breastfeeding for
440 the child significantly changed the practice of exclusive breastfeeding. The results
441 could reflect the fact that better-off individuals might have better access to the
442 antenatal clinic during pregnancy, where exclusive breastfeeding is a regular topic
443 during health education sessions and is commonly a part of advocacy messages.

444

445 These results have implications for SBC programming in northern Nigeria, where the
446 poor are consistently disadvantaged in the population's access to healthcare [49, 50].

447 For instance, though SBC interventions often employ multichannel approaches,
448 including the use of broadcasting mass communication approaches for behavioral
449 change, such as deploying the mass media approaches. An implicit assumption in
450 such programming strategy and the impact expectations is that all population groups
451 have uniform exposure. Non-uniform (inequal) exposure to population-based SBC
452 interventions could generate a skewed, non-uniform response across population sub-
453 groups. Skewed (inequal) endowments for responding to programs and interventions
454 might minimize the intensity of program impact in the disadvantaged groups and
455 favoring the advantaged groups in the population, ultimately resulting in inefficient
456 production of program impact. This tendency for inefficient production of impact is
457 directly proportional to the degree of the inequality as captured in the estimates of the
458 concentration indexes. This study showed a disproportionate distribution of the
459 endowment of exclusive breastfeeding and the enabling ideation factors to the
460 disadvantaged of the poorer subgroups in the population. It can be similarly argued
461 that the marginal propensity for program or intervention impact is higher among the
462 subgroups with the least distribution of exclusive breastfeeding behavior (the lower
463 socioeconomic groups of the population) than in subgroups with saturated (also, in
464 this case, are those in higher socioeconomic groups). SBC programs and interventions
465 for improving populations' exclusive breastfeeding behavior could efficiently achieve
466 a more significant impact if the inequality in exclusive breastfeeding behavior
467 inequality was addressed. The population subgroups with higher risk (poorer
468 exclusive breastfeeding behavior) and potentially limited access (socioeconomically

469 disadvantaged) require more intense intervention than the advantaged subgroups in
470 the population to potentially achieve more significant SBC program impact. SBC
471 communications could explore strategies for deliberate targeting or intensifying
472 programming among the disadvantaged.

473

474 The findings suggest that improving and expanding ANC coverage through pro-poor
475 intervention could improve breastfeeding practices among the socioeconomically
476 disadvantaged group of the population. The results showed that inequality in
477 exclusive breastfeeding practice is totally (100%) amenable and could be mitigated
478 through targeted interventions. Sociodemographic factors, which are unmodifiable
479 (constants) were not significant contributors to the inequality in exclusive
480 breastfeeding. Programmatically achieving a reduction in the inequality in exclusive
481 breastfeeding behavior by 10% could eliminate the inequality (zero inequality) in the
482 population distribution of positive exclusive breastfeeding behavior.

483

484 A percentage change in ANC 4+ visits will result in a 0.83% change in exclusive
485 breastfeeding behavior. Messages that reinforce exclusive breastfeeding behavior and
486 positively modulate ideation and breastfeeding norms are actively provided in the
487 health education routines for pregnant women attending ANC clinics in primary care
488 clinics in Nigeria. Also, spousal communication, in terms of a woman's partner
489 influencing her decision to breastfeed the child is significant. A change in this
490 variable results in a 0.14% change in exclusive breastfeeding practice. Further
491 exploration into the role of the males in SBC communication and in the decision to
492 exclusively breastfeed the child is necessary for informing future interventions.

493

494 There were inequalities in the ideational factors independently in themselves. For
495 instance, spontaneously reporting any benefits of EBF; spontaneously mentioning
496 immediate breastfeeding as a method to protect the health of the newborn after
497 delivery; agreeing (or disagreeing) that a mother's breastmilk after birth (colostrum) is
498 bad milk; agreeing on the importance of mothers to give their child only breastmilk in
499 the first six months of infant's life; and agreeing that most women in the community
500 give infants only breastmilk in first six months of life, were disproportionately
501 concentrated among the socioeconomically disadvantaged households - pro-
502 poor. Notably, these are in the knowledge domain of the cognitive dimension and the
503 injunctive and descriptive domains of the social dimension of the SBC and Kincaid
504 communication models. Maternal regular attendance at community meetings (in the
505 social domain of communication models) are disproportionately concentrated in the
506 socioeconomically advantaged households – pro-rich. We observe that exclusive
507 breastfeeding practices are mainly influenced by ideational domains within the
508 cognitive and social dimensions of the SBC communication models, unlike those
509 within the emotional dimension. Ideations in these dimensions could be the strategic
510 focus of SBC programming and intervention strategies.

511

512 A similar exploration of inequality in exclusive breastfeeding behavior and enabling
513 ideating norms is scarce in the published literature [51]. A systematic review did not
514 reveal similar studies that explored inequality in exclusive breastfeeding, whose
515 results could be compared with the results of this study. However, the results from
516 this study provide evidence and the basis for future comparison of the evidence of
517 inequality in exclusive breastfeeding practice. Further studies are necessary to

518 advance the understanding of the inequality in exclusive breastfeeding practice and its
519 ideating factors.

520

521 **Limitations**

522 This study has three notable limitations. First, data from a cross-sectional population
523 survey restricts the inferences around causal relationships between the exclusive
524 breastfeeding practice and the ideational determinants. Second, likely that the self-
525 reported (self-assessed) responses for breastfeeding behavior could have recall bias
526 with a possible underestimation that may affect the magnitude of the associations
527 analyzed in the CIx and decomposition models. Individuals in lower socioeconomic
528 groups have tended to rate their health more optimistically than those in higher
529 socioeconomic groups [52, 53]. The socioeconomically advantaged mothers may
530 report better self-rating [52, 54]. The analysis did not account for the possible
531 response bias. Thirdly, the Likert scale response is problematic for its possibility of
532 responses (due to social desirability), fatigue/inattention, and subjective interpretation
533 biases. Also, collapsing the Likert scale variables to bivariate variables may have
534 introduced categorization biases also.

535

536 **Conclusions**

537 Inequalities in the population distribution of exclusive breastfeeding practice, a
538 priority SBC behavior, and its associated ideational determinants exist among women
539 of childbearing age with a child under two in the north-western states
540 Nigeriadisfavoring the socioeconomically disadvantaged in the population. The
541 inequality is mostly avoidable and is amenable to programmatic intervention. A

542 10.7% redistribution could eliminate the inequality. Messaging and communications
543 for SBC programs and interventions to improve breastfeeding practices could be more
544 effective by targeting the mitigation of these inequalities among the population's
545 socioeconomically disadvantaged groups. This study contributes to the evidence of
546 inequality in exclusive breastfeeding practice with objective metrics. Further studies
547 would benefit from contrasting the results of this study with studies in other regions or
548 across other health areas and exploring the male (spouse) role in SBC breastfeeding
549 practice.

550 **List of Abbreviations**

- 551 1. AIC
- 552 2. ANC4+
- 553 3. BR-A
- 554 4. BR-N
- 555 5. BSS
- 556 6. CIx
- 557 7. EA
- 558 8. EBF
- 559 9. FGT-CI
- 560 10. FP
- 561 11. LGA
- 562 12. MNCH + N
- 563 13. SBC
- 564 14. USAID

566 **Ethics approval and consent to participate**

567
598 Data used for tis paper was from the Behavioral Sentinel survey. The BSS obtained
599 ethical approval from the National Health Research Ethics Committee
600 [NHREC/01/01/2007-02/09/2019] and the Tulane University Institutional Review
601 Board in Louisiana, USA [2019-1047]. Written infrmed consent was obtained from
602 all participants. Each participant signed or thumb printed their willingness to
603 participated on a consent form.

604

Availability of data and materials

The data that supports the findings of the current study are available from the corresponding author upon reasonable request.

605

606 Competing interests

607 The authors declare no conflict of interest.

608

609 Funding

610

This paper received no direct funding. The United States Agency for International Development (USAID) funded the research from which the data for this study was obtained through the Breakthrough RESEARCH cooperative agreement [AID-OAA-A-17-00018]. The funders had no role in the study design, data collection and analysis, data interpretation, manuscript preparation, or in the decision to submit for publication.

611 Authors' contributions

DA FA BF PLH designed and conceptualized this study. PLH EWJ developed the study instruments, supervised fieldwork, and data collection that produced the data used for this study. DA conducted the statistical analysis and interpretation of findings. DA UA PLH FA BF EWJ contributed to the interpretation of findings. DA wrote the first draft of the paper. PLH UA FA BF EWJ EM reviewed, revised, and contributed writing to the paper. All authors read and approved the final manuscript.

612 Acknowledgments

613

614 We thank the Breakthrough RESEARCH Nigeria, Population Council Washington

615 DC, and Tulane University for granting access to the data. Breakthrough Action

616 Nigeria for the strong collaboration in the SBC programs and research. CRERD

617 conducted the field exercise to obtain the data. We thank the Ministries of Health in
618 Kebbi Sokoto and Zamfara states for providing access to the study area.

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775 **Figure**

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777 Figure 1. Diverging bar Description of Exclusive breastfeeding behavior and ideation
 778 factors

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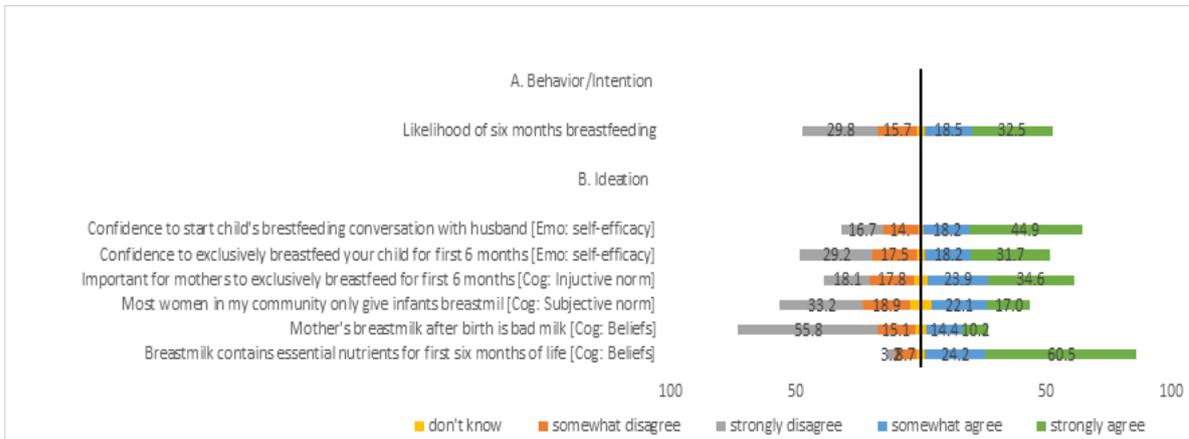
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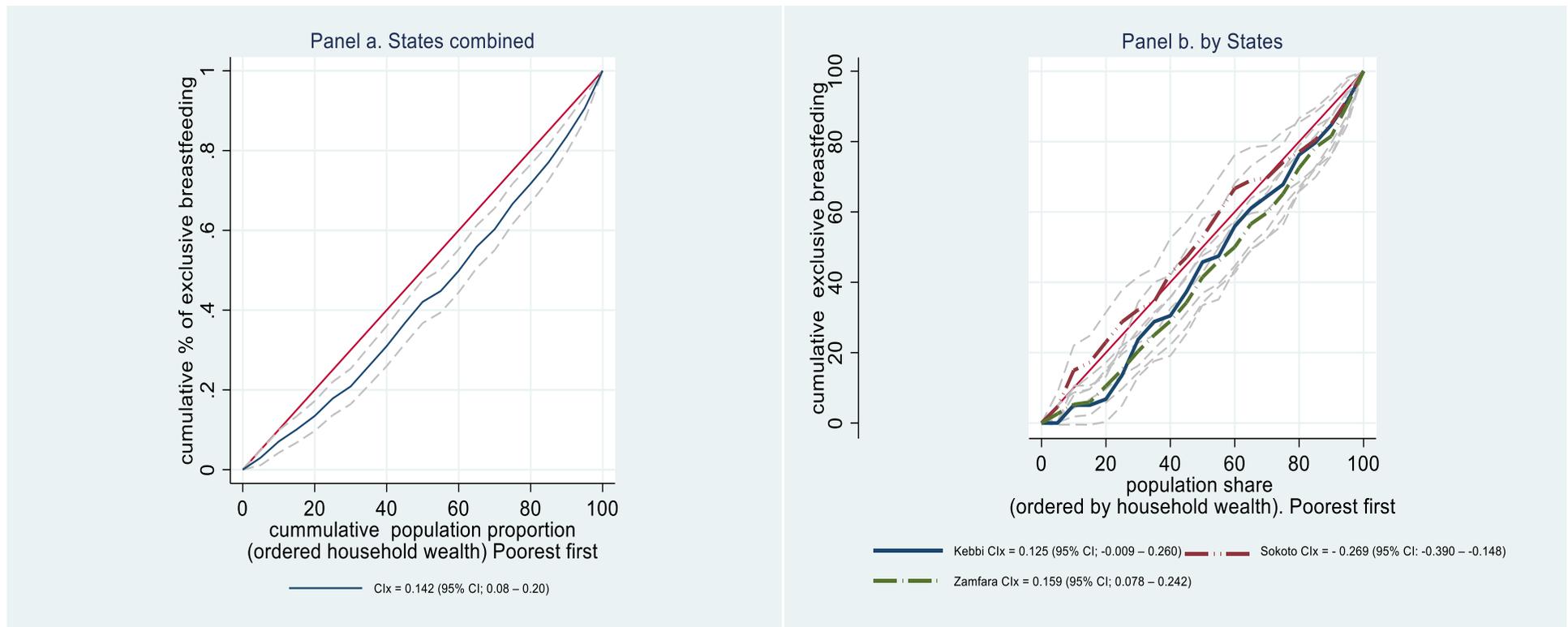
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Likert scale responses to exclusive breastfeeding behavior/intention and ideation queries positively skewed towards (somewhat and strongly agreeing with the behavior and ideation probes).

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Figure 2. Lorenz (Concentration) Curve: s Inequality in Exclusive breastfeeding practice among women in Sokoto Kebbi and Zamfara states.



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801 **Tables**802 **Table 1. Descriptive statistics of variables.**

803

Ideational Dimension	Domain	Variables	Response category	n	%
		Exclusive breastfeeding six months after birth	Yes	297	9.9
			No	2710	90.1
Cognitive	Knowledge	Spontaneously reports any benefits of EBF practice (first six months of infants' life) for the mother	YES	1480	49.2
			No	758	25.2
			Don't know	769	25.6
	Belief	Spontaneously mentions immediate breastfeeding as a method to protect the health of the newborn after delivery	YES	1903	63.3
			No	705	23.6
			Don't know	399	13.3
		Agreed (strongly or somewhat) that mother's breastmilk after birth is bad milk	Agree	741	24.6
			Disagree	2132	70.9
			Don't Know	134	4.5
Social	Injunctive norm	Agreed on the importance of mothers to give their child only breastmilk in the first six months of infant's life	Agree	1760	58.5
			Disagree	1080	35.9
			Don't Know	167	5.5
	Descriptive norms	Agreed that most women in the community give infants only breastmilk in the first six months of life.	Agree	1176	39.1
			Disagree	1566	52.1

			Don't Know	265	8,8
			no	2775	93.8
	Social-influence	Who influences mothers' decision to breastfeed?	Partner	1444	48.0
			No one else	1022	34.0
			Other friend and family	541	18.0
			Maternal regular attendance at community meetings	yes	183
Emotional	Self-efficacy	Confident to exclusively breastfeed a child in the first six month	Confident	1500	49.9
			uncertain	1403	46.7
			Don't know	104	3.5
-	-	ANC attendance (4+ visits)	yes	705	23.6
			No	2289	76.6
-	-	Number of equivalent adults in a household	Mean	2.9	3007
		Maternal Age	15-19	370	12.3
			20-24	895	29.8
			25-29	811	27.0
			30-34	548	18.2
			35-39	268	8.9
			40-44	90	3.0
			45-49	25	0.8

804 N = 3007

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Table 2. Generalized linear regression results for Exclusive breastfeeding behavior.

	Coef.	Robust Standard Error	z	P>z	[95% Confidence Interval]
Spontaneously reports any benefits of EBF practice (first six months of infants' life) for the mother	-0.0007	0.0002	-3.64	0.00**	-0.0010 - -0.0003
Spontaneously mentions immediate breastfeeding as a method to protect the health of the newborn after delivery	-0.0001	0.0003	-0.44	0.66	-0.0007 - 0.0004
Agreed (strongly or somewhat) that mother's breastmilk after birth is bad milk	0.0001	0.0005	0.27	0.79	-0.0009 - 0.0012
Agreed on the importance of mothers to give their child only breastmilk in the first six months of infant's life	0.0001	0.0005	0.31	0.76	-0.0008 - 0.0010
Confident to exclusively breastfeed a child in the first six month	-0.0002	0.0004	-0.47	0.64	-0.0010 - 0.0006
ANC attendance (4+ visit)	0.0624	0.0214	2.92	0.00**	0.0205 - 0.1044
Number of equivalent adults in household	-0.0570	0.0308	-1.85	0.06	-0.1174 - 0.0033
Maternal age	0.0023	0.0063	0.36	0.72	-0.0101 - 0.0147
Agreed that most women in the community give infants only breastmilk in the first six months of life	0.0003	0.0003	1.17	0.24	-0.0002 - 0.0009
Maternal regular attendance at community meetings	0.0242	0.0407	0.6	0.55	-0.0556 - 0.1040
Who influences mothers' decision to breastfeed?	0.0424	0.0169	2.51	0.01**	0.0093 - 0.0755
_cons	0.1403	0.0326	4.3	0.00	0.0764 - 0.2042

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** **P value = 0.000**, Log pseudolikelihood = -33293.97, Deviance = 3517.69, (1/df) Deviance = 1.1989, Pearson = 3517.69, (1/df) Pearson = 1.19894, AIC = 22.61, Variance function: V(u) = 1 [Gaussian], Link function: g(u) = u [Identity].

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Table 3. Decomposition of household inequality Exclusive Breastfeeding behavior.

Ideation factors	Concentration indexes	Elasticities	Contributions
Spontaneously reports any benefits of EBF practice (first six months of infants' life) for the mother	-0.1986**	-0.3289	0.0653
Spontaneously mentions immediate breastfeeding as a method to protect the health of the newborn after delivery	-0.2443**	-0.0262	0.0064
Agreed (strongly or somewhat) that mother's breastmilk after birth is bad milk	-0.3935**	0.0055	-0.0022
Agreed on the importance of mothers to give their child only breastmilk in the first six months of infant's life	-0.2507**	0.0089	-0.0022
Confident to exclusively breastfeed a child in the first six month	0.3463	0.0078	0.0027
ANC attendance (4+ times)	0.3722**	0.0825**	0.0307**
Maternal age	0.0161**	0.0674	0.0011
Agreed (strongly or somewhat) that most women in the community give infants only breastmilk in the first six months of life	-0.2365**	0.0265	-0.0063
Maternal regular attendance at community meetings	0.1887**	0.0100	0.0019
Who influences mothers' decision to breastfeed?	0.0042	0.1484**	0.0006
Residual			0.0250
Total			0.1236**

822
823

** P value = 0.000

1 **Additional files**

2

3 [Insert Additional File Information here]

4

5

6

7

Figures

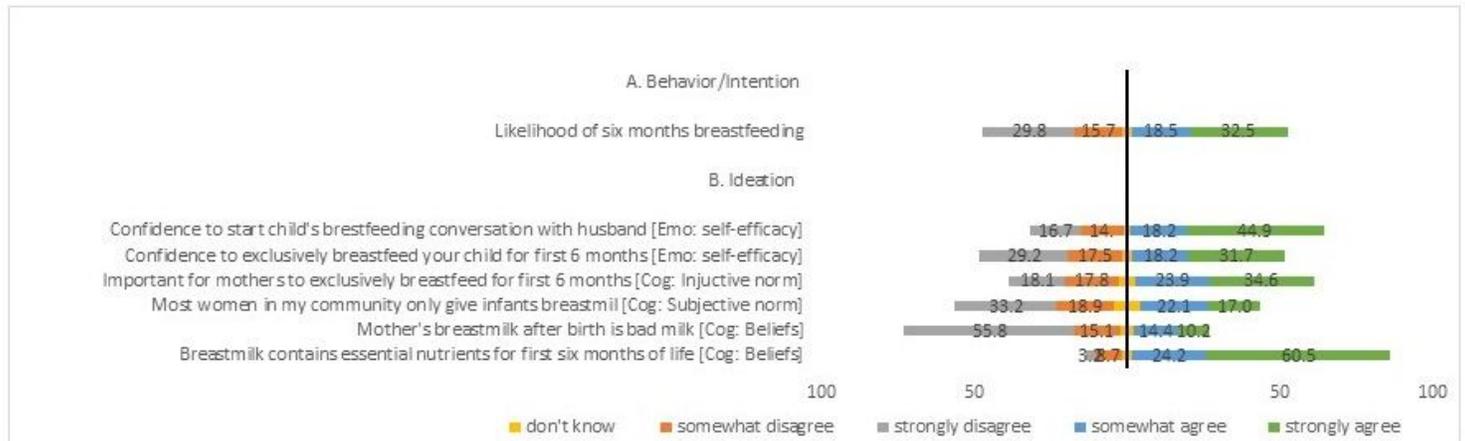


Figure 1

Diverging bar Description of Exclusive breastfeeding behavior and ideation factors. Likert scale responses to exclusive breastfeeding behavior/intention and ideation queries positively skewed towards (somewhat and strongly agreeing with the behavior and ideation probes).

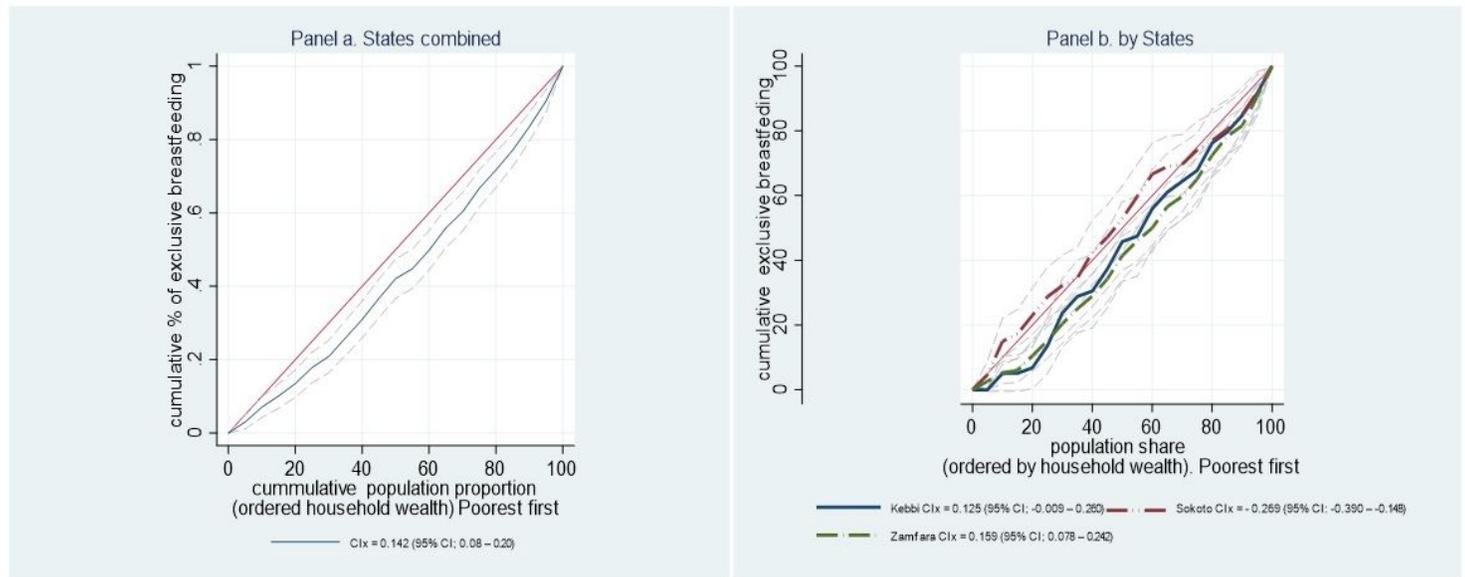


Figure 2

Lorenz (Concentration) Curve: s Inequality in Exclusive breastfeeding practice among women in Sokoto Kebbi and Zamfara states.