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# BMJ Open

## Healthcare seeking patterns of families of infants with circumcision-related morbidities from two population-based cohort studies in Ghana

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3 **Healthcare seeking patterns of families of infants with circumcision related morbidities**  
4 **from two population-based cohort studies in Ghana**  
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## ABSTRACT

**Objective:** This study assessed health care seeking patterns of families of infants with circumcision related morbidities and families of infants with acute illness in rural Ghana.

**Design:** Two population-based cohort studies.

**Setting:** Brong Ahafo Region of central rural Ghana.

**Participants:** A total of 22,955 infants enrolled in a large population based trial (Neovita trial) from 16<sup>th</sup> August 2010 to 7<sup>th</sup> November 2011 and 3141 infants in a circumcision study from 21<sup>st</sup> May 2012 to 31<sup>st</sup> December 2012.

**Primary Outcome:** Care seeking for circumcision related morbidities and acute illness unrelated to circumcision.

**Results:** Two hundred and thirty (8.1%) infants from the circumcision study had circumcision related morbidities and 6265 (27.3%) infants from the Neovita study had an acute illness unrelated to circumcision. A much lower proportion (35, 15.2%) of families of infants with circumcision related morbidities sought healthcare compared to families of infants with acute illnesses in the Neovita study (5520, 88.1%). More families sought care from formal providers (24, 69%) compared to informal providers (11, 31%) for circumcision related morbidities. There were no obvious determinants of care seeking for acute illness or circumcision related morbidities in the population.

**Conclusions:** Government and non-government organisations need to improve awareness about the complications and care seeking needed for circumcision related morbidities.

### Strengths and limitations of this study

- A major strength of this study is the use of two large community and population-based cohort studies.
- This is the first, study to our knowledge, to have compared health seeking patterns between families of infants with circumcision related morbidities and families of infants with acute illness that are not circumcision related.
- The main limitation was the small sample size in our circumcision cohort due to the low level of health care seeking so we were unable to statistically compare careseeking in the circumcision and total study cohort. However, we were able to assess the association between key socio demographic factors and healthcare seeking patterns in the larger Neovita cohort of 22,955 mother infant pairs.

## Introduction

Infant male circumcision is a common surgical procedure and is performed for cultural, religious and medical reasons. Approximately 90% of males aged under 12 weeks are circumcised in Ghana<sup>1</sup> and much of West Africa<sup>2</sup>. We reported a concerning high risk of circumcision related morbidity (8.1%), following infant male circumcision in our community-based study in rural Ghana<sup>1</sup>. Overall, 53% of the complications were observed following circumcision performed by an informal provider (including village-based traditional circumcision providers) and 47% after circumcision performed by formal healthcare providers including doctors, nurses, and medical assistants<sup>1</sup>.

Appropriate health care seeking for infants with circumcision related morbidities could minimise the occurrence of severe long and short-term morbidities. Studies conducted in rural Ghana have reported that poor women believe infant illnesses related to traditional practices are not meant to be managed in the hospital or clinic<sup>3-5</sup>. However, no other data on care seeking for infant male circumcision related morbidity in rural African areas are available. There are more studies that have examined the determinants of care seeking for acute infectious diseases and newborn complications in rural Africa<sup>6,7</sup>. A recent study conducted among mothers and infants in Ghana identified poor health care seeking behaviour in families of infants with acute illness during the postpartum period. In this study 29% and 54% of sick infants received health care within two and fourteen days, respectively<sup>8</sup>. Another Ghanaian study identified poverty and personal preferences as key determinants of poor care seeking behaviour by families of infants with illness<sup>9</sup>. A study from Burkina Faso also linked traditional concepts of illness in Africa to delays in seeking professional medical care by families of infants with malaria<sup>10</sup>. Distance to health facility, health provider attitude and

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3 inadequate supplies have also been reported as key determinants of delayed care seeking for  
4 malaria cases in infants in sub-Saharan African populations<sup>11</sup>. However, it appears that there  
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7 have been no studies which have compared health seeking behaviour between families of  
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10 infants with circumcision related morbidities and families of infants with acute illness that are  
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12 not circumcision related.  
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17 The overall aim of this study was to assess healthcare seeking patterns of families of infants  
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20 with circumcision related morbidities and families of infants with other acute illnesses in  
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22 rural Ghana. The primary objective was to investigate whether there were differences in the  
23  
24 healthcare seeking patterns of families of infants with circumcision related problems,  
25  
26 including infants who died, and families of infants with acute illness. The secondary  
27  
28 objective was to assess the factors that influence care seeking patterns of families in the study  
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30 area.  
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## 37 **Methods**

### 38 39 **Study design and setting**

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42 Data were analysed from two separate cohort studies in the same part of the Brong Ahafo  
43  
44 Region of central Ghana. The first was nested within a large population based trial of  
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46 newborn vitamin A supplementation (Neovita trial) which was conducted from 16<sup>th</sup> August  
47  
48 2010 to 7<sup>th</sup> November 2011 and included 22,955 mother infant pairs, full details have been  
49  
50 published previously<sup>12</sup>. The second was a circumcision study conducted between 21<sup>st</sup> May  
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52 2012 and December 31<sup>st</sup> 2012 in the same study area. This was implemented to obtain  
53  
54 additional observational data on births, cause specific mortality and circumcision related  
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56 morbidity in the study area. Over the period from 2010 to 2012, 80% of the study population  
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3 lived in rural settlements and 20% of mothers had no primary school education. Four major  
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5 district hospitals and over 80 small health facilities provided health care services to the  
6  
7 population. There were 30 doctors and 44 other formal health service providers (medical  
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9 assistants and nurses) providing curative services in the four district hospitals at the time of  
10  
11 the circumcision study. There were also approximately 120 informal care providers such as  
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13 drug sellers, traditional healers and religious leaders in the study area.  
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### 16 17 18 19 **Data collection**

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22 For the Neovita study, from Aug 2010 to Nov 2011, all births in the study area were reported  
23  
24 to the trial team via a network of fieldworkers and key informants. Fieldworkers visited all  
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26 families at home between two hours and two days after birth and interviewed the mother of  
27  
28 the infant or the primary care giver. Fieldworkers weighed the baby and asked the mother or  
29  
30 the primary care giver about: date of birth, site of birth, current address, distance to health  
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32 facilities, socio-demographic characteristics and socio-economic information (using an asset  
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34 index). At the monthly surveillance visits, the families were asked by fieldworkers for  
35  
36 detailed information on; infant illness including start and end dates; and healthcare seeking  
37  
38 during infant illness. Due to time constraints families were not asked exactly who they sought  
39  
40 care from. The fieldworkers also asked the families who sought healthcare whether the infant  
41  
42 was admitted to hospital. The fieldworkers next reviewed infant health records and checked  
43  
44 for consistency with family's report. The fieldworkers also collected data on the vital status  
45  
46 of the baby (including if the baby was alive, dead or hospitalised).  
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53 The circumcision study included all male liveborn infants who were born in the study  
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55 population from May to Dec 2012 and were aged under 12 weeks. Follow-up visits were  
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57 scheduled between eight to eleven weeks post birth and trained senior fieldworkers asked for  
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3 consent to collect additional detailed data on: age at circumcision, site of circumcision and  
4 type of circumcision provider. The fieldworkers asked about circumcision morbidities and  
5 whether these morbidities had been confirmed by a trained health professional. Families were  
6 also asked if they sought care for circumcision related morbidities and if they had been given  
7 advice about potential problems or careseeking. The fieldworkers also asked detailed  
8 information on the following; site of healthcare; type of healthcare provider; medicines  
9 prescribed; admissions; and surgery. Consent to access the baby's Neovita data including  
10 socioeconomic, demographic and care seeking was obtained.  
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24 In both studies the fieldworkers were trained for two weeks in all study procedures prior to  
25 the commencement of the study. Interrater reliability was checked between all fieldworkers.  
26 During the study fieldworkers had scheduled and unscheduled supervisory visits from the  
27 study coordinator to assess data quality and consistency. The fieldworkers used standardised  
28 paper based data collection tools (including a standardised list of closed ended questions) for  
29 all interviews.  
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### 39 **Study definitions and categories**

40 We defined a *formal health care service* as medical care provided at hospitals, clinics or  
41 health posts by professionally trained, licensed and regulated providers of medical services  
42 including; doctors, medical assistants, nurses or pharmacists. An *informal health care*  
43 *service* was defined as care provided by untrained, unlicensed, unregulated private provider  
44 of care services including: drug sellers, traditional healers and religious leaders. *Circumcision*  
45 *morbidities* were defined as complications occurring during or after the circumcision  
46 procedure as reported by the primary caregiver. An *acute illness* was defined as illness or  
47 injury other than circumcision related complications such as malaria, sepsis, acute respiratory  
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3 tract infection, diarrhea<sup>13,14</sup>. A *formal circumcision provider* referred to professionally  
4 trained, licensed and regulated providers of medical services. This included: doctors, medical  
5 assistants, or nurses. An *informal circumcision provider* was an untrained, unlicensed,  
6 unregulated private provider of medical services including: drug sellers, domestic staff,  
7 family members and Wanzams (village based traditional circumcision providers).  
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### 14 15 16 17 18 **Outcome**

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20 Our primary outcome was careseeking. In the circumcision study, we defined careseeking as  
21 the percentage of families of infants who sought care from either a formal healthcare provider  
22 or an informal care provider among families who reported of an infant having a circumcision  
23 related morbidity after circumcision during the circumcision follow-up visits (occurred  
24 between eight and eleven weeks post birth). In the Neovita study, careseeking was defined as  
25 the percentage of families of infants with acute illness unrelated to circumcision who sought  
26 care outside the home of the infant as reported by care givers during the Neovita infant  
27 follow-up visits (from four weeks up to fifty two weeks of age).  
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### 42 **Statistical analysis**

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45 Two hundred and thirty (8.1%) infants had circumcision related morbidities and of these,  
46 only 35 (15.2%) families sought care. Thus, we reported careseeking patterns in our  
47 circumcised cohort only using simple proportions and descriptive analyses. Statistical  
48 analyses were used to assess care seeking patterns in the larger Neovita cohort of 22,955  
49 infants. Multivariable logistic regression models were constructed *apriori* to assess the  
50 association between care seeking patterns and morbidity risk and adjusted for the effect of  
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3 important explanatory variables including: religion, maternal education level, maternal age,  
4 distance to health facility, site of delivery, sex, birth weight and income status. Adjusted odds  
5 ratios (ORs) and 95% confidence intervals (95% CI) were calculated. All analyses were  
6 conducted in STATA version 13.  
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### 11 12 13 14 **Ethical issues**

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17 Ethical approvals were obtained from Ghana Health Service (GHS) Ethical Review  
18 Committee, the Institutional Ethics Committee of Kintampo Health Research Centre  
19 (KHRC), the Research Ethics Committee of London School of Hygiene and Tropical  
20 Medicine, and the Human Research Ethics Committee of the University of Western Australia  
21 (UWA). Written informed consent was obtained from all the families of the circumcised male  
22 infants.  
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### 33 34 **RESULTS**

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36 From 16<sup>th</sup> August 2010 to 7<sup>th</sup> November 2011, 22,955 infants comprising 11,649 (50.8%)  
37 males and 11306 (49.3%) females were recruited into the Neovita trial (Figure 1). A total of  
38 4510 (19.7%) of the mothers were in the lowest socio-economic quintile, 17581 (76.6%)  
39 delivered in a health facility and 7127 (31.1%) had no primary education (Table 1).  
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49 From 21<sup>st</sup> May to 31<sup>st</sup> December 2012, 3141 male infants were recruited in the circumcision  
50 study (Figure 2). Overall, 2850 (90.7%) of these infants were circumcised. We excluded three  
51 babies (0.1%) who had no socio-economic or demographic data. A total of 503 (16.0%) of  
52 mothers were in the lowest income quintile; 2479 (78.9%) delivered in a facility and 601  
53 (19.1%) had no primary education (Table 2).  
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### Acute illness and careseeking

A total of 6265 (27.3%) Neovita trial infants had an acute illness during the first year of life. There was little difference in the prevalence of acute illness by sex in the Neovita population; 3296 (28.3%) males and 2969 (26.3%) females (Figure 1 and Table 1). Healthcare was sought for 5520 (88.1%) Neovita trial infants with acute illness and 608 (11.0%) were admitted to hospital (10.6% females and 10.1% males) (Figure 1 and Table 1). A total of 1033 (88.6%) families who sought care for acute illness were in the highest socio-economic quintile compared to 1147 (87.2%) in the lowest quintile, 4213 (88.2%) delivered in a health facility compared to 1307 (87.7%) who delivered at home and 2678 (88.9%) had more than primary school education compared to 1752 (86.2%) with no formal education (Table 1).

A slightly lower proportion of families of female infants with acute illness (87.2%) sought care compared to families of male infants (88.9%) (aOR 0.85, 95% CI 0.73, 0.99 p=0.039) (Table 3). Surprisingly, there were no obvious differences in the prevalence of health care seeking related to levels of education (aOR 0.89, 95% CI 0.72, 1.10 p=0.260), socio economic status (aOR 1.00, 95% CI 0.75, 1.33 p=0.848), maternal age (aOR 1.15, 95% CI 0.89, 1.48 p=0.131), site of delivery (aOR 1.01, 95% CI 0.83, 1.24 p=0.886), distance to health facility (aOR 0.96, 95% CI 0.68, 1.37 p=0.369) or birth weight (aOR 0.89, 95% CI 0.72, 1.09 p=0.260) in the Neovita trial population (Table 3).

### Circumcision complications and care seeking

Of the 2847 circumcised male infants included in the circumcision analysis, 230 (8.1%) had confirmed morbidities related to circumcision and two died. Only 35 (15.2%) families of

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3 infants with circumcision related morbidities sought care and 3 (8.6%) were admitted to  
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5 hospital (Figure 2 and Table 2).  
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11 The proportion of mothers aged less than 20 years who sought care for their infants with  
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13 circumcision related morbidity (3, [11.5%]) was slightly lower than mothers aged 30 years or  
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15 more (14, [18.9%]). Healthcare seeking of mothers of infants with low birth weight was  
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17 lower (1, [4.8%]) than mothers of infants with normal birth weight though the total numbers  
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19 were small (34, [16.3%]) (Table 2). There were no other obvious determinants of careseeking  
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21 for circumcision related morbidity.  
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### 28 **Type of provider**

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30 In the circumcision study, of the 35 families of infants who sought care for circumcision  
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32 related morbidity, 20 (57.1%) infants were circumcised by an informal provider and 15  
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34 (42.9%) by a formal provider (Table 4). Most families of infants circumcised by a formal  
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36 provider also sought care from a formal provider for complications (13, 87.7%). In contrast,  
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38 only 45% (9) families of infants circumcised by an informal provider also sought healthcare  
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40 for circumcision related morbidity from an informal healthcare provider (Table 4).  
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48 A similar proportion of mothers in the lowest income quintile (4, [66.7%]) sought healthcare  
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50 for circumcision related morbidity from an informal care provider compared to mothers in the  
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52 highest income quintile (2, [25.0%]), however numbers were low in this analysis (Table 4). A  
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54 greater proportion of mothers who delivered their infants at home (5, [71.4%]) sought  
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56 healthcare for circumcision related morbidity from an informal care provider compared to  
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3 mothers with health facility births (6, [21.4%]). The proportion of mothers who lived ten km  
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5 or more from a health facility (2, [66.7%]) who sought healthcare for circumcision related  
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7 morbidity from an informal care provider was higher than those who lived within one km  
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9 from a health facility (3, [14.3%]). There were no data on type of health care provider  
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11 available from the Neovita trial population.  
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## 14 15 16 17 **Discussion**

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20 There appeared to be substantial differences in healthcare seeking in families with infants  
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22 experiencing circumcision related morbidities and those with other acute illnesses in the  
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24 Brong Ahafo Region of central rural Ghana. A much lower proportion (15.2%) of families of  
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26 infants with circumcision related morbidities sought healthcare compared to families who had  
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28 an infant with an acute illness in the larger Neovita population (88.1%). However, the  
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30 proportion of hospital admissions in infants of families who sought health care was almost  
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32 the same (11% in the Neovita study and 9% in the circumcision study). There was some  
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34 indication that mothers of low birth weight infants had poorer careseeking for circumcision  
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36 related morbidities than mothers of infants with normal birth weight infants. There were no  
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38 other clear determinants of healthcare seeking for acute illnesses or circumcision related  
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40 morbidities in our study populations.  
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49 A study conducted in Nigeria also reported lower healthcare seeking by families of male  
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51 infants with circumcision related morbidities compared to infants with other health  
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53 problems<sup>15</sup>. Other studies have suggested that poor care seeking behaviour after circumcision  
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55 can be due to family expectations that complications will heal without any intervention<sup>15,16</sup>,  
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3 poor recognition of illness<sup>5,17,18</sup>, poor recognition of severity of illness<sup>5,19-21</sup>, and beliefs that  
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5 some infant illnesses are not meant to be treated in hospitals<sup>3,5</sup>.  
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11 Interestingly, the proportion of hospital admissions post care seeking was almost the same in  
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13 the Neovita and circumcision populations (11% of infants with acute morbidities whose  
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15 families sought care were hospitalised and 9% of infants with circumcision related  
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17 morbidities whose families sought health care were also hospitalised). This indicates that  
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19 families may not be seeking care for many circumcised infants in our study area with  
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21 morbidities that do require hospital admission and specialised hospital care. Overall, hospital  
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23 admission rates were similar to a recently published study from Ghana that reported rates of 9  
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25 to 18%<sup>22</sup>.  
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32 The determinants of careseeking for acute illness have been reported in low and middle  
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34 income countries<sup>5,23,24</sup>. However, few studies have reported population-based data on the care  
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36 seeking patterns of families with infants who experience circumcision related morbidities and  
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38 acute illness. There was some indication that mothers of low birth weight infants had poorer  
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40 careseeking for circumcision related morbidities (5%) than mothers of infants with normal  
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42 birth weight infants (16%) though numbers were small. These findings are similar to other  
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44 studies that reported poor careseeking for acute illness<sup>25</sup> and vaccination<sup>26</sup> in families of low  
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46 birth weight infants. We found no evidence that other socioeconomic and demographic  
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48 factors influence families careseeking behaviour for circumcision related morbidity and acute  
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50 illness in our population. These findings contrast with that of other earlier studies from  
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52 Ghana<sup>5,22,26,27</sup> and Bangladesh<sup>28</sup> that reported higher care seeking for infants with acute  
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3 illness by richer families, and mothers with higher educational levels. This indicates that  
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5 health care seeking behaviour for acute illness may be improving over time in rural Ghana.  
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10 Overall, we found that more families sought care for a circumcision related morbidity from  
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12 formal (68.6%) than informal (13.4%) healthcare providers. Unsurprisingly, most families of  
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14 infants circumcised by a formal provider also sought care from a formal provider for  
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16 complications. However, fewer families of infants circumcised by an informal provider  
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18 sought care from an informal provider (45%) than an formal provider (55%). These findings  
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20 differ from another published study from Kenya<sup>16</sup> which reported families of male infants  
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22 who were circumcised by an informal provider were two fold less likely to seek care for a  
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24 circumcision related morbidity from a formal healthcare provider<sup>16</sup>. We were not able to  
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26 assess the type of care provider for acute illness in the Neovita study as these data were not  
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28 collected in the Neovita study.  
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37 Generally, healthcare seeking for acute illness in the Neovita study population was very high  
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39 (88.1%). The proportion of families seeking health care in our study was higher than data  
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41 reported by the Ghana Demographic and Health Survey in 2008, close to the time of  
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43 conducting the Neovita study (acute respiratory infection 51.0%, fever 51.0%, and diarrhoea  
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45 35.2%)<sup>29</sup>. Careseeking for acute illness in rural populations has also been reported to be  
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47 around 61% in Kenya<sup>21</sup>, 47% in Nigeria<sup>30</sup> and 27% in Vietnam<sup>31</sup>. The high healthcare  
48  
49 seeking patterns for acute illnesses seen in our study population may be due to recent  
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51 communications and promotion of care seeking by the local government district health  
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53 management teams. However, that these communications do not appear to have influenced  
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55 careseeking for circumcision related morbidities to date.  
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6 The most important limitation to our study was the small sample size in our circumcision  
7 cohort due to the low level of health care seeking so we were unable to statistically compare  
8 careseeking in the circumcision and total study cohort. However we were able to assess the  
9 association between key socio demographic factors and healthcare seeking patterns in the  
10 22,955 infants in the community level population based Neovita cohort. Another limitation  
11 was our use of family level recall of health service utilisation which could have led to some  
12 episodes of care seeking being under reported in the circumcised cohort. However, both  
13 families and data collectors were blinded to the study hypothesis and our trained fieldworkers  
14 reviewed infant health records and checked for consistency with a family's report.  
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28 Our study has implications for policy and program development. Infant male circumcision is  
29 commonly practiced in many parts of sub-Saharan Africa including our study area. We report  
30 substantial differences in healthcare seeking patterns in families in the two cohorts in the  
31 Brong Ahafo Region of central rural Ghana. A much lower proportion of families of infants  
32 with circumcision related morbidity sought healthcare for acute morbidity compared to  
33 families of infants with acute illness. The findings from this study indicates that government  
34 and non-governmental organisations need to prioritise circumcision and improve awareness  
35 of this highly prevalent but potentially dangerous practice. Circumcision carries a triple  
36 burden of high prevalence, high morbidity load and poor care seeking. Community awareness  
37 of the burden, consequences and solutions needs to increase. This requires the involvement of  
38 community leaders and other stakeholders and include behaviour change communication  
39 strategies.  
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11 **Contributors:** GT drafted the manuscript which was edited and reviewed by all the authors.  
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14 KE, GT, KMc and NS designed the study. GT, KE, and MO were responsible for the study  
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analysed the data.

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Health Research Centre, the Research Ethics Committee of London School of Hygiene and  
Tropical Medicine, and the Human Research Ethics Committee of the University of Western  
Australia. Written informed consent was obtained from all the families of both the  
circumcised male infants and the Neovita trial infants.

**Availability of data and materials:** The dataset analysed during the current study available  
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Figure 1. Flow diagram for live births from Aug 2010 to Nov 2011 included in the Neovita study

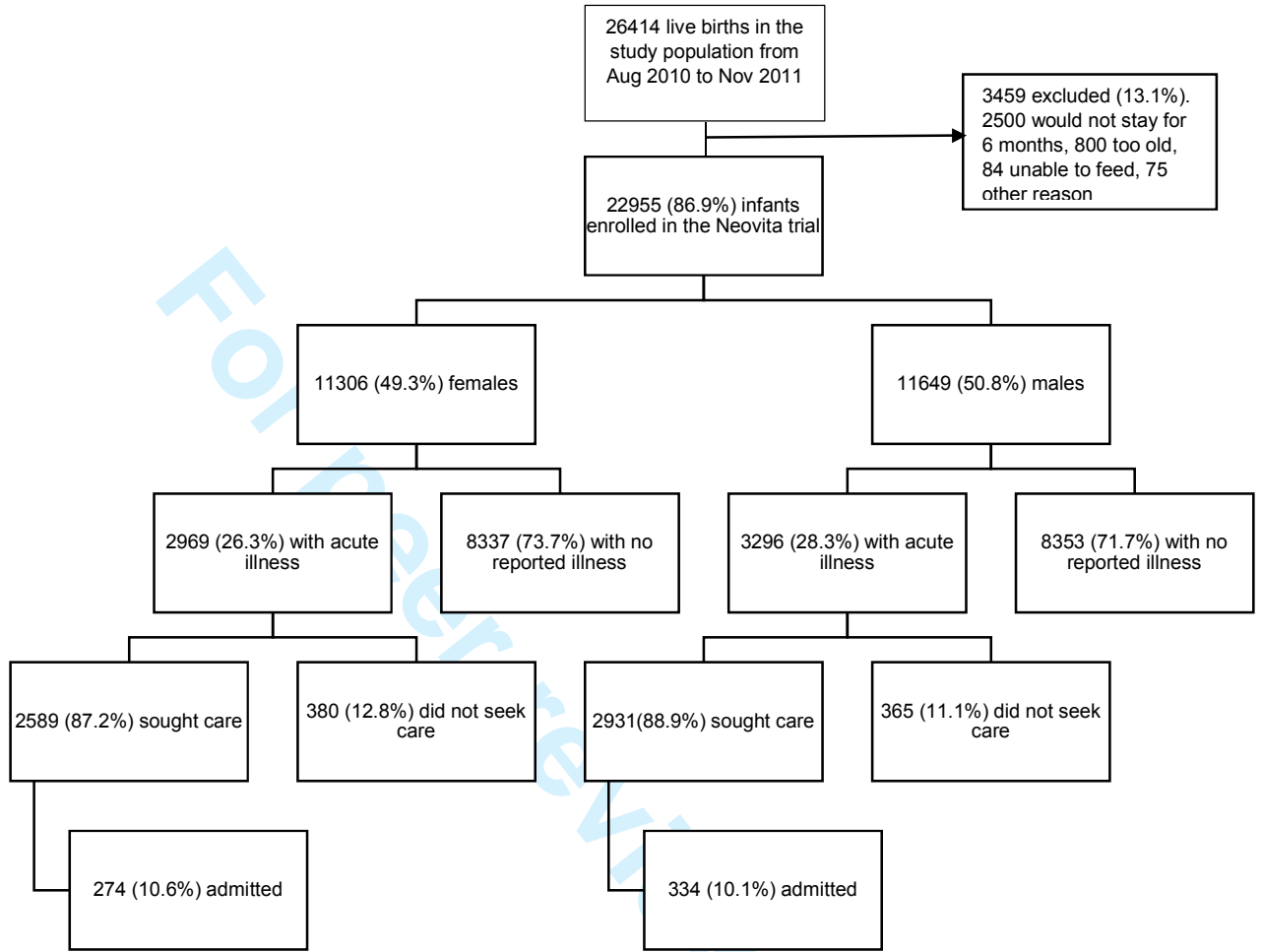


Figure 2. Flow diagram for live births from May 2012 to Dec 2012 included in the circumcision study

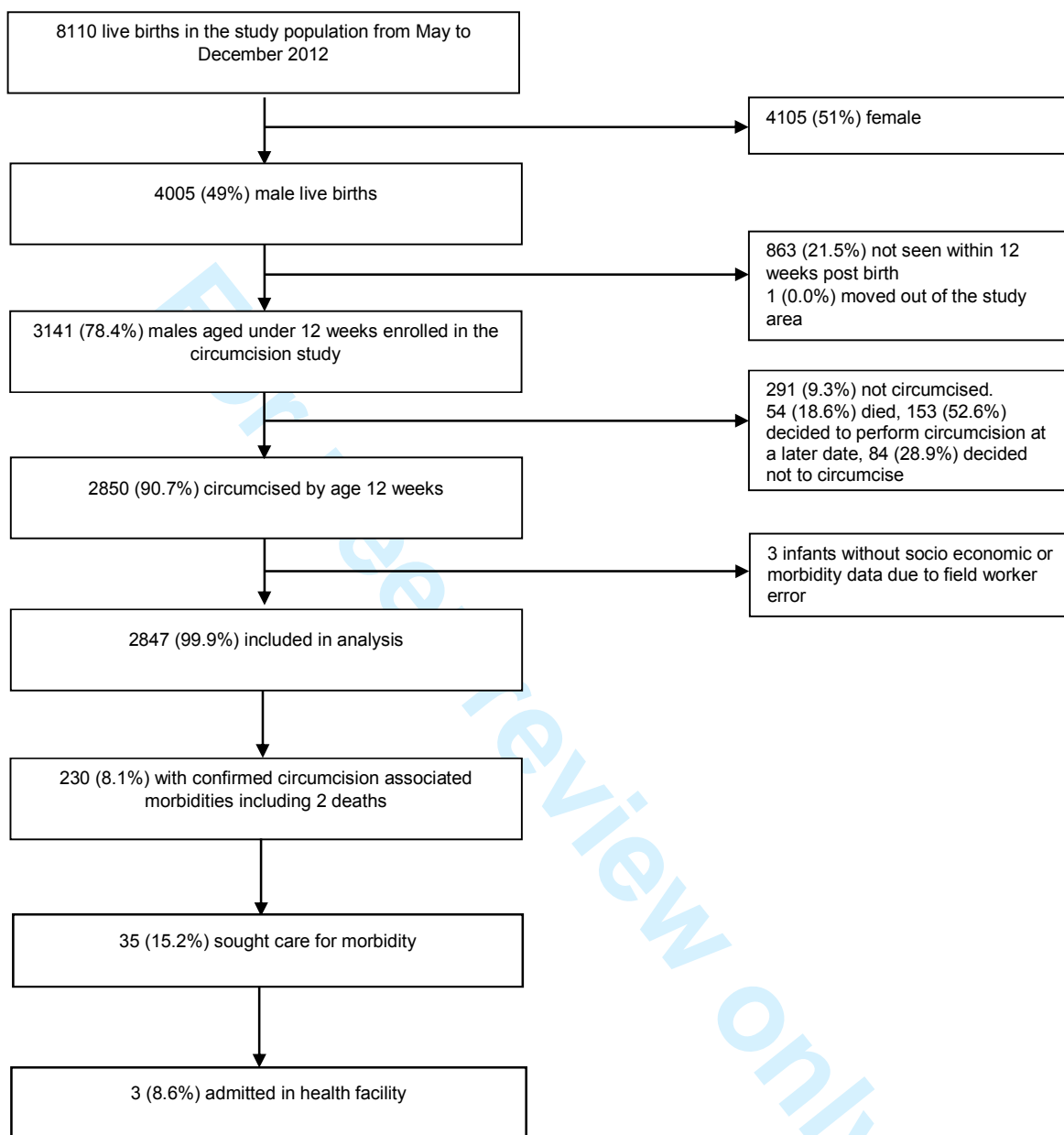


Table 1. Characteristics of families and infants who sought care for acute illness in the Neovita trial

Characteristics	Neovita study population n=22955	Neovita trial infants with acute illness n=6265 (27.3%)	Neovita trial infants with acute illness whose families sought care n=5520 (88.1%)
<b>Religion</b>			
Christian	15979	4314 (27.0%)	3820 (88.5%)
Muslim	5511	1566 (28.4%)	1357 (86.7%)
Traditional Africa/none	1465	385 (26.3%)	343 (89.1%)
Missing data	-	-	-
<b>Mother's highest educational level</b>			
None	7127	2009 (28.2%)	1752 (86.2%)
Primary	4236	1241 (29.3%)	1088 (87.7%)
Secondary	11578	3013 (26.0%)	2678 (88.9%)
Carer didn't know	14	2 (14.3%)	2
<b>Income status of household</b>			
1 (Lowest)	4510	1316 (29.2%)	1147 (87.2%)
2	4550	1297 (28.5%)	1147 (88.4%)
3	4583	1274 (27.8%)	1130 (88.7%)
4	4644	1212 (26.1%)	1063 (87.7%)
5 (Highest)	4668	1166 (25.0%)	1033 (88.6%)
Missing data	-	-	-
<b>Maternal age (years)</b>			
Less than 20	2646	760 (28.7%)	658 (86.6%)
20-29	12041	3269 (27.1%)	2900 (88.7%)
30 or more	8239	2228 (27.0%)	1954 (87.7%)
Carer didn't know	30	8 (26.7%)	8
<b>Site of delivery</b>			
Health facility	17 581	4775 (27.2%)	4213 (88.2%)
Home	5374	1490 (27.7%)	1307 (87.7%)
Missing data	-	-	-
<b>Distance to health facility</b>			
<1 km	13880	3657 (26.3%)	3234 (88.4%)
1 – 4.9 km	5285	1497 (28.3%)	1324 (88.4%)
5 – 10 km	2950	752 (25.5%)	646 (85.9%)
10 km or more	1197	359 (30.0%)	316 (88.0%)
Missing data	-	-	-
<b>Birth weight</b>			
Less than 2.5kg	3592	998 (27.8%)	867 (86.9%)
2.5kg or greater	19361	5267 (27.2%)	4653 (88.3%)
Missing data	-	-	-
<b>Sex</b>			
Male	11649	3296 (28.3%)	2931 (88.9%)
Female	11306	2969 (26.3%)	2589 (87.2%)

Table 2. Characteristics of families and infants who sought care for morbidity in the circumcision study

Characteristics	Circumcision study population n=3141	Circumcised infants n=2850* (90.7%)	Circumcised infants with morbidity n=230 (8.1%)	Circumcised infants with morbidity whose families sought care n=35 (15.0%)
<b>Religion</b>				
Christian	2234	2048 (91.7%)	172 (8.4%)	24 (14.0%)
Muslim	727	666 (91.6%)	49 (7.4%)	9 (18.4%)
Traditional Africa/none	171	129 (75.4%)	9 (7.0%)	2 (22.2%)
Missing data	9	7 (77.8%)	-	-
<b>Mother's highest educational level</b>				
None	601	512 (85.2%)	50 (9.8%)	6 (12.0%)
Primary	1619	1481 (91.5%)	127 (8.6%)	21 (16.5%)
Secondary	913	850 (93.1%)	53 (6.2%)	8 (15.1%)
Carer didn't know	8	7 (87.5%)	-	-
<b>Income status of household</b>				
1 (Lowest)	503	387 (76.9%)	28 (7.2%)	6 (21.4%)
2	608	532 (87.5%)	41 (7.7%)	4 (9.8%)
3	676	628 (92.9%)	47 (7.5%)	9 (19.1%)
4	725	687 (94.8%)	62 (9.0%)	8 (12.9%)
5 (Highest)	629	613 (97.5%)	52 (8.5%)	8 (15.4%)
Missing data	0	3 (0.1%)	-	-
<b>Maternal age (years)</b>				
Less than 20	360	319 (88.6%)	26 (8.2%)	3 (11.5%)
20-29	1603	1458 (91.0%)	130 (8.9%)	18 (13.8%)
30 or more	1170	1066 (91.1%)	74 (6.9%)	14 (18.9%)
Carer didn't know	8	7 (87.5%)	-	-
<b>Site of delivery</b>				
Health facility	2479	2292 (92.5%)	196 (8.6%)	28 (14.3%)
Home	650	549 (84.5%)	34 (6.2%)	7 (20.6%)
Missing data	12	6 (50.9%)	-	-
<b>Distance to health facility</b>				
<1 km	1545	1444 (93.5%)	110 (7.6%)	21 (19.1%)
1 – 4.9 km	801	741 (92.5%)	77 (10.4%)	7 (9.1%)
5 – 10 km	484	400 (82.6%)	27 (6.8%)	3 (11.1%)
10 km or more	231	186 (80.5%)	14 (7.5%)	3 (21.4%)
Missing data	80	76 (95.0%)	2 (2.6%)	1 (50.1%)
<b>Birth weight</b>				
Less than 2.5kg	255	214 (83.9%)	21 (9.1%)	1 (4.8%)
2.5kg or greater	2886	2633 (91.2%)	209 (7.9%)	34 (16.3%)
Missing data	0	-	-	-

\*Three circumcised infants had no socioeconomic and demographic data due to field worker error



Table 3. Predictors of care seeking behaviour in the Neovita trial population

Characteristics	Neovita study population n=22955	Neovita trial infants with acute illness n=6265 (27.3%)	Neovita trial infants whose families sought care n=5520 (88.1%)	Unadjusted Odds ratio (OR)	p-value	Adjusted Odds ratio (aOR)*	p-value
<b>Religion</b>							
Christian	15979	4314 (27.0%)	3820 (88.5%)	1.00	0.121	1.00	0.195
Muslim	5511	1566 (28.4%)	1357 (86.7%)	0.84 (0.70, 1.00)		0.86 (0.72, 1.03)	
Traditional Africa/none	1465	385 (26.3%)	343 (89.1%)	1.06 (0.76, 1.47)		1.10 (0.79, 1.55)	
Missing data	-	-	-				
<b>Mother's highest educational level</b>							
None	7127	2009 (28.2%)	1752 (86.2%)	0.89 (0.73, 1.09)		0.89 (0.72, 1.10)	
Primary	4236	1241 (29.3%)	1088 (87.7%)	0.85 (0.72, 1.01)		0.84 (0.69, 1.03)	
Secondary	11578	3013 (26.0%)	2678 (88.9%)	1.00	0.174	1.00	0.260
Carer didn't know	14	2 (14.3%)	2	-			
<b>Income status of household</b>							
1 (Lowest)	4510	1316 (29.2%)	1147 (86.6%)	0.87 (0.69, 1.11)		1.00 (0.75, 1.33)	
2	4550	1297 (28.5%)	1147 (86.4%)	0.98 (0.77, 1.26)		1.07 (0.82, 1.39)	
3	4583	1274 (27.8%)	1130 (88.7%)	1.01 (0.79, 1.30)		1.08 (0.83, 1.39)	
4	4644	1212 (26.1%)	1063 (87.7%)	0.92 (0.72, 1.18)		0.95 (0.74, 1.22)	
5 (Highest)	4668	1166 (25.0%)	1033 (88.6%)	1.00	0.714	1.00	0.848
Missing data	-	-	-				
<b>Maternal age (years)</b>							
Less than 20	2646	760 (28.7%)	658 (86.6%)	1.00	0.208	1.00	0.131
20-29	12041	3269 (27.1%)	2900 (88.7%)	1.22 (0.96, 1.54)		1.23 (0.97, 1.57)	
30 or more	8239	2228 (27.0%)	1954 (87.7%)	1.11 (0.87, 1.41)		1.15 (0.89, 1.48)	
Carer didn't know	30	8 (26.7%)	8	-			
<b>Site of delivery</b>							
Health facility	17 581	4775 (27.2%)	4213 (88.2%)	1.00	0.595	1.00	0.886
Home	5374	1490 (27.7%)	1307 (87.7%)	0.95 (0.80, 1.14)		1.01 (0.83, 1.24)	
Missing data	-	-	-				
<b>Distance to health facility</b>							
<1 km	13880	3657 (26.3%)	3234 (88.4%)	1.00	0.278	1.00	0.369
1 – 4.9 km	5285	1497 (28.3%)	1324 (88.4%)	1.00 (0.83, 1.21)		0.99 (1.82, 1.20)	
5 – 10 km	2950	752 (25.5%)	646 (85.9%)	0.80 (0.63, 1.00)		0.80 (0.62, 1.03)	
10 km or more	1197	359 (30.0%)	316 (88.0%)	0.96 (0.69, 1.34)		0.96 (0.68, 1.37)	
Missing data	-	-	-				
<b>Birth weight</b>							
Less than 2.5kg	3592	998 (27.8%)	867 (86.9%)	0.87 (0.71, 1.07)		0.89 (0.72, 1.09)	
2.5kg or greater	19361	5267 (27.2%)	4653 (88.3%)	1.00	0.194	1.00	0.260
Missing data	-	-	-				
<b>Sex</b>							
Male	11649	3296 (28.3%)	2931 (88.9%)	1.00	0.035	1.00	0.039
Female	11306	2969 (26.3%)	2589 (87.2%)	0.84 (0.73, 0.99)		0.85 (0.73, 0.99)	

\*Adjusted for religion, maternal education, distance to health facility, site of delivery and sex.

Table 4. Type of health care provider for circumcision-related morbidity

Characteristics	Circumcised infants whose families sought care n=35	Type of healthcare provider for circumcision morbidity	
		Formal provider 24 (68.6%)	Informal provider* 11 (31.4%)
<b>Religion</b>			
Christian	24	17 (70.8%)	7 (29.2%)
Muslim	9	6 (66.7%)	3 (33.3%)
Traditional Africa/none	2	1 (50.0%)	1 (50.0%)
Missing data	-	-	-
<b>Mother's highest educational level</b>			
None	6	2 (33.3%)	4 (66.7%)
Primary	21	15 (71.4%)	6 (28.6%)
Secondary	8	7 (87.5%)	1 (12.5%)
Carer didn't know	-	-	-
<b>Income status of household</b>			
1 (Lowest)	6	2 (33.3%)	4 (66.7%)
2	4	2 (50.0%)	2 (50.0%)
3	9	7 (77.8%)	2 (22.2%)
4	8	7 (87.5%)	1 (12.5%)
5 (Highest)	8	6 (75.0%)	2 (25.0%)
Missing data	-	-	-
<b>Maternal age (years)</b>			
Less than 20	3	3	-
20-29	18	11 (61.1%)	7 (38.9%)
30 or more	14	10 (71.4%)	4 (28.6%)
Carer didn't know	-	-	-
<b>Site of delivery</b>			
Health facility	28	22 (78.6%)	6 (21.4%)
Home	7	2 (28.6%)	5 (71.4%)
Missing data	-	-	-
<b>Distance to health facility</b>			
<1 km	21	18 (85.7%)	3 (14.3%)
1 – 4.9 km	7	3 (42.9%)	4 (57.1%)
5 – 10 km	3	1 (33.3%)	2 (66.7%)
10 km or more	3	1 (33.3%)	2 (66.7%)
Missing data	1	1	-
<b>Type of circumcision provider</b>			
Formal provider	15	13 (86.7%)	2 (13.3%)
Informal provider	20	11 (55.0%)	9 (45.0%)
Missing data	0	-	-
<b>Birth weight</b>			
Less than 2.5kg	1	-	1 (100.0%)
2.5kg or greater	34	24 (70.6%)	10 (29.4%)
Missing data	-	-	-

\* Informal care provider included; drug sellers, traditional healers and religious leaders

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2 & 3
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4 & 5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5 & 6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6 & 7
Bias	9	Describe any efforts to address potential sources of bias	8 & 9
Study size	10	Explain how the study size was arrived at	8 & 9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8 & 9
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8 & 9
		(b) Describe any methods used to examine subgroups and interactions	NA
		(c) Explain how missing data were addressed	NA
		(d) If applicable, describe analytical methods taking account of sampling strategy	NA
		(e) Describe any sensitivity analyses	NA
<b>Results</b>			

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Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9 & 10
		(b) Give reasons for non-participation at each stage	9 & 10
		(c) Consider use of a flow diagram	9 & 10
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9 & 10
		(b) Indicate number of participants with missing data for each variable of interest	9 & 10
Outcome data	15*	Report numbers of outcome events or summary measures	9 & 10
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10 & 11
		(b) Report category boundaries when continuous variables were categorized	10 & 11
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Healthcare seeking patterns of families of infants with circumcision-related morbidities from two population-based cohort studies in Ghana

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3 **Healthcare seeking patterns of families of infants with circumcision-related morbidities**  
4 **from two population-based cohort studies in Ghana**  
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## ABSTRACT

**Objective:** This study assessed health care seeking patterns of families of infants with circumcision related morbidities and families of infants with acute illnesses in rural Ghana.

**Design:** Two population-based cohort studies.

**Setting:** Brong Ahafo Region of central rural Ghana.

**Participants:** A total of 22,955 infants enrolled in a large population based trial (Neovita trial) from 16<sup>th</sup> August 2010 to 7<sup>th</sup> November 2011 and 3141 infants in a circumcision study from 21<sup>st</sup> May 2012 to 31<sup>st</sup> December 2012.

**Primary Outcome:** Care seeking for circumcision related morbidities and acute illnesses unrelated to circumcision.

**Results:** Two hundred and thirty (8.1%) infants from the circumcision study had circumcision related morbidities and 6265 (27.3%) infants from the Neovita study had acute illnesses unrelated to circumcision. A much lower proportion (35, 15.2%) of families of infants with circumcision related morbidities sought healthcare compared to families of infants with acute illnesses in the Neovita study (5520, 88.1%). More families sought care from formal providers (24, 69%) compared to informal providers (11, 31%) for circumcision related morbidities. There were no obvious determinants of care seeking for acute illnesses or circumcision related morbidities in the population.

**Conclusions:** Government and non-government organisations need to improve awareness about the complications and care seeking needed for circumcision related morbidities.

### Strengths and limitations of this study

- A major strength of this study is the use of two large community and population-based cohort studies.
- This is the first, study to our knowledge, to have compared health seeking patterns between families of infants with circumcision related morbidities and families of infants with acute illnesses that are not circumcision related.
- The main limitation was the small sample size in our circumcision cohort due to the low level of health care seeking so we were unable to statistically compare careseeking in the circumcision and total study cohort. However, we were able to assess the association between key socio demographic factors and healthcare seeking patterns in the larger Neovita cohort of 22,955 mother infant pairs.



## Introduction

Infant male circumcision is a common surgical procedure and is performed for cultural, religious and medical reasons. Approximately 90% of males aged under 12 weeks are circumcised in Ghana<sup>1</sup> and much of West Africa<sup>2</sup>. We reported a concerning high risk of circumcision related morbidity (8.1%), following infant male circumcision in our community-based study in rural Ghana<sup>1</sup>. Overall, 53% of the complications were observed following circumcision performed by an informal provider (including village-based traditional circumcision providers) and 47% after circumcision performed by formal healthcare providers including doctors, nurses, and medical assistants<sup>1</sup>.

Appropriate health care seeking for infants with circumcision related morbidities could minimise the occurrence of severe long and short-term morbidities. Studies conducted in rural Ghana have reported that poor women believe infant illnesses related to traditional practices are not meant to be managed in the hospital or clinic<sup>3-5</sup>. However, no other data on care seeking for infant male circumcision related morbidity in rural African areas are available. There are more studies that have examined the determinants of care seeking for acute infectious diseases and newborn complications in rural Africa<sup>6,7</sup>. A recent study conducted among mothers and infants in Ghana identified poor health care seeking behaviour in families of infants with acute illness during the postpartum period. In this study 29% and 54% of sick infants received health care within two and fourteen days, respectively<sup>8</sup>. Another Ghanaian study identified poverty and personal preferences as key determinants of poor care seeking behaviour by families of infants with illness<sup>9</sup>. A study from Burkina Faso also linked traditional concepts of illness in Africa to delays in seeking professional medical care by families of infants with malaria<sup>10</sup>. Distance to health facility, health provider attitude and

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3 inadequate supplies have also been reported as key determinants of delayed care seeking for  
4 malaria cases in infants in sub-Saharan African populations<sup>11</sup>. However, it appears that there  
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7 have been no studies which have compared health seeking behaviour between families of  
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10 infants with circumcision related morbidities and families of infants with acute illnesses that  
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12 are not circumcision related.  
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17 The overall aim of this study was to assess healthcare seeking patterns of families of infants  
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20 with circumcision related morbidities and families of infants with other acute illnesses in  
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22 rural Ghana. The primary objective was to investigate whether there were differences in the  
23  
24 healthcare seeking patterns of families of infants with circumcision related problems,  
25  
26 including infants who died, and families of infants with acute illnesses. The secondary  
27  
28 objective was to assess the factors that influence care seeking patterns of families in the study  
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30 area.  
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## 36 **Methods**

### 37 **Study design and setting**

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40 Data from two separate cohort studies in the same part of the Brong Ahafo Region of central  
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43 Ghana were analysed separately and compared descriptively. The larger of the two cohorts  
44  
45 includes data from a population based trial of newborn vitamin A supplementation (Neovita  
46  
47 trial), conducted between 16<sup>th</sup> August 2010 to 7<sup>th</sup> November 2011 and involving 22,955  
48  
49 mother infant pairs; full details have been published previously<sup>2</sup>. The smaller cohort was  
50  
51 conducted between 21<sup>st</sup> May 2012 and December 31<sup>st</sup> 2012 and focused on circumcision.  
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54 This was implemented to obtain additional observational data on births, cause specific  
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56 mortality and circumcision related morbidity in the study area. Over the period from 2010 to  
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3 2012, 80% of the study population lived in rural settlements and 20% of mothers had no  
4  
5 primary school education. Four major district hospitals and over 80 small health facilities  
6  
7 provided health care services to the population. There were 30 doctors and 44 other formal  
8  
9 health service providers (medical assistants and nurses) providing curative services in the  
10  
11 four district hospitals at the time of the circumcision study. There were also approximately  
12  
13 120 informal care providers such as drug sellers, traditional healers and religious leaders in  
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15 the study area.  
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### 20 21 **Data collection** 22 23

24  
25 For the Neovita study, from August 2010 to November 2011, all births in the study area were  
26  
27 reported to the trial team via a network of fieldworkers. Fieldworkers visited all families at  
28  
29 home between two hours and two days after birth and interviewed the mother of the infant or  
30  
31 the primary care giver. Fieldworkers weighed the baby and asked the mother or the primary  
32  
33 care giver about: date of birth, site of birth, current address, distance to health facilities,  
34  
35 socio-demographic characteristics and socio-economic information (using an asset index). At  
36  
37 the monthly surveillance visits, the families were asked by fieldworkers for detailed  
38  
39 information on; infant illness including start and end dates; and healthcare seeking during  
40  
41 infant illness. Due to time constraints families were not asked exactly who they sought care  
42  
43 from. The fieldworkers also asked the families who sought healthcare whether the infant was  
44  
45 admitted to hospital. The fieldworkers next reviewed infant health records and checked for  
46  
47 consistency with family's report. The fieldworkers also collected data on the vital status of  
48  
49 the baby (including if the baby was alive, dead or hospitalised).  
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56 The circumcision study included all male liveborn infants who were born in the study  
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58 population from May to December 2012 and were aged under 12 weeks. Follow-up visits  
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3 were scheduled between eight to eleven weeks post birth and trained senior fieldworkers  
4  
5 asked for consent to collect additional detailed data on: age at circumcision, site of  
6  
7 circumcision and type of circumcision provider. The fieldworkers asked about circumcision  
8  
9 morbidities and whether these morbidities had been confirmed by a trained health  
10  
11 professional. Families were also asked if they sought care for circumcision related  
12  
13 morbidities and if they had been given advice about potential problems or careseeking. The  
14  
15 fieldworkers also asked detailed information on the following; site of healthcare; type of  
16  
17 healthcare provider; medicines prescribed; admissions; and surgery. Consent to access the  
18  
19 baby's Neovita data including socioeconomic, demographic and care seeking was obtained.  
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26 In both studies the fieldworkers were trained for two weeks in all study procedures prior to  
27  
28 the commencement of the study. Interrater reliability was checked between all fieldworkers.  
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30 We did not perform statistical evaluation of agreements between the fieldworkers and the  
31  
32 study coordinator (GT). However, each fieldworker was supervised during 2 visits per month  
33  
34 as part of the study scheduled and unscheduled supervisory visits. During these visits, GT and  
35  
36 field supervisors observed the fieldworker interviewing mothers, and examined infants and  
37  
38 recorded findings independently. Recorded data were compared between the fieldworker and  
39  
40 GT/field supervisor and used to provide feedback after the home visits and at weekly  
41  
42 fieldworker meetings. The fieldworkers used standardised paper based data collection tools  
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44 (including a standardised list of closed ended questions) for all interviews.  
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### 50 **Study definitions**

51  
52 We defined a *formal health care service* as medical care provided at hospitals, clinics or  
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54 health posts by professionally trained, licensed and regulated providers of medical services  
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56 including; doctors, medical assistants, nurses or pharmacists. An *informal health care*  
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3 *service* was defined as care provided by untrained, unlicensed, unregulated private provider  
4 of care services including: drug sellers, traditional healers and religious leaders. *Circumcision*  
5 *related morbidities* were defined as complications occurring during or after the circumcision  
6 procedure as reported by the primary caregiver including; excess skin removal or incision,  
7 excess bleeding, inadequate skin removal, infection, abnormal stream of urine, glans  
8 amputation, ulcer<sup>1</sup>. *Acute illnesses* were defined as illnesses or injuries other than  
9 circumcision related complications such as malaria, sepsis, acute respiratory tract infection **or**  
10 diarrhoea<sup>13,14</sup>. A *formal circumcision provider* referred to professionally trained, licensed and  
11 regulated providers of medical services. This included: doctors, medical assistants, or nurses.  
12 An *informal circumcision provider* was an untrained, unlicensed, unregulated private  
13 provider of medical services including: drug sellers, domestic staff, family members and  
14 Wanzams (village based traditional circumcision providers).  
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### 33 **Outcome**

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36 Our primary outcome was careseeking. In the circumcision study, we defined careseeking as  
37 the percentage of families of infants who sought care from either a formal healthcare provider  
38 or an informal care provider among families who reported of an infant having a circumcision  
39 related morbidity after circumcision during the circumcision follow-up visits (occurred  
40 between eight and eleven weeks post birth). In the Neovita study, careseeking was defined as  
41 the percentage of families of infants with acute illnesses unrelated to circumcision who  
42 sought care outside the home of the infant as reported by care givers during the Neovita  
43 infant follow-up visits (from four weeks up to fifty two weeks of age).  
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### Statistical analysis

Two hundred and thirty (8.1%) infants had circumcision related morbidities and of these, only 35 (15.2%) families sought care. Thus, we reported careseeking patterns in our circumcised cohort only using simple proportions and descriptive analyses. Statistical analyses were used to assess care seeking patterns in the larger Neovita cohort of 22,955 infants. Multivariable logistic regression models were constructed *a priori* to assess the association between care seeking patterns and morbidity risk and adjusted for the effect of important explanatory variables including: religion, maternal education level, maternal age, distance to health facility, site of delivery, sex, birth weight and income status. Adjusted odds ratios (ORs) and 95% confidence intervals (95% CI) were calculated. All analyses were conducted in STATA version 13.

### Ethical issues

Ethical approvals were obtained from Ghana Health Service (GHS) Ethical Review Committee, the Institutional Ethics Committee of Kintampo Health Research Centre (KHRC), the Research Ethics Committee of London School of Hygiene and Tropical Medicine, and the Human Research Ethics Committee of the University of Western Australia (UWA). Written informed consent was obtained from all the families of the circumcised male infants.

### RESULTS

From 16<sup>th</sup> August 2010 to 7<sup>th</sup> November 2011, 22,955 infants comprising 11,649 (50.8%) males and 11306 (49.3%) females were recruited into the Neovita trial (Figure 1). A total of

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3 4510 (19.7%) of the mothers were in the lowest socio-economic quintile, 17581 (76.6%)  
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5 delivered in a health facility and 7127 (31.1%) had no primary education (Table 1).  
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11 From 21<sup>st</sup> May to 31<sup>st</sup> December 2012, 3141 male infants were recruited in the circumcision  
12 study (Figure 2). Overall, 2850 (90.7%) of these infants were circumcised. We excluded three  
13 babies (0.1%) who had no socio-economic or demographic data. A total of 503 (16.0%) of  
14 mothers were in the lowest income quintile; 2479 (78.9%) delivered in a facility and 601  
15 (19.1%) had no primary education (Table 2).  
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### 25 **Acute illness and careseeking**

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28 A total of 6265 (27.3%) Neovita trial infants had an acute illness during the first year of life.  
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30 There was little difference in the prevalence of acute illness by sex in the Neovita population;  
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32 3296 (28.3%) males and 2969 (26.3%) females (Figure 1 and Table 1). Healthcare was  
33  
34 sought for 5520 (88.1%) Neovita trial infants with acute illness and 608 (11.0%) were  
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36 admitted to hospital (10.6% females and 10.1% males) (Figure 1 and Table 1). A total of  
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38 1033 (88.6%) families who sought care for acute illness were in the highest socio-economic  
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40 quintile compared to 1147 (87.2%) in the lowest quintile, 4213 (88.2%) delivered in a health  
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42 facility compared to 1307 (87.7%) who delivered at home and 2678 (88.9%) had more than  
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44 primary school education compared to 1752 (86.2%) with no formal education (Table 1).  
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52 A slightly lower proportion of families of female infants with acute illness (87.2%) sought  
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54 care compared to families of male infants (88.9%) (aOR 0.85, 95% CI 0.73, 0.99 p=0.039)  
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56 (Table 3). Surprisingly, there were no obvious differences in the prevalence of health care  
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3 seeking related to levels of education (aOR 0.89, 95% CI 0.72, 1.10 p=0.260), socio  
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5 economic status (aOR 1.00, 95% CI 0.75, 1.33 p=0.848), maternal age (aOR 1.15, 95% CI  
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7 0.89, 1.48 p=0.131), site of delivery (aOR 1.01, 95% CI 0.83, 1.24 p=0.886), distance to  
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9 health facility (aOR 0.96, 95% CI 0.68, 1.37 p=0.369) or birth weight (aOR 0.89, 95% CI  
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11 0.72, 1.09 p=0.260) in the Neovita trial population (Table 3).  
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### 14 15 16 17 **Circumcision complications and care seeking** 18

19  
20 Of the 2847 circumcised male infants included in the circumcision analysis, 230 (8.1%) had  
21  
22 confirmed morbidities related to circumcision and two died. Only 35 (15.2%) families of  
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24 infants with circumcision related morbidities sought care and 3 (8.6%) were admitted to  
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26 hospital (Figure 2 and Table 2).  
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30 The proportion of mothers aged less than 20 years who sought care for their infants with  
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32 circumcision related morbidity (3, [11.5%]) was slightly lower than mothers aged 30 years or  
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34 more (14, [18.9%]). Healthcare seeking of mothers of infants with low birth weight was  
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36 lower (1, [4.8%]) than mothers of infants with normal birth weight though the total numbers  
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38 were small (34, [16.3%]) (Table 2). There were no other obvious determinants of careseeking  
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40 for circumcision related morbidity.  
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### 49 **Type of provider** 50

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52 In the circumcision study, of the 35 families of infants who sought care for circumcision  
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54 related morbidity, 20 (57.1%) infants were circumcised by an informal provider and 15  
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56 (42.9%) by a formal provider (Table 4). Most families of infants circumcised by a formal  
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3 provider also sought care from a formal provider for complications (13, 87.7%). In contrast,  
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5 only 45% (9) families of infants circumcised by an informal provider also sought healthcare  
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7 for circumcision related morbidity from an informal healthcare provider (Table 4).  
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12 A similar proportion of mothers in the lowest income quintile (4, [66.7%]) sought healthcare  
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14 for circumcision related morbidity from an informal care provider compared to mothers in the  
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16 highest income quintile (2, [25.0%]), however numbers were low in this analysis (Table 4). A  
17  
18 greater proportion of mothers who delivered their infants at home (5, [71.4%]) sought  
19  
20 healthcare for circumcision related morbidity from an informal care provider compared to  
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22 mothers with health facility births (6, [21.4%]). The proportion of mothers who lived 10 km  
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24 or more from a health facility (2, [66.7%]) who sought healthcare for circumcision related  
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26 morbidity from an informal care provider was higher than those who lived within 1 km from  
27  
28 a health facility (3, [14.3%]). There were no data on type of health care provider available  
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30 from the Neovita trial population.  
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### 39 **Discussion**

40  
41 There appeared to be substantial differences in healthcare seeking in families with infants  
42  
43 experiencing circumcision related morbidities and those with other acute illnesses in the  
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45 Brong Ahafo Region of central rural Ghana. A much lower proportion (15.2%) of families of  
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47 infants with circumcision related morbidities sought healthcare compared to families who had  
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49 an infant with an acute illness in the larger Neovita population (88.1%). However, the  
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51 proportion of hospital admissions in infants of families who sought health care was almost  
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53 the same (11% in the Neovita study and 9% in the circumcision study). There was some  
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55 indication that mothers of low birth weight infants had poorer careseeking for circumcision  
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3 related morbidities than mothers of infants with normal birth weight infants. There were no  
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5 other clear determinants of healthcare seeking for acute illnesses or circumcision related  
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7 morbidities in our study populations.  
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13 A study conducted in Nigeria also reported lower healthcare seeking by families of male  
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15 infants with circumcision related morbidities compared to infants with other health  
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17 problems<sup>15</sup>. Other studies have suggested that poor care seeking behaviour after circumcision  
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19 can be due to family expectations that complications will heal without any intervention<sup>15,16</sup>,  
20  
21 poor recognition of illness<sup>5,17,18</sup>, poor recognition of severity of illness<sup>5,19-21</sup>, and beliefs that  
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23 some infant illnesses are not meant to be treated in hospitals<sup>3,5</sup>.  
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30 Interestingly, the proportion of hospital admissions post care seeking was almost the same in  
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32 the Neovita and circumcision populations (11% of infants with acute morbidities whose  
33  
34 families sought care were hospitalised and 9% of infants with circumcision related  
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36 morbidities whose families sought health care were also hospitalised). This indicates that  
37  
38 families may not be seeking care for many circumcised infants in our study area with  
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40 morbidities that do require hospital admission and specialised hospital care. Overall, hospital  
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42 admission rates were similar to a recently published study from Ghana that reported rates of 9  
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44 to 18%<sup>22</sup>.  
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51 The determinants of careseeking for acute illness have been reported in low and middle  
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53 income countries<sup>5,23,24</sup>. However, few studies have reported population-based data on the care  
54  
55 seeking patterns of families with infants who experience circumcision related morbidities and  
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57 acute illness. There was some indication that mothers of low birth weight infants had poorer  
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3 careseeking for circumcision related morbidities (5%) than mothers of infants with normal  
4 birth weight infants (16%) though numbers were small. These findings are similar to other  
5 studies that reported poor careseeking for acute illness<sup>25</sup> and vaccination<sup>26</sup> in families of low  
6 birth weight infants. We found no evidence that other socioeconomic and demographic  
7 factors influence families careseeking behaviour for circumcision related morbidity and acute  
8 illness in our population. These findings contrast with that of other earlier studies from  
9 Ghana<sup>5,22,26,27</sup> and Bangladesh<sup>28</sup> that reported higher care seeking for infants with acute  
10 illness by richer families, and mothers with higher educational levels. This indicates that  
11 health care seeking behaviour for acute illness may be improving over time in rural Ghana.  
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26 Overall, we found that more families sought care for a circumcision related morbidity from  
27 formal (68.6%) than informal (13.4%) healthcare providers. Unsurprisingly, most families of  
28 infants circumcised by a formal provider also sought care from a formal provider for  
29 complications. However, fewer families of infants circumcised by an informal provider  
30 sought care from an informal provider (45%) than an formal provider (55%). These findings  
31 differ from another published study from Kenya<sup>16</sup> which reported families of male infants  
32 who were circumcised by an informal provider were two fold less likely to seek care for a  
33 circumcision related morbidity from a formal healthcare provider<sup>16</sup>. We were not able to  
34 assess the type of care provider for acute illness in the Neovita study as these data were not  
35 collected in the Neovita study.  
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52 Generally, healthcare seeking for acute illness in the Neovita study population was very high  
53 (88.1%). The proportion of families seeking health care in our study was higher than data  
54 reported by the Ghana Demographic and Health Survey in 2008, close to the time of  
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3 conducting the Neovita study (acute respiratory infection 51.0%, fever 51.0%, and diarrhoea  
4 35.2%)<sup>29</sup>. Careseeking for acute illness in rural populations has also been reported to be  
5 around 61% in Kenya<sup>21</sup>, 47% in Nigeria<sup>30</sup> and 27% in Vietnam<sup>31</sup>. The high healthcare  
6 seeking patterns for acute illnesses seen in our study population may be due to recent  
7 communications and promotion of care seeking by the local government district health  
8 management teams. However, that these communications do not appear to have influenced  
9 careseeking for circumcision related morbidities to date.  
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22 The most important limitation to our study was the small sample size in our circumcision  
23 cohort due to the low level of health care seeking so we were unable to statistically compare  
24 careseeking in the circumcision and total study cohort. However we were able to assess the  
25 association between key socio demographic factors and healthcare seeking patterns in the  
26 22,955 infants in the community level population based Neovita cohort. Another limitation  
27 was our use of family level recall of health service utilisation which could have led to some  
28 episodes of care seeking being under reported in the circumcised cohort. However, both  
29 families and data collectors were blinded to the study hypothesis and our trained fieldworkers  
30 reviewed infant health records and checked for consistency with a family's report. The  
31 Neovita study lacked data on the type of provider care was sought from. However, the  
32 population-based nature of the data on whether care was sought for acute illnesses, serves as  
33 a proxy for care seeking patterns. Understanding the type of care provider sought for acute  
34 illnesses would be important to investigate in the future  
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## Conclusions

Our study has implications for policy and program development. Infant male circumcision is commonly practiced in many parts of sub-Saharan Africa including our study area. We report substantial differences in healthcare seeking patterns in families in the two cohorts in the Brong Ahafo Region of central rural Ghana. A much lower proportion of families of infants with circumcision related morbidity sought healthcare for acute morbidity compared to families of infants with acute illness. The findings from this study indicates that government and non-governmental organisations need to prioritise circumcision and improve awareness of this highly prevalent but potentially dangerous practice. Circumcision carries a triple burden of high prevalence, high morbidity load and poor care seeking. Community awareness of the burden, consequences and solutions needs to increase. This requires the involvement of community leaders and other stakeholders and include behaviour change communication strategies.

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**Contributors:** GT drafted the manuscript which was edited and reviewed by all the authors. KE, GT, KMc and NS designed the study. GT, KE, and MO were responsible for the study conduct. GT, KE, KMc and MO managed the database and designed the analysis plan. GT analysed the data.

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3 **Declaration of interests:** None exist  
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7 **Ethics approval and consent to participate:** Ethical approvals were obtained from Ghana  
8 Health Service Ethical Review Committee, the Institutional Ethics Committee of Kintampo  
9 Health Research Centre, the Research Ethics Committee of London School of Hygiene and  
10 Tropical Medicine, and the Human Research Ethics Committee of the University of Western  
11 Australia. Written informed consent was obtained from all the families of both the  
12 circumcised male infants and the Neovita trial infants.  
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22 **Availability of data and materials:** The dataset analysed during the current study available  
23 from the corresponding author on reasonable request and with permission of KE.  
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Table 1. Characteristics of families and infants who sought care for acute illness in the Neovita trial

Characteristics	Neovita study population n=22955	Neovita trial infants with acute illness n=6265 (27.3%)	Neovita trial infants with acute illness whose families sought care n=5520 (88.1%)
<b>Religion</b>			
Christian	15979	4314 (27.0%)	3820 (88.5%)
Muslim	5511	1566 (28.4%)	1357 (86.7%)
Traditional Africa/none	1465	385 (26.3%)	343 (89.1%)
Missing data	-	-	-
<b>Mother's highest educational level</b>			
None	7127	2009 (28.2%)	1752 (86.2%)
Primary	4236	1241 (29.3%)	1088 (87.7%)
Secondary	11578	3013 (26.0%)	2678 (88.9%)
Carer didn't know	14	2 (14.3%)	2
<b>Income status of household</b>			
1 (Lowest)	4510	1316 (29.2%)	1147 (87.2%)
2	4550	1297 (28.5%)	1147 (88.4%)
3	4583	1274 (27.8%)	1130 (88.7%)
4	4644	1212 (26.1%)	1063 (87.7%)
5 (Highest)	4668	1166 (25.0%)	1033 (88.6%)
Missing data	-	-	-
<b>Maternal age (years)</b>			
Less than 20	2646	760 (28.7%)	658 (86.6%)
20-29	12041	3269 (27.1%)	2900 (88.7%)
30 or more	8239	2228 (27.0%)	1954 (87.7%)
Carer didn't know	30	8 (26.7%)	8
<b>Site of delivery</b>			
Health facility	17 581	4775 (27.2%)	4213 (88.2%)
Home	5374	1490 (27.7%)	1307 (87.7%)
Missing data	-	-	-
<b>Distance to health facility</b>			
<1 km	13880	3657 (26.3%)	3234 (88.4%)
1 – 4.9 km	5285	1497 (28.3%)	1324 (88.4%)
5 – 10 km	2950	752 (25.5%)	646 (85.9%)
10 km or more	1197	359 (30.0%)	316 (88.0%)
Missing data	-	-	-
<b>Birth weight</b>			
Less than 2.5kg	3592	998 (27.8%)	867 (86.9%)
2.5kg or greater	19361	5267 (27.2%)	4653 (88.3%)
Missing data	-	-	-
<b>Sex</b>			
Male	11649	3296 (28.3%)	2931 (88.9%)
Female	11306	2969 (26.3%)	2589 (87.2%)

Table 2. Characteristics of families and infants who sought care for morbidity in the circumcision study

Characteristics	Circumcision study population n=3141	Circumcised infants n=2850* (90.7%)	Circumcised infants with morbidity n=230 (8.1%)	Circumcised infants with morbidity whose families sought care n=35 (15.0%)
<b>Religion</b>				
Christian	2234	2048 (91.7%)	172 (8.4%)	24 (14.0%)
Muslim	727	666 (91.6%)	49 (7.4%)	9 (18.4%)
Traditional Africa/none	171	129 (75.4%)	9 (7.0%)	2 (22.2%)
Missing data	9	7 (77.8%)	-	-
<b>Mother's highest educational level</b>				
None	601	512 (85.2%)	50 (9.8%)	6 (12.0%)
Primary	1619	1481 (91.5%)	127 (8.6%)	21 (16.5%)
Secondary	913	850 (93.1%)	53 (6.2%)	8 (15.1%)
Carer didn't know	8	7 (87.5%)	-	-
<b>Income status of household</b>				
1 (Lowest)	503	387 (76.9%)	28 (7.2%)	6 (21.4%)
2	608	532 (87.5%)	41 (7.7%)	4 (9.8%)
3	676	628 (92.9%)	47 (7.5%)	9 (19.1%)
4	725	687 (94.8%)	62 (9.0%)	8 (12.9%)
5 (Highest)	629	613 (97.5%)	52 (8.5%)	8 (15.4%)
Missing data	0	3 (0.1%)	-	-
<b>Maternal age (years)</b>				
Less than 20	360	319 (88.6%)	26 (8.2%)	3 (11.5%)
20-29	1603	1458 (91.0%)	130 (8.9%)	18 (13.8%)
30 or more	1170	1066 (91.1%)	74 (6.9%)	14 (18.9%)
Carer didn't know	8	7 (87.5%)	-	-
<b>Site of delivery</b>				
Health facility	2479	2292 (92.5%)	196 (8.6%)	28 (14.3%)
Home	650	549 (84.5%)	34 (6.2%)	7 (20.6%)
Missing data	12	6 (50.9%)	-	-
<b>Distance to health facility</b>				
<1 km	1545	1444 (93.5%)	110 (7.6%)	21 (19.1%)
1 – 4.9 km	801	741 (92.5%)	77 (10.4%)	7 (9.1%)
5 – 10 km	484	400 (82.6%)	27 (6.8%)	3 (11.1%)
10 km or more	231	186 (80.5%)	14 (7.5%)	3 (21.4%)
Missing data	80	76 (95.0%)	2 (2.6%)	1 (50.1%)
<b>Birth weight</b>				
Less than 2.5kg	255	214 (83.9%)	21 (9.1%)	1 (4.8%)
2.5kg or greater	2886	2633 (91.2%)	209 (7.9%)	34 (16.3%)
Missing data	0	-	-	-

\*Three circumcised infants had no socioeconomic and demographic data due to field worker error

Table 3. Predictors of care seeking behaviour in the Neovita trial population

Characteristics	Neovita study population n=22955	Neovita trial infants with acute illness n=6265 (27.3%)	Neovita trial infants whose families sought care n=5520 (88.1%)	Unadjusted Odds ratio (OR)	p-value	Adjusted Odds ratio (aOR)*	p-value
<b>Religion</b>							
Christian	15979	4314 (27.0%)	3820 (88.5%)	1.00	0.121	1.00	0.195
Muslim	5511	1566 (28.4%)	1357 (86.7%)	0.84 (0.70, 1.00)		0.86 (0.72, 1.03)	
Traditional Africa/none	1465	385 (26.3%)	343 (89.1%)	1.06 (0.76, 1.47)		1.10 (0.79, 1.55)	
Missing data	-	-	-				
<b>Mother's highest educational level</b>							
None	7127	2009 (28.2%)	1752 (86.2%)	0.89 (0.73, 1.09)		0.89 (0.72, 1.10)	
Primary	4236	1241 (29.3%)	1088 (87.7%)	0.85 (0.72, 1.01)		0.84 (0.69, 1.03)	
Secondary	11578	3013 (26.0%)	2678 (88.9%)	1.00	0.174	1.00	0.260
Carer didn't know	14	2 (14.3%)	2	-			
<b>Income status of household</b>							
1 (Lowest)	4510	1316 (29.2%)	1147 (86.6%)	0.87 (0.69, 1.11)		1.00 (0.75, 1.33)	
2	4550	1297 (28.5%)	1147 (86.4%)	0.98 (0.77, 1.26)		1.07 (0.82, 1.39)	
3	4583	1274 (27.8%)	1130 (88.7%)	1.01 (0.79, 1.30)		1.08 (0.83, 1.39)	
4	4644	1212 (26.1%)	1063 (87.7%)	0.92 (0.72, 1.18)		0.95 (0.74, 1.22)	
5 (Highest)	4668	1166 (25.0%)	1033 (88.6%)	1.00	0.714	1.00	0.848
Missing data	-	-	-				
<b>Maternal age (years)</b>							
Less than 20	2646	760 (28.7%)	658 (86.6%)	1.00	0.208	1.00	0.131
20-29	12041	3269 (27.1%)	2900 (88.7%)	1.22 (0.96, 1.54)		1.23 (0.97, 1.57)	
30 or more	8239	2228 (27.0%)	1954 (87.7%)	1.11 (0.87, 1.41)		1.15 (0.89, 1.48)	
Carer didn't know	30	8 (26.7%)	8	-			
<b>Site of delivery</b>							
Health facility	17 581	4775 (27.2%)	4213 (88.2%)	1.00	0.595	1.00	0.886
Home	5374	1490 (27.7%)	1307 (87.7%)	0.95 (0.80, 1.14)		1.01 (0.83, 1.24)	
Missing data	-	-	-				
<b>Distance to health facility</b>							
<1 km	13880	3657 (26.3%)	3234 (88.4%)	1.00	0.278	1.00	0.369
1 – 4.9 km	5285	1497 (28.3%)	1324 (88.4%)	1.00 (0.83, 1.21)		0.99 (1.82, 1.20)	
5 – 10 km	2950	752 (25.5%)	646 (85.9%)	0.80 (0.63, 1.00)		0.80 (0.62, 1.03)	
10 km or more	1197	359 (30.0%)	316 (88.0%)	0.96 (0.69, 1.34)		0.96 (0.68, 1.37)	
Missing data	-	-	-				
<b>Birth weight</b>							
Less than 2.5kg	3592	998 (27.8%)	867 (86.9%)	0.87 (0.71, 1.07)		0.89 (0.72, 1.09)	
2.5kg or greater	19361	5267 (27.2%)	4653 (88.3%)	1.00	0.194	1.00	0.260
Missing data	-	-	-				
<b>Sex</b>							
Male	11649	3296 (28.3%)	2931 (88.9%)	1.00	0.035	1.00	0.039
Female	11306	2969 (26.3%)	2589 (87.2%)	0.84 (0.73, 0.99)		0.85 (0.73, 0.99)	

\*Adjusted for religion, maternal education, distance to health facility, site of delivery and sex.

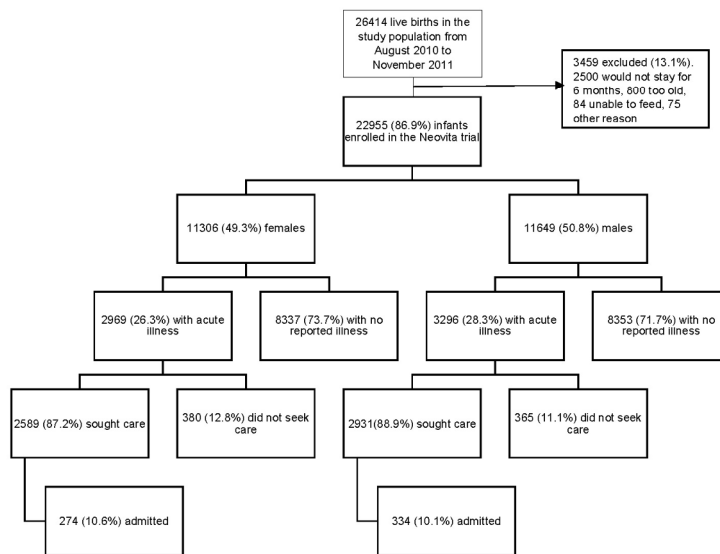
Table 4. Type of health care provider for circumcision-related morbidity

Characteristics	Circumcised infants whose families sought care n=35	Type of healthcare provider for circumcision morbidity	
		Formal provider 24 (68.6%)	Informal provider* 11 (31.4%)
<b>Religion</b>			
Christian	24	17 (70.8%)	7 (29.2%)
Muslim	9	6 (66.7%)	3 (33.3%)
Traditional Africa/none	2	1 (50.0%)	1 (50.0%)
Missing data	-	-	-
<b>Mother's highest educational level</b>			
None	6	2 (33.3%)	4 (66.7%)
Primary	21	15 (71.4%)	6 (28.6%)
Secondary	8	7 (87.5%)	1 (12.5%)
Carer didn't know	-	-	-
<b>Income status of household</b>			
1 (Lowest)	6	2 (33.3%)	4 (66.7%)
2	4	2 (50.0%)	2 (50.0%)
3	9	7 (77.8%)	2 (22.2%)
4	8	7 (87.5%)	1 (12.5%)
5 (Highest)	8	6 (75.0%)	2 (25.0%)
Missing data	-	-	-
<b>Maternal age (years)</b>			
Less than 20	3	3	-
20-29	18	11 (61.1%)	7 (38.9%)
30 or more	14	10 (71.4%)	4 (28.6%)
Carer didn't know	-	-	-
<b>Site of delivery</b>			
Health facility	28	22 (78.6%)	6 (21.4%)
Home	7	2 (28.6%)	5 (71.4%)
Missing data	-	-	-
<b>Distance to health facility</b>			
<1 km	21	18 (85.7%)	3 (14.3%)
1 – 4.9 km	7	3 (42.9%)	4 (57.1%)
5 – 10 km	3	1 (33.3%)	2 (66.7%)
10 km or more	3	1 (33.3%)	2 (66.7%)
Missing data	1	1	-
<b>Type of circumcision provider</b>			
Formal provider	15	13 (86.7%)	2 (13.3%)
Informal provider	20	11 (55.0%)	9 (45.0%)
Missing data	0	-	-
<b>Birth weight</b>			
Less than 2.5kg	1	-	1 (100.0%)
2.5kg or greater	34	24 (70.6%)	10 (29.4%)
Missing data	-	-	-

\* Informal care provider included; drug sellers, traditional healers and religious leaders

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Figure 1

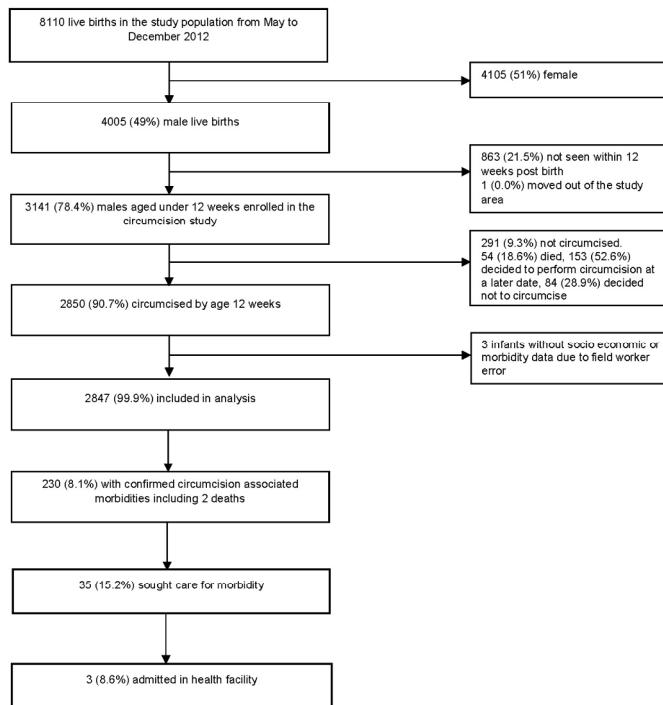


Flow diagram for live births from August 2010 to November 2011 included in the Neovita study

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Figure 2



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Flow diagram for live births from May 2012 to December 2012 included in the circumcision study

140x198mm (300 x 300 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4 & 5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5 & 6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6 & 7
Bias	9	Describe any efforts to address potential sources of bias	9
Study size	10	Explain how the study size was arrived at	9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	9
		(b) Describe any methods used to examine subgroups and interactions	NA
		(c) Explain how missing data were addressed	NA
		(d) If applicable, describe analytical methods taking account of sampling strategy	NA
		(e) Describe any sensitivity analyses	NA
<b>Results</b>			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9 & 10
		(b) Give reasons for non-participation at each stage	9 & 10
		(c) Consider use of a flow diagram	9, 10 and attached as separate document
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9 & 10
		(b) Indicate number of participants with missing data for each variable of interest	10
Outcome data	15*	Report numbers of outcome events or summary measures	9, 10 & 11
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10, 11 & 12
		(b) Report category boundaries when continuous variables were categorized	9, 10 & 11
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	16
Generalisability	21	Discuss the generalisability (external validity) of the study results	16
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).