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Healthcare seeking patterns of families of infants with circumcision related morbidities 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 16th August 2010 to 7th November 2011 and 3141 infants in a circumcision study from 21st May 2012 to 31st 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[1] and much of West Africa[2]. We reported a concerning high risk of circumcision related morbidity (8.1%), following infant male circumcision in our community-based study in rural Ghana[1]. 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[1].

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[3-5]. 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[6,7]. 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[8]. Another Ghanaian study identified poverty and personal preferences as key determinants of poor care seeking behaviour by families of infants with illness[9]. 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[10]. Distance to health facility, health provider attitude and

inadequate supplies have also been reported as key determinants of delayed care seeking for malaria cases in infants in sub-Saharan African populations[11]. However, it appears that there have been no studies which have compared health seeking behaviour between families of infants with circumcision related morbidities and families of infants with acute illness that are not circumcision related.

The overall aim of this study was to assess healthcare seeking patterns of families of infants with circumcision related morbidities and families of infants with other acute illnesses in rural Ghana. The primary objective was to investigate whether there were differences in the healthcare seeking patterns of families of infants with circumcision related problems, including infants who died, and families of infants with acute illness. The secondary objective was to assess the factors that influence care seeking patterns of families in the study area.

Methods

Study design and setting

Data were analysed from two separate cohort studies in the same part of the Brong Ahafo Region of central Ghana. The first was nested within a large population based trial of newborn vitamin A supplementation (Neovita trial) which was conducted from 16th August 2010 to 7th November 2011 and included 22,955 mother infant pairs, full details have been published previously[12]. The second was a circumcision study conducted between 21st May 2012 and December 31st 2012 in the same study area. This was implemented to obtain additional observational data on births, cause specific mortality and circumcision related morbidity in the study area. Over the period from 2010 to 2012, 80% of the study population

lived in rural settlements and 20% of mothers had no primary school education. Four major district hospitals and over 80 small health facilities provided health care services to the population. There were 30 doctors and 44 other formal health service providers (medical assistants and nurses) providing curative services in the four district hospitals at the time of the circumcision study. There were also approximately 120 informal care providers such as drug sellers, traditional healers and religious leaders in the study area.

Data collection

For the Neovita study, from Aug 2010 to Nov 2011, all births in the study area were reported to the trial team via a network of fieldworkers and key informants. Fieldworkers visited all families at home between two hours and two days after birth and interviewed the mother of the infant or the primary care giver. Fieldworkers weighed the baby and asked the mother or the primary care giver about: date of birth, site of birth, current address, distance to health facilities, socio-demographic characteristics and socio-economic information (using an asset index). At the monthly surveillance visits, the families were asked by fieldworkers for detailed information on; infant illness including start and end dates; and healthcare seeking during infant illness. Due to time constraints families were not asked exactly who they sought care from. The fieldworkers also asked the families who sought healthcare whether the infant was admitted to hospital. The fieldworkers next reviewed infant health records and checked for consistency with family's report. The fieldworkers also collected data on the vital status of the baby (including if the baby was alive, dead or hospitalised).

The circumcision study included all male liveborn infants who were born in the study population from May to Dec 2012 and were aged under 12 weeks. Follow-up visits were scheduled between eight to eleven weeks post birth and trained senior fieldworkers asked for

consent to collect additional detailed data on: age at circumcision, site of circumcision and type of circumcision provider. The fieldworkers asked about circumcision morbidities and whether these morbidities had been confirmed by a trained health professional. Families were also asked if they sought care for circumcision related morbidities and if they had been given advice about potential problems or careseeking. The fieldworkers also asked detailed information on the following; site of healthcare; type of healthcare provider; medicines prescribed; admissions; and surgery. Consent to access the baby's Neovita data including socioeconomic, demographic and care seeking was obtained.

In both studies the fieldworkers were trained for two weeks in all study procedures prior to the commencement of the study. Interrater reliability was checked between all fieldworkers. During the study fieldworkers had scheduled and unscheduled supervisory visits from the study coordinator to assess data quality and consistency. The fieldworkers used standardised paper based data collection tools (including a standardised list of closed ended questions) for all interviews.

Study definitions and categories

We defined a *formal health care service* as medical care provided at hospitals, clinics or health posts by professionally trained, licensed and regulated providers of medical services including; doctors, medical assistants, nurses or pharmacists. An *informal health care service* was defined as care provided by untrained, unlicensed, unregulated private provider of care services including: drug sellers, traditional healers and religious leaders. *Circumcision morbidities* were defined as complications occurring during or after the circumcision procedure as reported by the primary caregiver. An *acute illness* was defined as illness or injury other than circumcision related complications such as malaria, sepsis, acute respiratory

tract infection, diarrhea[13,14]. A *formal circumcision provider* referred to professionally trained, licensed and regulated providers of medical services. This included: doctors, medical assistants, or nurses. An *informal circumcision provider* was an untrained, unlicensed, unregulated private provider of medical services including: drug sellers, domestic staff, family members and Wanzams (village based traditional circumcision providers).

Outcome

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

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 *apriori* 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 16th August 2010 to 7th 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 4510 (19.7%) of the mothers were in the lowest socio-economic quintile, 17581 (76.6%) delivered in a health facility and 7127 (31.1%) had no primary education (Table 1).

From 21st May to 31st December 2012, 3141 male infants were recruited in the circumcision study (Figure 2). Overall, 2850 (90.7%) of these infants were circumcised. We excluded three babies (0.1%) who had no socio-economic or demographic data. A total of 503 (16.0%) of mothers were in the lowest income quintile; 2479 (78.9%) delivered in a facility and 601 (19.1%) had no primary education (Table 2).

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

infants with circumcision related morbidities sought care and 3 (8.6%) were admitted to hospital (Figure 2 and Table 2).

The proportion of mothers aged less than 20 years who sought care for their infants with circumcision related morbidity (3, [11.5%]) was slightly lower than mothers aged 30 years or more (14, [18.9%]). Healthcare seeking of mothers of infants with low birth weight was lower (1, [4.8%]) than mothers of infants with normal birth weight though the total numbers were small (34, [16.3%]) (Table 2). There were no other obvious determinants of careseeking for circumcision related morbidity.

Type of provider

In the circumcision study, of the 35 families of infants who sought care for circumcision related morbidity, 20 (57.1%) infants were circumcised by an informal provider and 15 (42.9%) by a formal provider (Table 4). Most families of infants circumcised by a formal provider also sought care from a formal provider for complications (13, 87.7%). In contrast, only 45% (9) families of infants circumcised by an informal provider also sought healthcare for circumcision related morbidity from an informal healthcare provider (Table 4).

A similar proportion of mothers in the lowest income quintile (4, [66.7%]) sought healthcare for circumcision related morbidity from an informal care provider compared to mothers in the highest income quintile (2, [25.0%]), however numbers were low in this analysis (Table 4). A greater proportion of mothers who delivered their infants at home (5, [71.4%] sought healthcare for circumcision related morbidity from an informal care provider compared to

mothers with health facility births (6, [21.4%]). The proportion of mothers who lived ten km or more from a health facility (2, [66.7%]) who sought healthcare for circumcision related morbidity from an informal care provider was higher than those who lived within one km from a health facility (3, [14.3%]). There were no data on type of health care provider available from the Neovita trial population.

Discussion

There appeared to be substantial differences in healthcare seeking in families with infants experiencing circumcision related morbidities and those with other acute illnesses in the Brong Ahafo Region of central rural Ghana. A much lower proportion (15.2%) of families of infants with circumcision related morbidities sought healthcare compared to families who had an infant with an acute illness in the larger Neovita population (88.1%). However, the proportion of hospital admissions in infants of families who sought health care was almost the same (11% in the Neovita study and 9% in the circumcision study). There was some indication that mothers of low birth weight infants had poorer careseeking for circumcision related morbidities than mothers of infants with normal birth weight infants. There were no other clear determinants of healthcare seeking for acute illnesses or circumcision related morbidities in our study populations.

A study conducted in Nigeria also reported lower healthcare seeking by families of male infants with circumcision related morbidities compared to infants with other health problems[15]. Other studies have suggested that poor care seeking behaviour after circumcision can be due to family expectations that complications will heal without any intervention[15,16],

poor recognition of illness [5,17,18], poor recognition of severity of illness[5,19-21], and beliefs that some infant illnesses are not meant to be treated in hospitals[3,5].

Interestingly, the proportion of hospital admissions post care seeking was almost the same in the Neovita and circumcision populations (11% of infants with acute morbidities whose families sought care were hospitalised and 9% of infants with circumcision related morbidities whose families sought health care were also hospitalised). This indicates that families may not be seeking care for many circumcised infants in our study area with morbidities that do require hospital admission and specialised hospital care. Overall, hospital admission rates were similar to a recently published study from Ghana that reported rates of 9 to 18%[22].

The determinants of careseeking for acute illness have been reported in low and middle income countries[5,23,24]. However, few studies have reported population-based data on the care seeking patterns of families with infants who experience circumcision related morbidities and acute illness. There was some indication that mothers of low birth weight infants had poorer careseeking for circumcision related morbidities (5%) than mothers of infants with normal birth weight infants (16%) though numbers were small. These findings are similar to other studies that reported poor careseeking for acute illness[25] and vaccination[26] in families of low birth weight infants. We found no evidence that other socioeconomic and demographic factors influence families careseeking behaviour for circumcision related morbidity and acute illness in our population. These findings contrast with that of other earlier studies from Ghana[5,22,26,27] and Bangladesh[28] that reported higher care seeking for infants with acute

illness by richer families, and mothers with higher educational levels. This indicates that health care seeking behaviour for acute illness may be improving over time in rural Ghana.

Overall, we found that more families sought care for a circumcision related morbidity from formal (68.6%) than informal (13.4%) healthcare providers. Unsurprisingly, most families of infants circumcised by a formal provider also sought care from a formal provider for complications. However, fewer families of infants circumcised by an informal provider sought care from an informal provider (45%) than an formal provider (55%). These findings differ from another published study from Kenya[16] which reported families of male infants who were circumcised by an informal provider were two fold less likely to seek care for a circumcision related morbidity from a formal healthcare provider[16]. We were not able to assess the type of care provider for acute illness in the Neovita study as these data were not collected in the Neovita study.

Generally, healthcare seeking for acute illness in the Neovita study population was very high (88.1%). The proportion of families seeking health care in our study was higher than data reported by the Ghana Demographic and Health Survey in 2008, close to the time of conducting the Neovita study (acute respiratory infection 51.0%, fever 51.0%, and diarrhoea 35.2%)[29]. Careseeking for acute illness in rural populations has also been reported to be around 61% in Kenya[21], 47% in Nigeria[30] and 27% in Vietnam[31]. The high healthcare seeking patterns for acute illnesses seen in our study population may be due to recent communications and promotion of care seeking by the local government district health management teams. However, that these communications do not appear to have influenced careseeking for circumcision related morbidities to date.

The most important limitation to our study 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 22,955 infants in the community level population based Neovita cohort. Another limitation was our use of family level recall of health service utilisation which could have led to some episodes of care seeking being under reported in the circumcised cohort. However, both families and data collectors were blinded to the study hypothesis and our trained fieldworkers reviewed infant health records and checked for consistency with a family's report.

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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Declaration of interests: None exist

Ethics approval and consent to participate: Ethical approvals were obtained from Ghana Health Service Ethical Review Committee, the Institutional Ethics Committee of Kintampo 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 from the corresponding author on reasonable request and with permission of KE.

REFERENCES

1. Gyan, Thomas, et al. "Determinants of morbidity associated with infant male circumcision: community-level population-based study in rural Ghana." *Tropical medicine & international health*; 2017; 22 (3): 312-322.
2. Weiss H, Larke N, Halperin D, Schenker I. Neonatal and child male circumcision: a global review. *UNAIDS Technical Bulletin. UNAIDS,* Geneva Switzerland, 2010.
3. Okyere E, Tawiah-Agyemang C, Manu A, Deganus S, Kirkwood B, Hill Z. Newborn care: the effect of a traditional illness, asram, in Ghana. *Annals of Tropical Paediatrics: International Child Health* 2010; **30**(4): 321-8.

4. Hill Z, Manu A, Tawiah-Agyemang C, et al. How did formative research inform the development of a home-based neonatal care intervention in rural Ghana&quest. *Journal of Perinatology* 2008; **28**: S38-S45.
5. Hill Z, Kendall C, Arthur P, Kirkwood B, Adjei E. Recognizing childhood illnesses and their traditional explanations: exploring options for care-seeking interventions in the context of the IMCI strategy in rural Ghana. *Tropical Medicine & International Health* 2003; **8**(7): 668-76.
6. Manu AA, ten Asbroek A, Soremekun S, et al. Evaluating the implementation of community volunteer assessment and referral of sick babies: lessons learned from the Ghana Newhints home visits cluster randomized controlled trial. *Health Policy and Planning* 2014; **29**(suppl 2): ii114-ii27.
7. Rutherford ME, Mulholland K, Hill PC. How access to health care relates to under-five mortality in sub-Saharan Africa: systematic review. *Tropical Medicine & International Health* 2010; **15**(5): 508-19.
8. Okawa S, Ansah EK, Nanishi K, et al. High Incidence of Neonatal Danger Signs and Its Implications for Postnatal Care in Ghana: A Cross-Sectional Study. *PloS One* 2015; **10**(6): e0130712.
9. Bazzano AN, Kirkwood BR, Tawiah-Agyemang C, Owusu-Agyei S, Adongo PB. Beyond symptom recognition: care-seeking for ill newborns in rural Ghana. *Tropical Medicine & International Health* 2008; **13**(1): 123-8.
10. Beiersmann C, Sanou A, Wladarsch E, De Allegri M, Kouyaté B, Müller O. Malaria in rural Burkina Faso: local illness concepts, patterns of traditional treatment and influence on health-seeking behaviour. *Malaria Journal* 2007; **6**(1): 1.
11. Ahorlu CK, Koram KA, Ahorlu C, De Savigny D, Weiss MG. Socio-cultural determinants of treatment delay for childhood malaria in southern Ghana. *Tropical Medicine & International Health* 2006; **11**(7): 1022-31.
12. Edmond KM, Newton S, Shannon C, et al. Effect of early neonatal vitamin A supplementation on mortality during infancy in Ghana (Neovita): a randomised, double-blind, placebo-controlled trial. *The Lancet* 2015; **385**(9975): 1315-23.
13. Lambrechts T, Bryce J, Orinda V. Integrated management of childhood illness: a summary of first experiences. *Bulletin of the World Health Organization* 1999; **77**(7): 582.
14. Gove S. Integrated management of childhood illness by outpatient health workers: technical basis and overview. The WHO Working Group on Guidelines for Integrated Management of the Sick Child. *Bulletin of the World Health Organization* 1997; **75**(Suppl 1): 7.
15. Osifo OD, Oriaifo IA. Circumcision mishaps in Nigerian children. *Annals of African Medicine* 2009; **8**(4): 266.
16. Bailey RC, Egesah O, Rosenberg S. Male circumcision for HIV prevention: a prospective study of complications in clinical and traditional settings in Bungoma, Kenya. *Bulletin of the World Health Organization* 2008; **86**(9): 669-77.
17. Geldsetzer P, Williams TC, Kirolos A, et al. The recognition of and care seeking behaviour for childhood illness in developing countries: a systematic review. *PloS One* 2014; **9**(4): e93427.
18. Nabiwemba EL, Atuyambe L, Criel B, Kolsteren P, Orach CG. Recognition and home care of low birth weight neonates: a qualitative study of knowledge, beliefs and practices of mothers in Iganga-Mayuge Health and Demographic Surveillance Site, Uganda. *BMC Public Health* 2014; **14**(1): 546.
19. Paudel M. Male circumcision: care practices and attitudes in a Muslim community of western Nepal. *Italian Journal of Public Health* 2012; **8**(1).

20. Muula AS, Prozesky HW, Mataya RH, Ikechebelu JI. Prevalence of complications of male circumcision in Anglophone Africa: a systematic review. *BMC Urology* 2007; **7**(1): 4.
21. Taffa N, Chepngeno G. Determinants of health care seeking for childhood illnesses in Nairobi slums. *Tropical Medicine & International Health* 2005; **10**(3): 240-5.
22. Manu A, Hill Z, ten Asbroek AHA, et al. Increasing access to care for sick newborns: evidence from the Ghana Newhints cluster-randomised controlled trial. *BMJ Open* 2016; **6**(6): e008107.
23. Colvin CJ, Smith HJ, Swartz A, et al. Understanding careseeking for child illness in sub-Saharan Africa: a systematic review and conceptual framework based on qualitative research of household recognition and response to child diarrhoea, pneumonia and malaria. *Social Science & Medicine* 2013; **86**: 66-78.
24. Mohan P, Iyengar SD, Martines J, Cousens S, Sen K. Impact of counselling on careseeking behaviour in families with sick children: cluster randomised trial in rural India. *BMJ* 2004; **329**(7460): 266.
25.O'Leary M., Edmond K., Floyd S., Newton S., Gyan T. & Thomas L. S. A cohort study of low birth weight and health outcomes in the first year of life, Ghana. Bulletin of the World Health Organization 2017; In Press.
26. O'Leary M, Edmond K, Floyd S, et al. Neonatal vaccination of low birthweight infants in Ghana. *Archives of Disease in Childhood* 2016: archdischild 2016-311227.
27. Kirkwood BR, Manu A, ten Asbroek AHA, et al. Effect of the Newhints home-visits intervention on neonatal mortality rate and care practices in Ghana: a cluster randomised controlled trial. *The Lancet* 2013; **381**(9884): 2184-92.
28. Shah R, Mullany LC, Darmstadt GL, et al. Determinants and pattern of care seeking for preterm newborns in a rural Bangladeshi cohort. *BMC Health Services Research* 2014; **14**(1): 417.
29. Ghana Statistical Service (GSS), Ghana Health Service (GHS), and ICF Macro. 2009. Ghana Demographic and Health Survey 2008. Accra, Ghana: GSS, GHS, and ICF Macro.
30. National Population Commission (NPC) [Nigeria] and ICF Macro. 2009. Nigeria Demographic and Health Survey 2008. Abuja, Nigeria: National Population Commission and ICF Macro. .
31. Lee H-Y, Van Huy N, Choi S. Determinants of early childhood morbidity and proper treatment responses in Vietnam: results from the Multiple Indicator Cluster Surveys, 2000–2011. *Global Health Action* 2016; **9**.

Figure 1. Flow diagram for live births from Aug 2010 to Nov 2011 included in the Neovita study

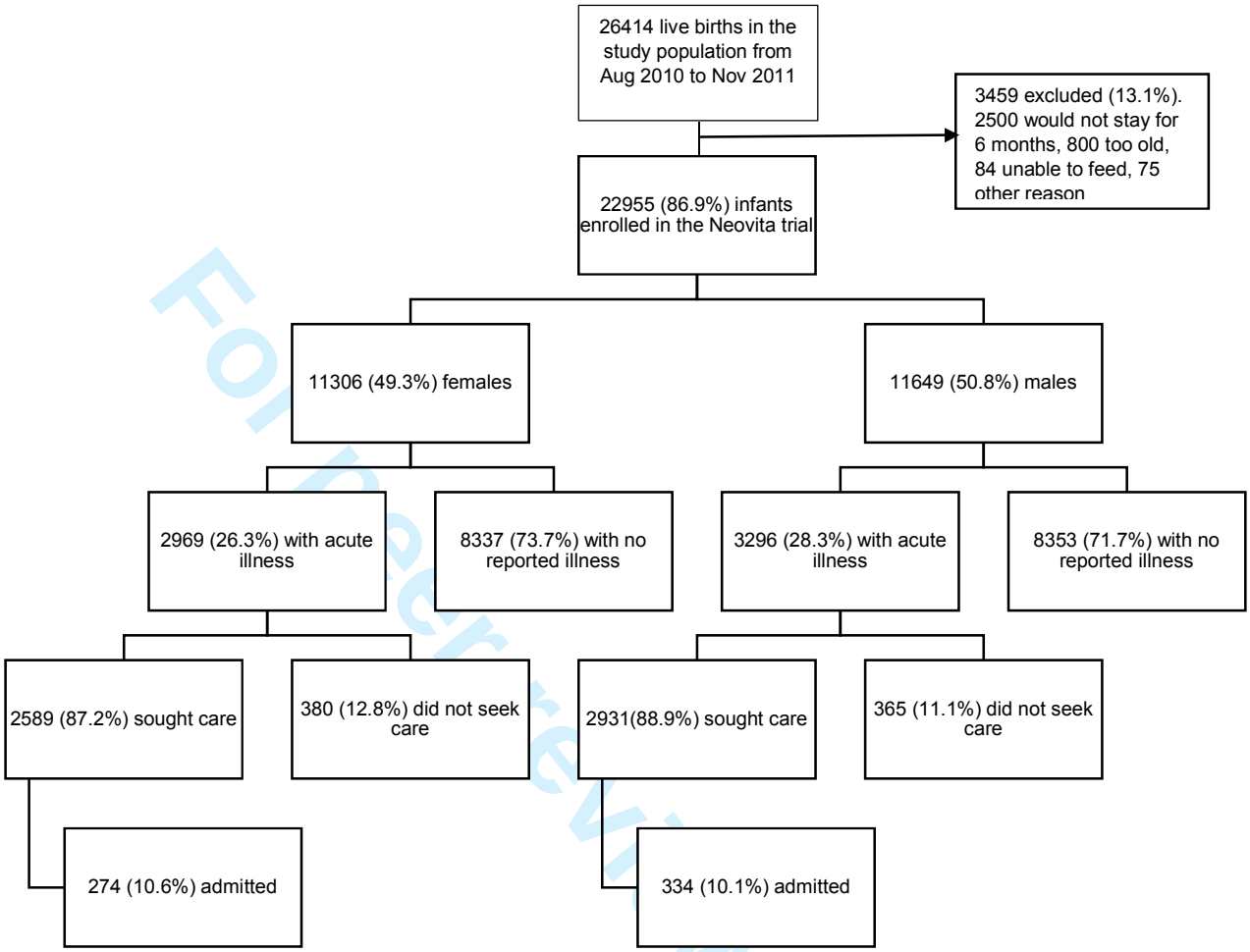

Figure 2. Flow diagram for live births from May 2012 to Dec 2012 included in the circumcision study

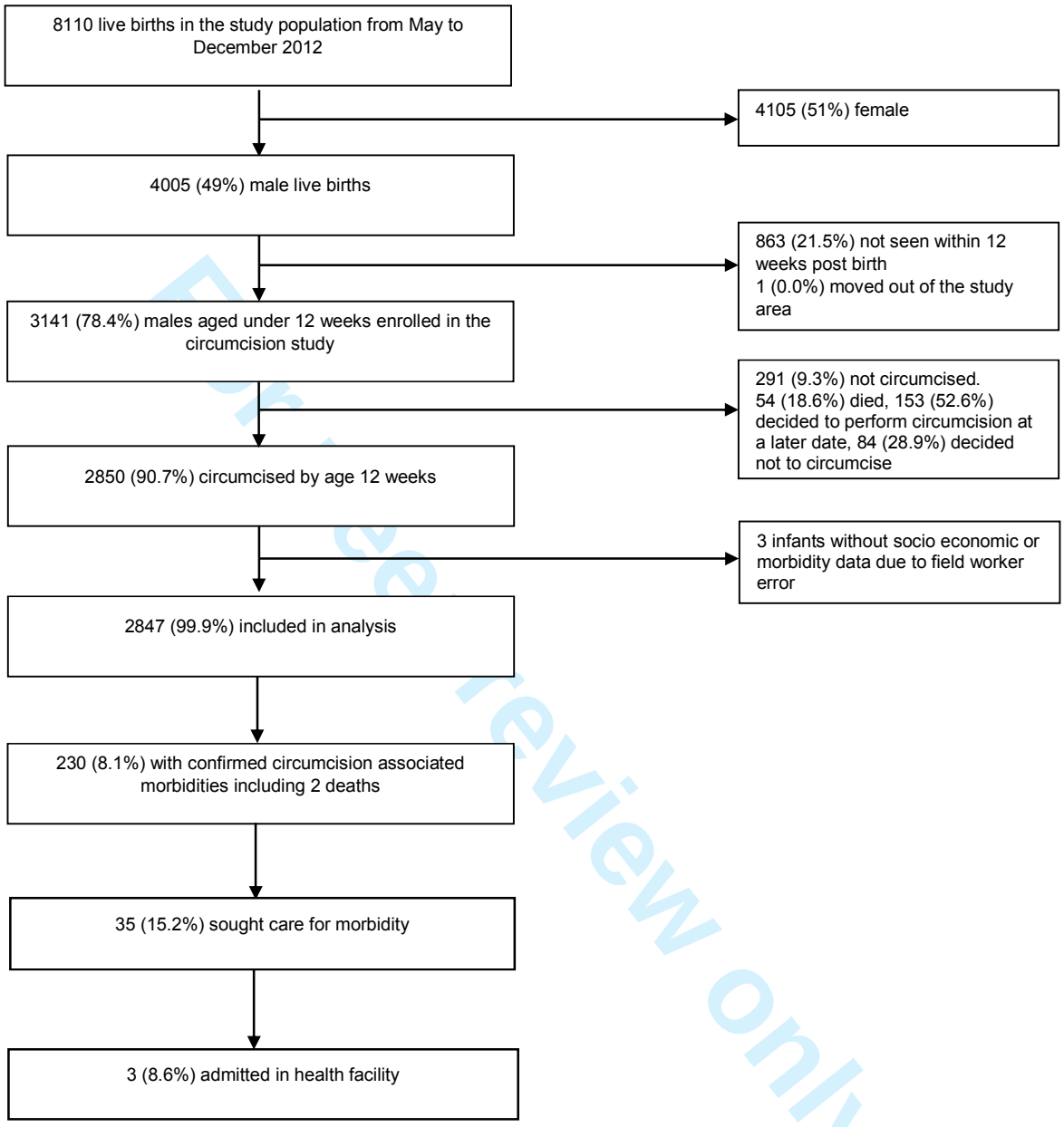

Table 1. Characteristics of families and infants who sought care for acute illness in the Neovita trial

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%)
Religion				
	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	-	-	-
Mother's highest educational level				
	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
Income status of household				
	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	-	-	-
Maternal age (years)				
	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
Site of delivery				
	Health facility	17 581	4775 (27.2%)	4213 (88.2%)
	Home	5374	1490 (27.7%)	1307 (87.7%)
	Missing data	-	-	
Distance to health facility				
	<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	-	-	-
Birth weight				
	Less than 2.5kg	3592	998 (27.8%)	867 (86.9%)
	2.5kg or greater	19361	5267 (27.2%)	4653 (88.3%)
	Missing data	-	-	-
Sex				
	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	Circumcised infants	Circumcised infants with morbidity	Circumcised infants with morbidity whose families sought care
		n=3141	n=2850* (90.7%)	n=230 (8.1%)	n=35 (15.0%)
Religion					
	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%)	-	-
Mother's highest educational level					
	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%)	-	-
Income status of household					
	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%)	-	-
Maternal age (years)					
	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%)	-	-
Site of delivery					
	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%)	-	-
Distance to health facility					
	<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%)
Birth weight		-			
	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
Religion							
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	-	-					
Mother's highest educational level							
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	-			
Income status of household							
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	-	-	-				
Maternal age (years)							
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	-			
Site of delivery							
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	-						
Distance to health facility							
<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	-	-	-	-		-	
Birth weight							
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	-	-	-				
Sex							
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	Type of healthcare provider for circumcision morbidity	
		n=35	Formal provider 24 (68.6%)	Informal provider* 11 (31.4%)
Religion				
	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	-	-	-
Mother's highest educational level				
	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	-	-	-
Income status of household				
	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	-	-	-
Maternal age (years)				
	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	-	-	-
Site of delivery				
	Health facility	28	22 (78.6%)	6 (21.4%)
	Home	7	2 (28.6%)	5 (71.4%)
	Missing data	-	-	-
Distance to health facility				
	<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	-
Type of circumcision provider				
	Formal provider	15	13 (86.7%)	2 (13.3%)
	Informal provider	20	11 (55.0%)	9 (45.0%)
	Missing data	0	-	-
Birth weight				
	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
Introduction			
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
Methods			
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
Results			

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
Discussion			
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
Other information			
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.

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

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Healthcare seeking patterns of families of infants with circumcision-related morbidities 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 16th August 2010 to 7th November 2011 and 3141 infants in a circumcision study from 21st May 2012 to 31st 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[1] and much of West Africa[2]. We reported a concerning high risk of circumcision related morbidity (8.1%), following infant male circumcision in our community-based study in rural Ghana[1]. 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[1].

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[3-5]. 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[6,7]. 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[8]. Another Ghanaian study identified poverty and personal preferences as key determinants of poor care seeking behaviour by families of infants with illness[9]. 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[10]. Distance to health facility, health provider attitude and

inadequate supplies have also been reported as key determinants of delayed care seeking for malaria cases in infants in sub-Saharan African populations[11]. However, it appears that there have been no studies which have compared health seeking behaviour between families of infants with circumcision related morbidities and families of infants with acute illnesses that are not circumcision related.

The overall aim of this study was to assess healthcare seeking patterns of families of infants with circumcision related morbidities and families of infants with other acute illnesses in rural Ghana. The primary objective was to investigate whether there were differences in the healthcare seeking patterns of families of infants with circumcision related problems, including infants who died, and families of infants with acute illnesses. The secondary objective was to assess the factors that influence care seeking patterns of families in the study area.

Methods

Study design and setting

Data from two separate cohort studies in the same part of the Brong Ahafo Region of central Ghana were analysed separately and compared descriptively. The larger of the two cohorts includes data from a population based trial of newborn vitamin A supplementation (Neovita trial), conducted between 16th August 2010 to 7th November 2011 and involving 22,955 mother infant pairs; full details have been published previously[2]. The smaller cohort was conducted between 21st May 2012 and December 31st 2012 and focused on circumcision. This was implemented to obtain additional observational data on births, cause specific mortality and circumcision related morbidity in the study area. Over the period from 2010 to

2012, 80% of the study population lived in rural settlements and 20% of mothers had no primary school education. Four major district hospitals and over 80 small health facilities provided health care services to the population. There were 30 doctors and 44 other formal health service providers (medical assistants and nurses) providing curative services in the four district hospitals at the time of the circumcision study. There were also approximately 120 informal care providers such as drug sellers, traditional healers and religious leaders in the study area.

Data collection

For the Neovita study, from August 2010 to November 2011, all births in the study area were reported to the trial team via a network of fieldworkers. Fieldworkers visited all families at home between two hours and two days after birth and interviewed the mother of the infant or the primary care giver. Fieldworkers weighed the baby and asked the mother or the primary care giver about: date of birth, site of birth, current address, distance to health facilities, socio-demographic characteristics and socio-economic information (using an asset index). At the monthly surveillance visits, the families were asked by fieldworkers for detailed information on; infant illness including start and end dates; and healthcare seeking during infant illness. Due to time constraints families were not asked exactly who they sought care from. The fieldworkers also asked the families who sought healthcare whether the infant was admitted to hospital. The fieldworkers next reviewed infant health records and checked for consistency with family's report. The fieldworkers also collected data on the vital status of the baby (including if the baby was alive, dead or hospitalised).

The circumcision study included all male liveborn infants who were born in the study population from May to December 2012 and were aged under 12 weeks. Follow-up visits

were scheduled between eight to eleven weeks post birth and trained senior fieldworkers asked for consent to collect additional detailed data on: age at circumcision, site of circumcision and type of circumcision provider. The fieldworkers asked about circumcision morbidities and whether these morbidities had been confirmed by a trained health professional. Families were also asked if they sought care for circumcision related morbidities and if they had been given advice about potential problems or careseeking. The fieldworkers also asked detailed information on the following; site of healthcare; type of healthcare provider; medicines prescribed; admissions; and surgery. Consent to access the baby's Neovita data including socioeconomic, demographic and care seeking was obtained.

In both studies the fieldworkers were trained for two weeks in all study procedures prior to the commencement of the study. Interrater reliability was checked between all fieldworkers. We did not perform statistical evaluation of agreements between the fieldworkers and the study coordinator (GT). However, each fieldworker was supervised during 2 visits per month as part of the study scheduled and unscheduled supervisory visits. During these visits, GT and field supervisors observed the fieldworker interviewing mothers, and examined infants and recorded findings independently. Recorded data were compared between the fieldworker and GT/field supervisor and used to provide feedback after the home visits and at weekly fieldworker meetings. The fieldworkers used standardised paper based data collection tools (including a standardised list of closed ended questions) for all interviews.

Study definitions

We defined a *formal health care service* as medical care provided at hospitals, clinics or health posts by professionally trained, licensed and regulated providers of medical services including; doctors, medical assistants, nurses or pharmacists. An *informal health care*

service was defined as care provided by untrained, unlicensed, unregulated private provider of care services including: drug sellers, traditional healers and religious leaders. *Circumcision related morbidities* were defined as complications occurring during or after the circumcision procedure as reported by the primary caregiver including; excess skin removal or incision, excess bleeding, inadequate skin removal, infection, abnormal stream of urine, glans amputation, ulcer[1]. A*cute illnesses* were defined as illnesses or injuries other than circumcision related complications such as malaria, sepsis, acute respiratory tract infection **or** diarrhoea[13,14]. A *formal circumcision provider* referred to professionally trained, licensed and regulated providers of medical services. This included: doctors, medical assistants, or nurses. An *informal circumcision provider* was an untrained, unlicensed, unregulated private provider of medical services including: drug sellers, domestic staff, family members and Wanzams (village based traditional circumcision providers).

Outcome

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

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 *apriori* 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 16th August 2010 to 7th 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

4510 (19.7%) of the mothers were in the lowest socio-economic quintile, 17581 (76.6%) delivered in a health facility and 7127 (31.1%) had no primary education (Table 1).

From 21st May to 31st December 2012, 3141 male infants were recruited in the circumcision study (Figure 2). Overall, 2850 (90.7%) of these infants were circumcised. We excluded three babies (0.1%) who had no socio-economic or demographic data. A total of 503 (16.0%) of mothers were in the lowest income quintile; 2479 (78.9%) delivered in a facility and 601 (19.1%) had no primary education (Table 2).

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 infants with circumcision related morbidities sought care and 3 (8.6%) were admitted to hospital (Figure 2 and Table 2).

The proportion of mothers aged less than 20 years who sought care for their infants with circumcision related morbidity (3, [11.5%]) was slightly lower than mothers aged 30 years or more (14, [18.9%]). Healthcare seeking of mothers of infants with low birth weight was lower (1, [4.8%]) than mothers of infants with normal birth weight though the total numbers were small (34, [16.3%]) (Table 2). There were no other obvious determinants of careseeking for circumcision related morbidity.

Type of provider

In the circumcision study, of the 35 families of infants who sought care for circumcision related morbidity, 20 (57.1%) infants were circumcised by an informal provider and 15 (42.9%) by a formal provider (Table 4). Most families of infants circumcised by a formal

provider also sought care from a formal provider for complications (13, 87.7%). In contrast, only 45% (9) families of infants circumcised by an informal provider also sought healthcare for circumcision related morbidity from an informal healthcare provider (Table 4).

A similar proportion of mothers in the lowest income quintile (4, [66.7%]) sought healthcare for circumcision related morbidity from an informal care provider compared to mothers in the highest income quintile (2, [25.0%]), however numbers were low in this analysis (Table 4). A greater proportion of mothers who delivered their infants at home (5, [71.4%] sought healthcare for circumcision related morbidity from an informal care provider compared to mothers with health facility births (6, [21.4%]). The proportion of mothers who lived 10 km or more from a health facility (2, [66.7%]) who sought healthcare for circumcision related morbidity from an informal care provider was higher than those who lived within 1 km from a health facility (3, [14.3%]). There were no data on type of health care provider available from the Neovita trial population.

Discussion

There appeared to be substantial differences in healthcare seeking in families with infants experiencing circumcision related morbidities and those with other acute illnesses in the Brong Ahafo Region of central rural Ghana. A much lower proportion (15.2%) of families of infants with circumcision related morbidities sought healthcare compared to families who had an infant with an acute illness in the larger Neovita population (88.1%). However, the proportion of hospital admissions in infants of families who sought health care was almost the same (11% in the Neovita study and 9% in the circumcision study). There was some indication that mothers of low birth weight infants had poorer careseeking for circumcision

related morbidities than mothers of infants with normal birth weight infants. There were no other clear determinants of healthcare seeking for acute illnesses or circumcision related morbidities in our study populations.

A study conducted in Nigeria also reported lower healthcare seeking by families of male infants with circumcision related morbidities compared to infants with other health problems[15]. Other studies have suggested that poor care seeking behaviour after circumcision can be due to family expectations that complications will heal without any intervention[15,16], poor recognition of illness [5,17,18], poor recognition of severity of illness[5,19-21], and beliefs that some infant illnesses are not meant to be treated in hospitals[3,5].

Interestingly, the proportion of hospital admissions post care seeking was almost the same in the Neovita and circumcision populations (11% of infants with acute morbidities whose families sought care were hospitalised and 9% of infants with circumcision related morbidities whose families sought health care were also hospitalised). This indicates that families may not be seeking care for many circumcised infants in our study area with morbidities that do require hospital admission and specialised hospital care. Overall, hospital admission rates were similar to a recently published study from Ghana that reported rates of 9 to 18%[22].

The determinants of careseeking for acute illness have been reported in low and middle income countries[5,23,24]. However, few studies have reported population-based data on the care seeking patterns of families with infants who experience circumcision related morbidities and acute illness. There was some indication that mothers of low birth weight infants had poorer

careseeking for circumcision related morbidities (5%) than mothers of infants with normal birth weight infants (16%) though numbers were small. These findings are similar to other studies that reported poor careseeking for acute illness[25] and vaccination[26] in families of low birth weight infants. We found no evidence that other socioeconomic and demographic factors influence families careseeking behaviour for circumcision related morbidity and acute illness in our population. These findings contrast with that of other earlier studies from Ghana[5,22,26,27] and Bangladesh[28] that reported higher care seeking for infants with acute illness by richer families, and mothers with higher educational levels. This indicates that health care seeking behaviour for acute illness may be improving over time in rural Ghana.

Overall, we found that more families sought care for a circumcision related morbidity from formal (68.6%) than informal (13.4%) healthcare providers. Unsurprisingly, most families of infants circumcised by a formal provider also sought care from a formal provider for complications. However, fewer families of infants circumcised by an informal provider sought care from an informal provider (45%) than an formal provider (55%). These findings differ from another published study from Kenya[16] which reported families of male infants who were circumcised by an informal provider were two fold less likely to seek care for a circumcision related morbidity from a formal healthcare provider[16]. We were not able to assess the type of care provider for acute illness in the Neovita study as these data were not collected in the Neovita study.

Generally, healthcare seeking for acute illness in the Neovita study population was very high (88.1%). The proportion of families seeking health care in our study was higher than data reported by the Ghana Demographic and Health Survey in 2008, close to the time of

conducting the Neovita study (acute respiratory infection 51.0%, fever 51.0%, and diarrhoea 35.2%)[29]. Careseeking for acute illness in rural populations has also been reported to be around 61% in Kenya[21], 47% in Nigeria[30] and 27% in Vietnam[31]. The high healthcare seeking patterns for acute illnesses seen in our study population may be due to recent communications and promotion of care seeking by the local government district health management teams. However, that these communications do not appear to have influenced careseeking for circumcision related morbidities to date.

The most important limitation to our study 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 22,955 infants in the community level population based Neovita cohort. Another limitation was our use of family level recall of health service utilisation which could have led to some episodes of care seeking being under reported in the circumcised cohort. However, both families and data collectors were blinded to the study hypothesis and our trained fieldworkers reviewed infant health records and checked for consistency with a family's report. The Neovita study lacked data on the type of provider care was sought from. However, the population-based nature of the data on whether care was sought for acute illnesses, serves as a proxy for care seeking patterns. Understanding the type of care provider sought for acute illnesses would be important to investigate in the future

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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Availability of data and materials: The dataset analysed during the current study available from the corresponding author on reasonable request and with permission of KE.

REFERENCES

1. Gyan T, McAuley K, Strobel NA, et al. Determinants of morbidity associated with infant male circumcision: community-level population-based study in rural Ghana. Tropical Medicine & International health 2017; **22**(3): 312-22.
2. Weiss H, Larke N, Halperin D, Schenker I. Neonatal and child male circumcision: a global review. UNAIDS Technical Bulletin 2010.
3. Okyere E, Tawiah-Agyemang C, Manu A, Deganus S, Kirkwood B, Hill Z. Newborn care: the effect of a traditional illness, asram, in Ghana. Annals of Tropical Paediatrics: International Child Health 2010; **30**(4): 321-8.
4. Hill Z, Manu A, Tawiah-Agyemang C, et al. How did formative research inform the development of a home-based neonatal care intervention in rural Ghana&quest. Journal of Perinatology 2008; **28**: S38-S45.
5. Hill Z, Kendall C, Arthur P, Kirkwood B, Adjei E. Recognizing childhood illnesses and their traditional explanations: exploring options for care-seeking interventions in the context of the IMCI strategy in rural Ghana. Tropical Medicine & International Health 2003; **8**(7): 668-76.
6. Manu AA, ten Asbroek A, Soremekun S, et al. Evaluating the implementation of community volunteer assessment and referral of sick babies: lessons learned from the Ghana Newhints home visits cluster randomized controlled trial. Health Policy and Planning 2014; **29**(suppl 2): ii114-ii27.
7. Rutherford ME, Mulholland K, Hill PC. How access to health care relates to under-five mortality in sub-Saharan Africa: systematic review. Tropical Medicine & International Health 2010; **15**(5): 508-19.

8. Okawa S, Ansah EK, Nanishi K, et al. High Incidence of Neonatal Danger Signs and Its Implications for Postnatal Care in Ghana: A Cross-Sectional Study. PloS One 2015; **10**(6): e0130712.
9. Bazzano AN, Kirkwood BR, Tawiah-Agyemang C, Owusu-Agyei S, Adongo PB. Beyond symptom recognition: care-seeking for ill newborns in rural Ghana. Tropical Medicine & International Health 2008; **13**(1): 123-8.
10. Beiersmann C, Sanou A, Wladarsch E, De Allegri M, Kouyaté B, Müller O. Malaria in rural Burkina Faso: local illness concepts, patterns of traditional treatment and influence on health-seeking behaviour. Malaria Journal 2007; **6**(1): 1.
11. Ahorlu CK, Koram KA, Ahorlu C, De Savigny D, Weiss MG. Socio-cultural determinants of treatment delay for childhood malaria in southern Ghana. Tropical Medicine & International Health 2006; **11**(7): 1022-31.
12. Edmond KM, Newton S, Shannon C, et al. Effect of early neonatal vitamin A supplementation on mortality during infancy in Ghana (Neovita): a randomised, double-blind, placebo-controlled trial. The Lancet 2015; **385**(9975): 1315-23.
13. Lambrechts T, Bryce J, Orinda V. Integrated management of childhood illness: a summary of first experiences. Bulletin of the World Health Organization 1999; **77**(7): 582.
14. Gove S. Integrated management of childhood illness by outpatient health workers: technical basis and overview. The WHO Working Group on Guidelines for Integrated Management of the Sick Child. Bulletin of the World Health Organization 1997; **75**(Suppl 1): 7.
15. Osifo O.D, Oriaifo I.A. Circumcision mishaps in Nigerian children. Annals of African Medicine 2009; **8**(4): 266.
16. Bailey RC, Egesah O, Rosenberg S. Male circumcision for HIV prevention: a prospective study of complications in clinical and traditional settings in Bungoma, Kenya. Bulletin of the World Health Organization 2008; **86**(9): 669-77.
17. Geldsetzer P, Williams TC, Kirolos A, et al. The recognition of and care seeking behaviour for childhood illness in developing countries: a systematic review. PloS One 2014; **9**(4): e93427.
18. Nabiwemba EL, Atuyambe L, Criel B, Kolsteren P, Orach CG. Recognition and home care of low birth weight neonates: a qualitative study of knowledge, beliefs and practices of mothers in Iganga-Mayuge Health and Demographic Surveillance Site, Uganda. BMC Public Health 2014; **14**(1): 546.
19. Paudel M. Male circumcision: care practices and attitudes in a Muslim community of western Nepal. Italian Journal of Public Health 2012; **8**(1).
20. Muula AS, Prozesky HW, Mataya RH, Ikechebelu JI. Prevalence of complications of male circumcision in Anglophone Africa: a systematic review. BMC Urology 2007; **7**(1): 4.
21. Taffa N, Chepngeno G. Determinants of health care seeking for childhood illnesses in Nairobi slums. Tropical Medicine & International Health 2005; **10**(3): 240-5.
22. Manu A, Hill Z, ten Asbroek AHA, et al. Increasing access to care for sick newborns: evidence from the Ghana Newhints cluster-randomised controlled trial. BMJ Open 2016; **6**(6): e008107.
23. Colvin CJ, Smith HJ, Swartz A, et al. Understanding careseeking for child illness in sub-Saharan Africa: a systematic review and conceptual framework based on qualitative research of household recognition and response to child diarrhoea, pneumonia and malaria. Social Science & Medicine 2013; **86**: 66-78.
24. Mohan P, Iyengar SD, Martines J, Cousens S, Sen K. Impact of counselling on careseeking behaviour in families with sick children: cluster randomised trial in rural India. BMJ 2004; **329**(7460): 266.

25. O'Leary M., Edmond K., Floyd S., Newton S., Gyan T. & Thomas L. S. A cohort study of low birth weight and health outcomes in the first year of life, Ghana. Bulletin of the World Health Organization 2017. In Press.
26. O'Leary M, Edmond K, Floyd S, et al. Neonatal vaccination of low birthweight infants in Ghana. Archives of Disease in Childhood 2016: Archdischild-2016-311227.
27. Kirkwood BR, Manu A, ten Asbroek AHA, et al. Effect of the Newhints home-visits intervention on neonatal mortality rate and care practices in Ghana: a cluster randomised controlled trial. The Lancet 2013; **381**(9884): 2184-92.
28. Shah R, Mullany LC, Darmstadt GL, et al. Determinants and pattern of care seeking for preterm newborns in a rural Bangladeshi cohort. BMC Health Services Research 2014; **14**(1): 417.
29. Ghana Statistical Service (GSS), Ghana Health Service (GHS), and ICF Macro. 2009. Ghana Demographic and Health Survey 2008. Accra, Ghana: GSS, GHS, and ICF Macro.
30. National Population Commission (NPC) [Nigeria] and ICF Macro. 2009. Nigeria Demographic and Health Survey 2008. Abuja, Nigeria: National Population Commission and ICF Macro. .
31. Lee H-Y, Van Huy N, Choi S. Determinants of early childhood morbidity and proper treatment responses in Vietnam: results from the Multiple Indicator Cluster Surveys, 2000–2011. Global Health Action 2016; **9**.

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%)
Religion			
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	-	-	-
Mother's highest educational level			
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
Income status of household			
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	-	-	-
Maternal age (years)			
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
Site of delivery			
Health facility	17 581	4775 (27.2%)	4213 (88.2%)
Home	5374	1490 (27.7%)	1307 (87.7%)
Missing data	-	-	
Distance to health facility			
<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	-	-	-
Birth weight			
Less than 2.5kg	3592	998 (27.8%)	867 (86.9%)
2.5kg or greater	19361	5267 (27.2%)	4653 (88.3%)
Missing data	-	-	-
Sex			
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	Circumcised infants	Circumcised infants with morbidity	Circumcised infants with morbidity whose families sought care
	n=3141	n=2850* (90.7%)	n=230 (8.1%)	n=35 (15.0%)
Religion				
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%)	-	-
Mother's highest educational level				
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%)	-	-
Income status of household				
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%)	-	-
Maternal age (years)				
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%)	-	-
Site of delivery				
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%)	-	-
Distance to health facility				
<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%)
Birth weight	-			
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
Religion							
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	-	-					
Mother's highest educational level							
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	-			
Income status of household							
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	-	-	-				
Maternal age (years)							
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	-			
Site of delivery							
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	-						
Distance to health facility							
<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	-	-	-	-		-	
Birth weight							
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	-	-	-				
Sex							
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)	

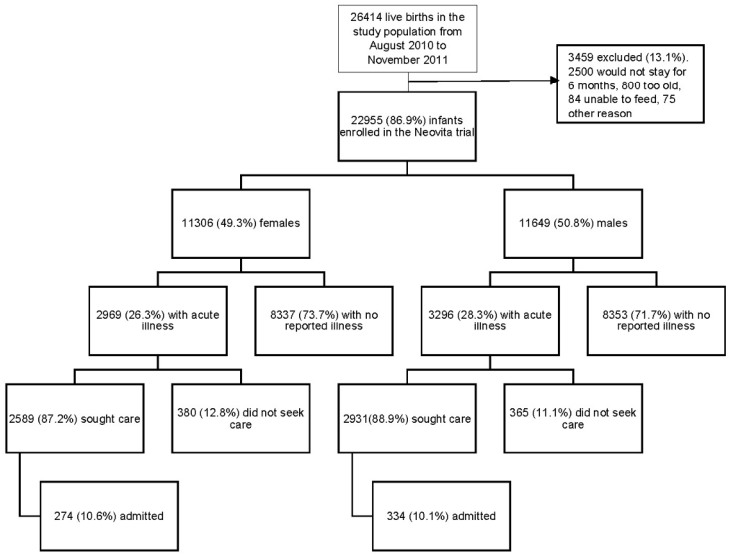
*Adjusted for religion, maternal education, distance to health facility, site of delivery and sex.

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

Characteristics		Circumcised infants whose families sought care	Type of healthcare provider for circumcision morbidity	
		n=35	Formal provider 24 (68.6%)	Informal provider* 11 (31.4%)
Religion				
	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	-	-	-
Mother's highest educational level				
	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	-	-	-
Income status of household				
	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	-	-	-
Maternal age (years)				
	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	-	-	-
Site of delivery				
	Health facility	28	22 (78.6%)	6 (21.4%)
	Home	7	2 (28.6%)	5 (71.4%)
	Missing data	-	-	-
Distance to health facility				
	<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	-
Type of circumcision provider				
	Formal provider	15	13 (86.7%)	2 (13.3%)
	Informal provider	20	11 (55.0%)	9 (45.0%)
	Missing data	0	-	-
Birth weight				
	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

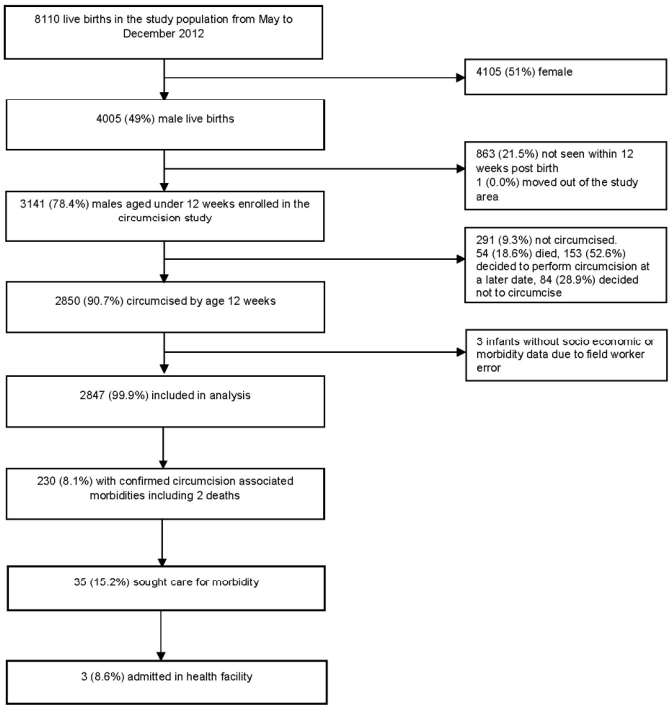
Figure 1



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

140x198mm (300 x 300 DPI)

Figure 2



1

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
Introduction			
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
Methods			
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
Results			

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
Discussion			
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
Other information			
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.