Published in final edited form as:

Trop Med Int Health. 2010 April ; 15(4): 442–453. doi:10.1111/j.1365-3156.2010.02474.x.

A population-based study of how children are exposed to saliva in KwaZulu-Natal Province, South Africa: implications for the spread of saliva-borne pathogens to children

L. M. Butler¹, T. B. Neilands², A. Mosam³, S. Mzolo³, and J. N. Martin¹

¹Department of Epidemiology and Biostatistics, University of California, San Francisco, CA, USA

²Center for AIDS Prevention Studies, University of California, San Francisco, CA, USA

³University of KwaZulu-Natal, Durban, South Africa

Summary

Objectives—In sub-Saharan Africa, many viral infections, including Epstein–Barr virus, cytomegalovirus, Kaposi’s sarcoma-associated herpesvirus and hepatitis B are acquired in childhood. While saliva is an important transmission conduit for these viruses, little is known about how saliva is passed to African children. We endeavoured to identify the range and determinants of acts by which African children are exposed to saliva.

Methods—To identify the range of acts by which African children are exposed to saliva, we conducted focus groups, semi-structured interviews and participant observations in an urban and a rural community in South Africa. To measure the prevalence and determinants of the identified acts, we administered a questionnaire to a population-based sample of caregivers.

Results—We identified 12 caregiving practices that expose a child’s oral–respiratory mucosa, cutaneous surfaces or anal–rectal mucosa to saliva. Several acts were heretofore not described in the contemporary literature (e.g., caregiver inserting finger lubricated with saliva into child’s rectum to relieve constipation). Among 896 participants in the population-based survey, many of the acts were commonly practised by all respondent types (mothers, fathers, grandmothers and siblings). The most common were premastication of food, sharing sweets and premastication of medicinal plants that are spit onto a child’s body.

Conclusions—African children are exposed to saliva through a variety of acts, practised by a variety of caregivers, with no single predominant practice. This diversity poses challenges for epidemiologic work seeking to identify specific saliva-passing practices that transmit viruses. Most acts could be replaced by other actions and are theoretically preventable.

Keywords

Kaposi’s sarcoma-associated herpesvirus; cytomegalovirus; hepatitis B virus; Epstein–Barr Virus; saliva; South Africa

Introduction

A variety of chronic viral infections are acquired in childhood in sub-Saharan Africa. While some organisms (e.g., herpes simplex virus 1) have only minor clinical consequences, others such as Epstein–Barr virus (EBV, causal agent of Burkitt’s lymphoma)(De-The *et al.* 1978); cytomegalovirus (CMV, a causal agent of several end-organ diseases) (Gandhi & Khanna 2004); Kaposi’s sarcoma-associated herpesvirus (KSHV, causal agent of Kaposi’s sarcoma) (Chang *et al.* 1994); and hepatitis B virus (HBV, causal agent of hepatocellular carcinoma) (Beasley *et al.* 1981) are responsible for substantial morbidity and mortality. The importance of these infections, in particular CMV and KSHV, has been magnified by the HIV epidemic (Chokunonga *et al.* 2000; Wabinga *et al.* 2000; Heiden *et al.* 2007; Mosam *et al.* 2009). Horizontal, non-sexual transmission of these viruses is suggested by a direct relationship between age and prevalence of infection (Biggar *et al.* 1978; Krech & Tobin 1981; Whittle *et al.* 1983; Stroffolini *et al.* 1993; Martinson *et al.* 1998; Mayama *et al.* 1998; Gessain *et al.* 1999; Mbulaiteye *et al.* 2006). While most children in sub-Saharan Africa are infected with EBV and CMV in early childhood (Biggar *et al.* 1978; Krech & Tobin 1981; Stroffolini *et al.* 1993; Mbulaiteye *et al.* 2006), the majority of HBV and KSHV infections occur after 1 year of age but before puberty (Martinson *et al.* 1998; Mayama *et al.* 1998; Gessain *et al.* 1999).

Common to EBV, CMV, KSHV and HBV is their presence in saliva (Bello & Whittle 1991; Zhevachevsky *et al.* 2000; Dedicoat *et al.* 2004; Mbulaiteye *et al.* 2006), a recognised conduit for transmission for these viruses and a likely explanation for a pattern of horizontal non-sexual spread among African children (Martinson *et al.* 1998; Dedicoat *et al.* 2004). However, little is known about the circumstances by which African children are exposed to saliva and whether such exposures are preventable. With respect to individual organisms, some have hypothesised that KSHV is spread via premastication of food (Plancoulaine *et al.* 2000; Mbulaiteye *et al.* 2003) or via exposure to saliva used to relieve the itch of an arthropod bite (Coluzzi *et al.* 2002). For HBV, one report has implicated acts such as the sharing of chewing gum or candy, dental cleaning materials and bath towels (Martinson *et al.* 1998). More broadly, an historical review of ethnographies from the early to mid-20th century revealed a range of practices in which saliva is used in medicinal, ritualistic or feeding practices (Wojcicki 2003). More recently, a qualitative study also described a variety of practices whereby adults spread saliva to children in Zambia (Wojcicki *et al.* 2007). While this prior work suggests a range of practices in which saliva is passed to children, it is not known how often these various practices occur in contemporary communities, which are most common, and which contacts of children most commonly perform the practices. Aside from immunisation, which currently only exists for HBV, it is only by population-level knowledge of how saliva is passed to children can progress be made in averting transmission of saliva-borne viruses.

To comprehensively understand how children are exposed to saliva in sub-Saharan Africa, we first conducted a series of qualitative studies in South Africa to identify the range and purposes of practices by which saliva is passed to children. This qualitative work informed the construction of a quantitative questionnaire to assess the prevalence, frequency and

determinants of the identified acts, which was subsequently administered to a population-based sample of individuals who reside with children.

Methods

The study was conducted in two phases in 2003 (Phase 1: October; Phase 2: November–December), in two settings within KwaZulu-Natal Province, South Africa: Cato Manor, an urban community near Durban, and KwaXimba, a rural community.

Qualitative phase: identification of acts that expose children to saliva

To identify the range of acts by which children are exposed to saliva, we conducted focus groups, semi-structured interviews and participant observations in KwaXimba and Cato Manor. Focus groups comprised individuals who commonly interact with children 6 years old, including mothers, fathers, grandmothers, grandfathers, older siblings and traditional healers. Participants were purposively recruited with the assistance of local traditional leaders and community health workers. Each focus group consisted of 7–10 people, lasted 1.5–2 h, and was conducted in the local vernacular (isiZulu). Topics included which individuals are directly responsible for the everyday care of children, common ailments and treatments for children involving the eyes, nose, mouth, ears, skin and rectum, and how saliva plays a role, if at all, during caregiving or play. Next, semi-structured interviews were conducted with mothers, fathers, grandparents and traditional healers. Finally, participant observations were conducted in homes and community settings where young children interacted with older children and/or adults (e.g., church, market, creche). During the observations, the author (L. M. Butler) lived and worked in close contact with families.

Quantitative phase: prevalence, frequency and determinants of acts that expose children to saliva

Based on information collected during the qualitative phase, we developed two structured quantitative questionnaires regarding the practise of specific acts by which saliva is passed to children. One questionnaire was designed for adults (mothers, fathers or grandmothers) who reside with children 6 years old, and another was designed for older siblings (7–18 years of age) of children 6 years old. Grandfathers were excluded given that their role in the day-to-day care of young children was relatively limited. The questionnaires were administered to individuals residing in a previously described population-based sample of homes in either Cato Manor or KwaXimba in which one or more children 6 years old resided (Butler *et al.* 2009a). In brief, we examined aerial photographs and, using roads as landmarks, circumscribed the two communities and divided each into sections. Households from each section were then randomly sampled. At each approached household, the team determined whether a child 6 years old resided within. Within each household deemed eligible for inclusion, a household census was taken and one eligible respondent (i.e., mother, father, grandmother, brother or sister of child/children <6 years old) was randomly selected.

Upon provision of verbal informed consent, each respondent was administered a structured questionnaire regarding acts involving the passage of saliva to a child and socio-

demographic characteristics. Participants were asked if they had ever engaged in each act with a child 6 years of age in the household and about the frequency of their practise of each act over the past 6 months.

Statistical analysis

Logistic regression was used to estimate independent associations between lifetime practise of each saliva-passing act and *a priori* selected caregiver-related socio-demographic characteristics (i.e., age, sex, residence, ethnicity, education) and household density. To adjust for possible confounding, all potential explanatory variables were retained in these models. We also assessed, by use of interaction terms, whether associations between respondent's gender and each act were modified by respondent's age or place of residence.

Ethical approval

Institutional review board approval was obtained from the University of California, San Francisco Committee for Human Research and the University of KwaZulu-Natal Biomedical Research Ethics Committee.

Results

Acts that expose children to saliva

We conducted 15 focus groups with 106 participants [27 mothers (three groups), 25 fathers (three groups), 24 grandmothers (three groups), 20 siblings (two groups with girls, two groups with boys) and 10 traditional healers (one group with women, one group with men)]. Semi-structured interviews were conducted with 10 mothers, 10 fathers, five grandmothers, five grandfathers and five traditional healers. Participant observations were made over 14 non-consecutive days in the homes of children 6 years of age and in community settings (e.g., church, marketplace, ceremonial gatherings). These qualitative methods revealed 12 practices by which children are exposed to saliva, which fell into three categories: those that (i) expose oral–respiratory mucosa to saliva, (ii) expose cutaneous surfaces to saliva and (iii) expose anal–rectal mucosa to saliva (Table 1).

Population-based door-to-door sample

To determine the population-level prevalence and determinants of the 12 identified acts by which African children 6 years of age are exposed to saliva, we enrolled 258 mothers, 198 fathers, 204 grandmothers and 236 siblings (97 brothers and 139 sisters) who reside with children 6 years old ($n = 896$) (Table 2). There were no refusals. The majority of participants were Zulu, and approximately half (51%) lived in crowded conditions (1.5 persons per room). While most of the parents had a secondary level of education or more, the majority of grandmothers had a primary level education or less. About 10% of grandmothers, 6% of fathers and 2% of mothers reported practising as a traditional healer.

Prevalence of acts involving passage of saliva to children

Of all 896 participants in the population-based survey, 93% reported engaging in one or more of the 12 identified acts involving passage of saliva to children 6 years old residing in

their household at some point during the child/children's lifetime. These practices were widespread across respondent types (Table 3). The majority of the 660 adult respondents (68%) also reported engaging in one or more of the 12 identified acts with children younger than 2 years old.

More than 90% of all participants reported having engaged in at least one of the eight identified acts that expose a child's oral-respiratory mucosa to saliva (Table 3). Among all participants, the most commonly reported acts were sharing sweets (68%), premastication of food (66%) and premastication of medicinal plants and spitting or rubbing the mixture onto the child's face, head or body (64%). Fewer than half of participants reported having used their tongue, or finger or a cloth moistened with saliva, to clean a child's face or eyes (27%) or hands or fingers (29%) and blowing *mpuphu* (powdered *muthi* – a traditional Zulu medicine) into a child's nostrils with their mouth or through a reed or pipe (29%). Somewhat fewer reported sharing a toothbrush/toothstick (16%) or sucking mucus from a child's nostrils (16%).

One-fifth (20%) of all participants reported engaging in one or both of the acts that expose a child's cutaneous surfaces to saliva (Table 3). Among all participants, 16% reported using their tongue, or finger or a cloth moistened with saliva, to soothe the itch from an arthropod bite, and 13% reported using their tongue, or finger or a cloth moistened with saliva, to clean a cut or scrape.

Approximately one-quarter (27%) of adult respondents (n = 660) reported engaging in one or both of the acts that expose a child's anal-rectal mucosa to saliva (Table 3). Among adult participants, 16% reported having inserted their finger lubricated with saliva into the rectum of a child for the purpose of relieving constipation, and 19% reported blowing water or *mpuphu* through a small reed or pipe into the rectum of a child for healing purposes.

Frequency of acts involving passage of saliva to children

To estimate the frequency of engagement in each of the 12 identified acts, participants who stated that they had ever practised each act were asked how frequently they had engaged in the act in the prior 6 months. Acts that were most commonly reported – premastication of food, sharing sweets and premastication of medicinal plants that are spit and rubbed onto a child's head, face and/or body – were reported to be practised more frequently in the past 6 months (Table 4). For these acts, between 85% and 88% of all participants who reported performing an act in the prior 6 months performed it more than once. For those acts that were the least commonly reported (i.e., practised by fewer than 20% of all respondents), the reported frequency of performance was also lower. Specifically, between 69% and 82% (depending upon the act) of all participants who reported performing these less common acts performed it more than once.

Determinants of engagement in acts involving passage of saliva to children

For most of the 12 acts, mothers and grandmothers engaged in these acts more commonly than fathers, even after adjustment for age, ethnicity, place of residence, education and household density (Table 5). In only one act (blowing *mpuphu* into a child's nostrils through

reed/pipe) was there strong evidence of a difference between mothers and grandmothers. Other than caregiver type, we also found that older age, residence in the rural community and female gender were independently associated with the practise of most of the acts (Tables 6 and 7). Specifically, for 9 of the 12 acts, the odds of engaging in that act were significantly increased with advancing age. For 11 of the 12 acts, the odds of engaging in that act were two to three times higher for participants living in the rural than in the urban community. For 9 of the 12 acts, the odds of engaging in that act were 2.3–27 times higher for female than male participants. Household density of the participants was also influential, albeit in just 4 of the 12 acts, with higher density being associated with more common practise of the acts.

For each of the 12 identified acts, we assessed whether associations between respondent's gender and each act were modified by respondent's age or place of residence. For only one act – premasticating food – the effect of respondent's gender differed by respondent's age ($p_{\text{interaction}} < 0.05$)(Table 6). For this act, there was no evidence of a difference between males and females when limited to individuals <15 years old, but women performed the act more commonly in the older age groups. The effect of respondent's gender differed by respondent's place of residence (i.e., urban vs. rural) for three acts – sharing sweets ($p_{\text{interaction}} < 0.01$), inserting a finger lubricated with saliva into the rectum ($p_{\text{interaction}} < 0.01$) and blowing water or *mpuphu* through a reed or pipe into the rectum ($p_{\text{interaction}} < 0.01$)(Tables 6 and 7).

Discussion

The prevalence of EBV, CMV, HBV and KSHV infection is high among children in sub-Saharan Africa, and because it commonly harbours these viruses, saliva is likely the chief conduit in their transmission. However, other than for HBV, any ability to thwart transmission of these viruses has been halted by the scant knowledge of how African children are exposed to saliva. While some acts involving the use of saliva for healing or other traditional purposes has been described in recent qualitative work (Wojcicki 2003; Wojcicki *et al.* 2007), little is known about the quantitative population-level frequency of such acts in contemporary African communities. In what we believe is the first population-based investigation, we identified specific caregiving acts that expose oral–respiratory and anal–rectal mucosa as well as cutaneous surfaces of children to saliva. While the diversity of acts and practitioners of these acts poses substantial difficulty for epidemiologic work seeking to identify the independent role of each act for transmission of specific viruses, most of the acts could be replaced by other actions and are thus theoretically preventable.

While several of the acts identified in this study have been described previously (e.g., premastication of food, application of saliva to cuts or wounds, sharing of sweets/chewing gum and sharing of dental cleaning materials) (Martinson *et al.* 1998; Wojcicki 2003), we identified several acts that have not been heretofore recognised in the ethnographic or biomedical literature. For example, in the realm of acts which expose a child's oral–respiratory mucosa to saliva, we identified the practise of blowing *mpuphu* into the child's nostrils for healing purposes. For acts that expose a child's cutaneous surfaces to saliva, the practise of using saliva to soothe blood-sucking arthropod bites has been previously

theoretically described (Coluzzi *et al.* 2002), but we now have quantitated its prevalence. Finally, we have uncovered two acts that expose a child's anal-rectal mucosa to saliva, namely the insertion of a caregiver's finger lubricated with saliva into the rectum of a child to relieve constipation and a caregiver's blowing water or mpuphu from his/her mouth into a child's rectum to relieve constipation or other healing purposes. While exposure of anal-rectal mucosa to saliva has not been widely studied, recent data have demonstrated how homosexual men in the United States commonly use saliva as a lubricant in their anal sexual practices (Butler *et al.* 2009b). This behaviour has been hypothesised to account for high KSHV prevalence in homosexual men, which is otherwise uncommon in the United States. That children in Africa – an area endemic for KSHV – also have their anal-rectal mucosa exposed to saliva gives special impetus for the investigation of practices that expose anal-rectal mucosa to saliva for their transmission of KSHV. In summary, there are many practices that expose children's oral-respiratory, anal-rectal mucosa or cutaneous surfaces to saliva, and thus may serve as the route by which various pathogens, such as HBV, KSHV, CMV and EBV, are spread.

In addition to the diversity in the types of acts that expose children to saliva, we also observed substantial variability across acts in their frequency. While it might be reasonable to assume that those acts practised most commonly are the most relevant culprits in transmitting saliva-borne pathogens, this may not necessarily be the case. Indeed, it may be the case for some pathogens – like HBV and KSHV – that saliva-passing acts that are only performed by a minority of the population are responsible for why some persons, but not most, become infected.

We found that the frequency of engaging in most acts depended on the relationship of the respondent to the child. For example, while we observed little difference between mothers and grandmothers for acts related to the direct care of children (e.g., acts performed for the purpose of feeding or cleaning a child or for curative purposes), significantly fewer fathers reported engaging in most of those acts. The practical implication of these caregiver differences on transmission of saliva-borne pathogens cannot be determined with our data. Specifically, even caregivers who practise the acts less commonly could still be very relevant in pathogen transmission if the acts are efficient in biological infectivity. Thus, our findings that all acts were performed by at least some of the various caregiver types serve to highlight the potential role of non-maternal sources in the spread of saliva-borne pathogens.

There are several limitations of our work. First is the self-reported nature of the data. However, given that there are currently no community prevention messages pertaining to the acts described here, we do not believe that caregivers underreported or over reported these acts to provide socially desirable responses. Second, we did not collect data on individuals' beliefs or attitudes about engaging in acts involving the passage of saliva to children. This information would be useful to optimise a culturally appropriate educational intervention aimed at reducing practise of these acts, but this was outside of the scope of this study. Third, we do not have data on practices of caregivers or other children who live outside of the household. Such persons could have equally high prevalence of some acts, such as sharing sweets, but lower prevalence of most caregiving acts where saliva is passed. We

concede that the existence of these interactions that occur outside of the household makes epidemiologic work, as described later, even more challenging.

There are several implications of these findings with respect to epidemiologic research. First, it will be difficult to establish an independent relationship between exposure to saliva via any specific act and infection with saliva-borne viruses. The presence of so many closely correlated acts practised by different types of caregivers indicates that only detailed prospective measurement will be able to distinguish the independent relationships. Second, to understand transmission of viruses such as HBV, KSHV, CMV and EBV within a community, we must identify and understand cultural and other practices in a given setting. While this study has established a number of acts involving saliva passage to children in two communities in South Africa, it is possible that there are different practices in other communities in Africa.

Most of the practices we identified may be amenable to modification. Even in the absence of epidemiologic data that shows an independent relationship between any of these acts and viral transmission, we could consider age- and culturally appropriate health education that aims to modify the practice of these acts. For example, a rubber bulb syringe may be used to relieve constipation, rather than using one's finger lubricated with saliva for the same purpose. While we recognise that some of these acts are important culturally (e.g., application of premasticated plant material on children's bodies to ward off 'bad spirits'), we believe that consideration is needed as to their value relative to potential health implications. This is particularly the case for some of the acts more than others. For example, premastication of food has been associated with transmission of group A streptococci (Steinkuller *et al.* 1992), *Helicobacter pylori* (Taylor & Blaser 1991) and, most recently, HIV (Gaur *et al.* 2009). At a minimum, education is needed within the community to explain the potential risks. Finally, because there will likely be persistent tension between the potential risks and benefits of these acts, further research is required to determine which acts contribute the most to the transmission of saliva-borne pathogens to children in sub-Saharan Africa. Finally, to optimise educational programs that aim to explain and reduce the risks of exposing children to saliva, further research is also required to better understand individuals' motivations for engaging in such practices.

Acknowledgments

We are grateful to the communities of KwaXimba and Cato Manor in South Africa for welcoming our study team and to the study participants and their families for their cooperation. We thank the field staff for their efforts: S. Maphumulo, T.I. Mbumbi, B. Mkhize, M.I. Mlaba, M.I. Mngadi, D. Ndlovu, E.S.B. Ndlovu, J.R. Ngcobo, S. Nzuza, M. Peta, and N.N. Pheta. We are grateful to Kate Steiner Scott and Xuan Li for data management. Finally, we acknowledge the following colleagues for their helpful review of this work: Arthur Reingold, Alan Hubbard and Gertrude Buehring.

This work was supported by National Institutes of Health individual grants, the University of California, San Francisco-Gladstone Institute of Virology and Immunology Center for AIDS Research and the Center for AIDS Prevention Studies; it was presented in part at the 11th International Conference on Malignancies in AIDS and Other Immunodeficiencies: Basic, Epidemiologic and Clinical Research. Bethesda, Maryland, October 6–7 2008.

References

- Beasley RP, Hwang LY, Lin CC, Chien CS. Hepatocellular carcinoma and hepatitis B virus. A prospective study of 22 707 men in Taiwan. *Lancet*. 1981; 2:1129–1133. [PubMed: 6118576]
- Bello C, Whittle H. Cytomegalovirus infection in Gambian mothers and their babies. *Journal of Clinical Pathology*. 1991; 44:366–369. [PubMed: 1646236]
- Biggar RJ, Henle W, Fleisher G, Bocker J, Lennette ET, Henle G. Primary Epstein-Barr virus infections in African infants. I. Decline of maternal antibodies and time of infection. *International Journal of Cancer*. 1978; 22:239–243.
- Butler LM, Dorsey G, Hladik W, et al. Kaposi sarcoma-associated herpesvirus (KSHV) seroprevalence in population-based samples of African children: evidence for at least 2 patterns of KSHV transmission. *Journal of Infectious Diseases*. 2009a; 200:430–438. [PubMed: 19534596]
- Butler LM, Osmond DH, Jones AG, Martin JN. Use of saliva as a lubricant in anal sexual practices among homosexual men. *Journal of Acquired Immune Deficiency Syndromes*. 2009b; 50:162–167. [PubMed: 19131893]
- Chang Y, Cesarman E, Pessin MS, et al. Identification of herpesvirus-like DNA sequences in AIDS-associated Kaposi's sarcoma. *Science*. 1994; 266:1865–1869. [PubMed: 7997879]
- Chokunonga E, Levy LM, Bassett MT, Mauchaza BG, Thomas DB, Parkin DM. Cancer incidence in the African population of Harare, Zimbabwe: second results from the cancer registry 1993–1995. *International Journal of Cancer*. 2000; 85:54–59.
- Coluzzi M, Manno D, Guzzinati S, et al. The bloodsucking arthropod bite as possible cofactor in the transmission of human herpesvirus-8 infection and in the expression of Kaposi's sarcoma disease. *Parassitologia*. 2002; 44:123–129. [PubMed: 12404820]
- Dedicoat M, Newton R, Alkharsah KR, et al. Mother-to-child transmission of human herpesvirus-8 in South Africa. *Journal of Infectious Diseases*. 2004; 190:1068–1075. [PubMed: 15319855]
- De-The G, Geser A, Day NE, et al. Epidemiological evidence for causal relationship between Epstein-Barr virus and Burkitt's lymphoma from Ugandan prospective study. *Nature*. 1978; 274:756–761. [PubMed: 210392]
- Gandhi MK, Khanna R. Human cytomegalovirus: clinical aspects, immune regulation, and emerging treatments. *The Lancet infectious diseases*. 2004; 4:725–738. [PubMed: 15567122]
- Gaur AH, Dominguez KL, Kalish ML, et al. Practice of feeding pre-masticated food to infants: a potential risk factor for HIV transmission. *Pediatrics*. 2009; 124:658–666. [PubMed: 19620190]
- Gessain A, Maucel P, Van Beveren M, et al. Human herpesvirus 8 primary infection occurs during childhood in Cameroon, Central Africa. *International Journal of Cancer*. 1999; 81:189–192.
- Heiden D, Ford N, Wilson D, et al. Cytomegalovirus retinitis: the neglected disease of the AIDS pandemic. *PLoS Medicine*. 2007; 4:e334. [PubMed: 18052600]
- Krech U, Tobin J. A collaborative study of cytomegalovirus antibodies in mothers and young children in 19 countries. *Bulletin of the World Health Organization*. 1981; 59:605–610. [PubMed: 6274535]
- KwaZulu-Natal Department of Agriculture and Environmental Affairs. Natural Control of Plant Diseases and Insects. 1998.
- Martinson FE, Weigle KA, Royce RA, Weber DJ, Suchindran CM, Lemon SM. Risk factors for horizontal transmission of hepatitis B virus in a rural district in Ghana. *American Journal of Epidemiology*. 1998; 147:478–487. [PubMed: 9525535]
- Mayama S, Cuevas LE, Sheldon J, et al. Prevalence and transmission of Kaposi's sarcoma-associated herpesvirus (human herpesvirus 8) in Ugandan children and adolescents. *International Journal of Cancer*. 1998; 77:817–820.
- Mbulaiteye SM, Pfeiffer RM, Whitby D, Brubaker GR, Shao J, Biggar RJ. Human herpesvirus-8 infection within families in rural Tanzania. *Journal of Infectious Diseases*. 2003; 187:1780–1785. [PubMed: 12751036]
- Mbulaiteye SM, Walters M, Engels EA, et al. High levels of Epstein-Barr virus DNA in saliva and peripheral blood from Ugandan mother-child pairs. *Journal of Infectious Diseases*. 2006; 193:422–426. [PubMed: 16388490]

- Mosam A, Carrara H, Shaik F, et al. Increasing incidence of Kaposi's sarcoma in black South Africans in KwaZulu-Natal, South Africa (1983–2006). *International Journal of STD and AIDS*. 2009; 20:553–556. [PubMed: 19625587]
- Plancoulaine S, Abel L, Van Beveren M, et al. Human herpesvirus 8 transmission from mother to child and between siblings in an endemic population. *Lancet*. 2000; 356:1062–1065. [PubMed: 11009141]
- Steinkuller JS, Chan K, Rinehouse SE. Prechewing of food by adults and streptococcal pharyngitis in infants. *Journal of Pediatrics*. 1992; 120:563–564. [PubMed: 1552394]
- Stroffolini T, Ngatchu T, Chiaramonte M, et al. Prevalence of cytomegalovirus seropositivity in an urban childhood population in Cameroon. *New Microbiologica*. 1993; 16:83–85. [PubMed: 8385733]
- Taylor DN, Blaser MJ. The epidemiology of *Helicobacter pylori* infection. *Epidemiologic Reviews*. 1991; 13:42–59. [PubMed: 1765119]
- Wabinga HR, Parkin DM, Wabwire-Mangen F, Namboze S. Trends in cancer incidence in Kyadondo County, Uganda 1960–1997. *British Journal of Cancer*. 2000; 82:1585–1592. [PubMed: 10789729]
- Whittle HC, Bradley AK, Mclachlan K, et al. Hepatitis B virus infection in two Gambian villages. *Lancet*. 1983; 1:1203–1206. [PubMed: 6133999]
- Wojcicki JM. Traditional behavioural practices, the exchange of saliva and HHV-8 transmission in sub-Saharan African populations. *British Journal of Cancer*. 2003; 89:2016–2017. [PubMed: 14612917]
- Wojcicki JM, Kankasa C, Mitchell C, Wood C. Traditional practices and exposure to bodily fluids in Lusaka, Zambia. *Tropical Medicine and International Health*. 2007; 12:150–155. [PubMed: 17207159]
- Zhevachevsky NG, Nomokonova NY, Beklemishev AB, Belov GF. Dynamic study of HBsAg and HBeAg in saliva samples from patients with hepatitis B infection: diagnostic and epidemiological significance. *Journal of Medical Virology*. 2000; 61:433–438. [PubMed: 10897060]

Table 1**Acts that expose African children to saliva****Acts that expose a child's oral-respiratory mucosa to saliva**

Premastication of food. The act of putting food into the mouth either to cool or to chew and make food soft before feeding it to a child

Use of tongue, or finger or a cloth moistened with saliva, for cleaning face or eyes of a child

Use of tongue, or finger or a cloth moistened with saliva, for cleaning fingers or hands of a child

Sharing of a toothbrush or toothstick (small piece of wood) with a child

Sharing of candy/sweets (i.e., hard candies, lollipops, chewing gum) with a child

Using one's own mouth to suck mucus from a child's nostrils to relieve congestion

Blowing *mpuphu* (powdered *muthi* – traditional Zulu medicine) into the nostrils of a child from the caregiver's mouth or through a small reed or pipe as a means of providing relief from a headache or other healing purposes

Premasticating plant material and then spitting the mixture directly onto the face, head and body of a child or spitting the mixture into the (caregiver's) hands and then rubbing the mixture onto the face, head and body of a child. Two types of plants were mentioned: *Amafutha umhlaba* (botanical name: *Aloe spp.*), a succulent plant found throughout the KwaZulu-Natal region, and Isiqunga (botanical name: *Cymbopogon nardus*), an aromatic perennial grass that grows commonly in the region (KwaZulu-Natal Department of Agriculture and Environmental Affairs 1998)

Note: *Amafutha umhlaba* is used to rid a child's 'night terrors'. Isiqunga is primarily used in two situations: (i) when a child was to come into contact with another person who had just previously attended a funeral and (ii) when a child was to come into contact with others who may themselves be taking 'strong (traditional) medicine', for example, when the child would

Acts that expose a child's cutaneous surfaces to saliva

Use of tongue, or finger or a cloth moistened with saliva, to clean a cut or scrape on the child's body

Use of tongue, or finger or a cloth moistened with saliva, to soothe itch from an arthropod bite on the child's body

Acts that expose a child's anal-rectal mucosa to saliva

Inserting a finger lubricated with saliva into the child's rectum to relieve constipation

Blowing water or *mpuphu* (powdered *muthi* – traditional Zulu medicine) through a small reed or pipe into the child's rectum as a remedy for constipation or other healing purposes

Table 2

Sociodemographic characteristics of participants in population-based sample

	Mothers n = 258	Fathers n = 198	Grandmothers n = 204	Siblings n = 236
Site				
Urban	165 (64)	78 (39.4)	87 (42.7)	68 (28.8)
Rural	93 (36.1)	120 (60.6)	117 (57.4)	168 (71.2)
Age*				
<15 years	0 (0)	0 (0)	0 (0.0)	207 (87.7)
15 to <30 years	150 (58.1)	44 (22.4)	1 (0.50)	29 (12.3)
30 to <40 years	93 (36.1)	104 (52.8)	7 (3.5)	0 (0.0)
40 years	15 (5.8)	49 (24.9)	194 (96.0)	0 (0.0)
Ethnicity				
Zulu	208 (80.6)	173 (87.4)	179 (87.8)	224 (94.9)
Other	50 (19.4)	25 (12.6)	25 (12.3)	12 (5.1)
Education				
None	6 (2.3)	4 (2.0)	74 (36.5)	5 (2.1)
Primary	53 (20.5)	29 (14.7)	103 (50.7)	192 (81.4)
Secondary	189 (73.3)	158 (79.8)	25 (12.3)	39 (16.5)
>Secondary	10 (3.9)	7 (3.5)	1 (0.49)	–
Traditional healer	5 (1.9)	12 (6.1)	22 (10.8)	Not asked
Household materials				
Brick/cement	74 (28.7)	95 (48.0)	64 (31.4)	83 (35.2)
Mud, sticks, stones and/or corrugated iron	184 (71.3)	103 (52.0)	140 (68.6)	153 (64.8)
Household density (persons/room)				
<1.5	86 (33.3)	112 (56.6)	92 (45.1)	147 (62.3)
1.5–2.24	63 (24.4)	52 (26.3)	65 (31.9)	52 (22.0)
<2.25	109 (42.3)	34 (17.2)	47 (23.0)	37 (15.7)

The values given in parenthesis are expressed in percentage.

* Missing for three participants.

Table 3

Percentage of caregivers who reported ever practising acts passing saliva to children 6 years old and children 2 years old

Act	Mothers n = 258		Fathers n = 198		Grandmothers n = 204		Siblings* n = 236	
	6 years	<2 years	6 years	<2 years	6 years	<2 years	6 years	<2 years
Acts that expose a child's oral-respiratory mucosa to saliva								
Premastication of food	174 (67.4)	134 (51.9)	88 (44.4)	82 (41.4)	165 (80.9)	144 (70.6)	160 (67.8)	160 (67.8)
Use of the tongue or finger or a cloth moistened with saliva to clean child's face/eyes	73 (28.3)	55 (21.3)	20 (10.1)	19 (9.6)	115 (56.4)	103 (50.5)	35 (14.8)	35 (14.8)
Use of the tongue or finger or a cloth moistened with saliva to clean child's hands/fingers	87 (33.7)	61 (23.6)	38 (19.2)	37 (18.7)	86 (42.2)	76 (37.3)	44 (18.6)	44 (18.6)
Sharing of a toothbrush/tooth stick with child	35 (13.6)	24 (9.3)	18 (9.1)	11 (5.6)	45 (22.1)	30 (14.7)	45 (19.1)	45 (19.1)
Sharing of sweets with child	142 (55.0)	131 (50.8)	132 (66.7)	121 (61.1)	132 (64.7)	120 (58.8)	205 (86.9)	205 (86.9)
Blowing <i>mpuphu</i> into a child's nostrils through reed or pipe	83 (32.2)	67 (26.0)	24 (12.1)	22 (11.1)	123 (60.3)	108 (52.9)	31 (13.1)	31 (13.1)
Sucking mucus from child's nostrils	45 (17.4)	34 (13.2)	3 (1.5)	3 (1.5)	85 (41.7)	75 (36.8)	13 (5.5)	13 (5.5)
Premasticating medicinal plants and spitting or rubbing mixture onto child's face, head and/or body	166 (64.3)	122 (47.3)	151 (76.3)	142 (71.7)	168 (82.4)	147 (72.1)	91 (38.6)	91 (38.6)
Acts that expose a child's cutaneous surfaces to saliva								
Use of tongue or finger or a cloth moistened with saliva to clean a child's cut or scrape	31 (12.0)	24 (9.3)	16 (8.1)	13 (6.6)	55 (27.0)	44 (21.6)	12 (5.1)	12 (5.1)
Use of tongue or finger or a cloth moistened with saliva to soothe arthropod bite	47 (18.2)	34 (13.2)	19 (9.6)	18 (9.1)	58 (28.4)	52 (25.5)	19 (8.1)	19 (8.1)
Acts that expose a child's anal-rectal mucosa to saliva								
Inserting a finger lubricated with saliva into child's rectum	39 (15.1)	29 (11.2)	8 (4.0)	7 (3.5)	58 (28.4)	55 (27.0)	Not asked	Not asked
Blowing water or <i>mpuphu</i> into child's rectum	42 (16.3)	27 (10.5)	9 (4.6)	6 (3.0)	72 (35.3)	64 (31.4)	Not asked	Not asked

The values given in parenthesis are expressed in percentage.

* Siblings were not asked about their practices with child/children were 2 years old.

Table 4

Frequency in past 6 months of engaging in acts where saliva is passed to children 6 years old

Act	Frequency in past 6 months			
	Never	Once	2 to 5 times	1 or more times/month
Acts that expose a child's oral-respiratory mucosa to saliva *				
Premastication of food	360 (40.2)	66 (7.4)	214 (23.9)	256 (28.6)
Use of the tongue or finger or a cloth moistened with saliva to clean child's face/eyes	677 (75.6)	36 (4.0)	115 (12.8)	68 (7.6)
Use of the tongue or finger or a cloth moistened with saliva for cleaning child's hands/fingers	660 (73.7)	45 (5.0)	106 (11.8)	85 (9.5)
Sharing of a toothbrush/tooth stick with child	763 (85.2)	39 (4.4)	59 (6.6)	35 (3.9)
Sharing of sweets with child	294 (32.9)	84 (9.4)	304 (33.9)	214 (23.9)
Blowing <i>mpuphu</i> into a child's nostrils through reed or pipe	671 (74.9)	60 (6.7)	84 (9.4)	81 (9.0)
Sucking mucus from nostrils	776 (86.6)	38 (4.2)	42 (4.7)	40 (4.5)
Premasticating medicinal plants and spitting or rubbing mixture onto child's face, head and/or body	363 (40.5)	78 (8.7)	211 (23.6)	244 (27.2)
Acts that expose a child's cutaneous surfaces to saliva *				
Use of the tongue or finger or a cloth moistened with saliva to clean a cut or scrape	785 (87.6)	35 (3.9)	45 (5.0)	31 (3.5)
Use of the tongue or finger or a cloth moistened with saliva to soothe arthropod bite	757 (84.5)	26 (2.9)	69 (7.7)	44 (4.9)
Acts that expose a child's anal-rectal mucosa to saliva †				
Inserting a finger lubricated with saliva into child's rectum	570 (86.4)	28 (4.2)	29 (4.4)	33 (5.0)
Blowing water or <i>mpuphu</i> through a small reed or pipe into the child's rectum	555 (85.1)	23 (3.5)	51 (7.7)	31 (4.7)

The values given in parenthesis are expressed in percentage.

* Asked of all participants ($n = 896$).† (Asked of adult participants only ($n = 660$)).

Table 5
Associations between respondent type and engagement in acts involving passage of saliva to children (n = 660)

	Mother vs. Father (reference) [*] OR (95% CI)	P value	Mother vs. Grandmother (reference) [*] OR (95% CI)	P value	Father vs. Grandmother (reference) [*] OR (95% CI)	P value
Acts that expose a child's oral-respiratory mucosa to saliva						
Premastication of food	3.5 (2.2–5.4)	P < 0.001	0.65 (0.31–1.3)	P = 0.24	0.19 (0.10–0.36)	P < 0.001
Use of the tongue or finger or a cloth moistened with saliva to clean child's face/eyes	5.6 (3.1–10.1)	P < 0.001	0.48 (0.22–1.02)	P = 0.06	0.09 (0.04–0.18)	P < 0.001
Use of the tongue or finger or a cloth moistened with saliva for cleaning child's hands/fingers	2.6 (1.6–4.2)	P < 0.001	1.01 (0.50–2.05)	P = 0.97	0.39 (0.20–0.75)	P < 0.01
Sharing of a toothbrush/tooth stick with child	2.2 (1.1–4.2)	P = 0.02	1.6 (0.65–3.9)	P = 0.31	0.73 (0.32–1.7)	P = 0.46
Sharing of sweets with child	0.85 (0.55–1.3)	P = 0.47	0.77 (0.38–1.5)	P = 0.45	0.90 (0.48–1.7)	P = 0.74
Blowing <i>mpuphu</i> into a child's nostrils through reed or pipe	4.2 (2.4–7.2)	P < 0.001	0.33 (0.16–0.68)	P < 0.01	0.08 (0.04–0.16)	P < 0.001
Sucking mucus from nostrils	18.6 (5.5–62.8)	P < 0.001	0.59 (0.25–1.4)	P = 0.22	0.03 (0.01–0.12)	P < 0.001
Premasticating medicinal plants and spitting or rubbing mixture onto child's face, head and/or body	0.89 (0.54–1.5)	P = 0.65	0.60 (0.26–1.4)	P = 0.22	0.67 (0.32–1.4)	P = 0.31
Acts that expose a child's cutaneous surfaces to saliva						
Use of the tongue or finger or a cloth moistened with saliva to clean a cut or scrape	2.5 (1.2–5.0)	P = 0.01	1.3 (0.55–3.2)	P = 0.53	0.54 (0.24–1.2)	P = 0.14
Use of the tongue or finger or a cloth moistened with saliva to soothe arthropod bite	2.8 (1.5–5.1)	P = 0.001	1.03 (0.45–2.4)	P = 0.95	0.37 (0.17–0.82)	P = 0.01
Acts that expose a child's anal-rectal mucosa to saliva						
Inserting a finger lubricated with saliva into child's rectum	8.6 (3.7–20.1)	P < 0.001	1.6 (0.64–4.0)	P = 0.31	0.19 (0.07–0.49)	P < 0.001
Blowing water or <i>mpuphu</i> through a small reed or pipe into the child's rectum	6.0 (2.7–13.4)	P < 0.001	1.1 (0.48–2.6)	P = 0.80	0.19 (0.08–0.46)	P < 0.001

^{*} Adjusted for respondent age, place of residence, ethnicity, household density and education.

Table 6

Associations between participant characteristics and engagement in acts involving passage of saliva to children ($n = 893^*$)

OR (95% CI) [‡]						
	Premastication of food	Sharing sweets	Sharing toothbrush/ toothstick	Using tongue or finger or a cloth moistened with saliva to clean eyes or face	Using tongue or finger or a cloth moistened with saliva to clean hands or fingers	Premasticated medicinal plant spit/rubbed on face/head/body
Age						
<15 years	Ref	Ref	Ref	Ref	Ref	Ref
15 to 29 years	0.81 (0.48–1.4) [‡]	0.23 (0.13–0.41)	1.2 (0.62–2.4)	2.0 (1.1–3.9)	1.6 (0.92–2.8)	4.7 (2.7–8.1)
30 to 39 years	0.90 (0.54–1.5) [‡]	0.25 (0.14–0.45)	0.82 (0.42–1.6)	2.7 (1.4–4.9)	1.8 (1.03–3.1)	6.3 (3.7–10.7)
40 years	1.1 (0.71–1.7) [‡]	0.29 (0.17–0.47)	1.02 (0.62–1.7)	5.0 (3.1–8.1)	2.2 (1.4–3.4)	11.1 (6.9–17.9)
	<i>P</i> = 0.68	<i>P</i> < 0.001	<i>P</i> = 0.65	<i>P</i> < 0.001	<i>P</i> = 0.007	<i>P</i> < 0.001
Site						
Urban	Ref	Ref	Ref	Ref	Ref	Ref
Rural	2.7 (1.9–3.9)	3.8 (2.6–5.5) [§]	2.8 (1.7–4.6)	2.4 (1.6–3.6)	1.9 (1.3–2.7)	3.9 (2.6–5.8)
	<i>P</i> < 0.001	<i>P</i> < 0.001	<i>P</i> < 0.001	<i>P</i> < 0.001	<i>P</i> = 0.001	<i>P</i> < 0.001
Sex						
Male	Ref	Ref	Ref	Ref	Ref	Ref
Female	2.8 (2.0–3.9) [‡]	0.99 (0.69–1.4) [§]	1.5 (0.96–2.3)	5.7 (3.6–8.9)	2.34 (1.6–3.4)	1.3 (0.93–1.9)
	<i>P</i> < 0.001	<i>P</i> = 0.96	<i>P</i> = 0.08	<i>P</i> < 0.001	<i>P</i> < 0.001	<i>P</i> = 0.12
Ethnicity						
Other	Ref	Ref	Ref	Ref	Ref	Ref
Zulu	0.78 (0.49–1.2)	0.91 (0.58–1.4)	0.63 (0.34–1.2)	2.3 (1.2–3)	0.67 (0.42–1.1)	1.6 (0.99–2.5)
	<i>P</i> = 0.28	<i>P</i> = 0.67	<i>P</i> = 0.15	<i>P</i> = 0.01	<i>P</i> = 0.10	<i>P</i> = 0.05
Education						
Secondary	Ref	Ref	Ref	Ref	Ref	Ref
Primary	1.2 (0.80–1.8)	0.72 (0.48–1.1)	1.6 (0.94–2.7)	1.1 (0.68–1.7)	1.1 (0.73–1.7)	0.80 (0.53–1.2)
	<i>P</i> = 0.40	<i>P</i> = 0.11	<i>P</i> = 0.08	<i>P</i> = 0.78	<i>P</i> = 0.65	<i>P</i> = 0.28
Household density (persons/room)						
<1.5	Ref	Ref	Ref	Ref	Ref	Ref

OR (95% CI) [†]						
	Premastication of food	Sharing sweets	Sharing toothbrush/ toothstick	Using tongue or finger or a cloth moistened with saliva to clean eyes or face	Using tongue or finger or a cloth moistened with saliva to clean hands or fingers	Premasticated medicinal plant spit/rubbed on face/head/body
1.5 to 2.24	1.4 (0.94–2.0)	1.6 (1.1–2.4)	1.7 (1.1–2.7)	1.2 (0.77–1.74)	1.2 (0.86–1.8)	1.03 (0.69–1.5)
2.25	1.4 (0.95–2.1)	1.4 (0.90–2.0)	1.9 (1.1–3.2)	0.89 (0.56–1.4)	1.5 (0.98–2.3)	1.1 (0.72–1.7)
	<i>P</i> = 0.14	<i>P</i> = 0.05	<i>P</i> = 0.02	<i>P</i> = 0.55	<i>P</i> = 0.16	<i>P</i> = 0.91

* $n = 893$ because of missing age data for three participants.

[†] Adjusted for all variables in column. Omnibus Wald chi-squared test performed to calculate P value.

[‡] The odds of engaging in the act did not differ between females and males who were younger than 15 years old (OR = 1.5, 95% CI 0.80–2.7, $P = 0.21$). Males and females differed significantly in the 15- to 29-year-old age group (OR = 3.9, 95% CI 2.1–7.5, $P < 0.001$), the 30- to 39-year-old age group (OR = 2.6, 95% CI 1.4–4.8, $P = 0.002$) and in the 40-year age group (OR = 5.0, 95% CI 2.5–9.9, $P < 0.001$) such that females exhibited a higher odds of premastication in each of these three groups.

[§] The odds of engaging in the act by females compared to males differed significantly in the urban community ('OR = 0.60, 95% CI 0.36–0.99, $P < 0.05$), such that the odds of engaging in the act were lower for females than males. Among persons residing in the rural community, there was a trend for females practising the act more commonly than males (OR = 1.6, 95% CI 0.99–2.6, $P = 0.06$).

Table 7

Associations between participant characteristics and engagement in acts involving passage of saliva to children ($n = 893^*$)

	OR (95% CI) [†]					
	Blown <i>mpuphu</i> into nostril through reed or pipe	Sucked mucus from child's nostrils with mouth	Using tongue or finger or a cloth moistened with saliva to clean scrape or cut	Using tongue or finger or a cloth moistened with saliva to relieve itch from arthropod bite	Inserting a finger lubricated with saliva into child's rectum [‡]	Blowing water or <i>mpuphu</i> through a small reed or pipe into child's rectum [‡]
Age						
<15 years	Ref	Ref	Ref	Ref	–	–
15 to 29 years	2.7 (1.4–5.0)	5.1 (2.1–12.2)	1.4 (0.56–3.5)	1.5 (0.69–3.1)	Ref	Ref
30 to 39 years	3.2 (1.7–5.8)	3.4 (1.4–8.2)	3.0 (1.3–6.8)	2.6 (1.3–5.3)	1.1 (0.53–2.2)	1.7 (0.88–3.4)
40 years	6.5 (4.0–10.6)	8.5 (4.3–16.9)	4.7 (2.4–9.4)	2.9 (1.6–5.2)	2.8 (1.4–5.9)	4.5 (2.2–8.8)
	$P < 0.001$	$P < 0.001$	$P < 0.001$	$P < 0.001$	$P = 0.006$	$P < 0.001$
Site						
Urban	Ref	Ref	Ref	Ref	Ref	Ref
Rural	2.1 (1.4–3.1)	2.1 (1.3–3.5)	1.9 (1.1–3.1)	2.4 (1.5–3.8)	2.9 (1.7–5.0) [§]	1.5 (0.89–2.5) [§]
	$P < 0.001$	$P < 0.01$	$P = 0.02$	$P < 0.001$	$P < 0.001$	$P = 0.14$
Sex						
Male	Ref	Ref	Ref	Ref	Ref	Ref
Female	5.1 (3.3–7.9)	27.1 (8.4–87.2)	2.5 (1.4–4.4)	2.5 (1.5–4.0)	6.9 (3.1–15.2) [§]	6.2 (3.0–13.1) [¶]
	$P < 0.001$	$P < 0.001$	$P < 0.01$	$P < 0.001$	$P < 0.001$	$P < 0.001$
Ethnicity						
Other	Ref	Ref	Ref	Ref	Ref	Ref
Zulu	1.2 (0.68–2.0)	0.98 (0.50–1.9)	0.67 (0.35–1.3)	1.009 (0.53–1.9)	2.2 (0.87–5.4)	0.84 (0.44–1.6)
	$P = 0.60$	$P = 0.95$	$P = 0.24$	$P = 0.98$	$P = 0.10$	$P = 0.59$
Education						
Secondary	Ref	Ref	Ref	Ref	Ref	Ref
Primary	1.2 (0.76–1.8)	1.7 (0.97–2.9)	1.1 (0.61–1.89)	1.1 (0.65–1.8)	0.66 (0.34–1.2)	0.87 (0.49–1.5)
	$P = 0.50$	$P = 0.07$	$P = 0.80$	$P = 0.78$	$P = 0.20$	$P = 0.62$
Household density (persons/room)						
<1.5	Ref	Ref	Ref	Ref	Ref	Ref

OR (95% CI) [†]					
1.5-2.24	2.25	Blown <i>mpuphu</i> into nostril through reed or pipe	Sucked mucus from child's nostrils with mouth	Using tongue or finger or a cloth moistened with saliva to clean scrape or cut	Using tongue or finger or a cloth moistened with saliva to relieve itch from arthropod bite
		Blowing water or <i>mpuphu</i> through a small reed or pipe into child's rectum [‡]	Inserting a finger lubricated with saliva into child's rectum [‡]	Blowing water or <i>mpuphu</i> through a small reed or pipe into child's rectum [‡]	Inserting a finger lubricated with saliva into child's rectum [‡]
		1.01 (0.68-1.5)	1.2 (0.72-1.9)	1.9 (1.2-3.2)	2.4 (1.5-3.8)
		0.96 (0.62-1.5)	0.64 (0.36-1.1)	1.4 (0.79-2.5)	2.5 (1.5-4.2)
		$P = 0.98$	$P = 0.11$	$P = 0.03$	$P < 0.001$
					$P = 0.37$
					$P = 0.13$

* $n = 893$ because of missing age data for three participants.

[†] Adjusted for all variables in column. Omnibus Wald chi-squared test performed to calculate P value.

[‡] Asked of adult participants only ($n = 660$).

[§] There was no difference in the odds of engaging in the act between females and males who were living in the urban community (OR = 1.4, 95% CI 0.53-3.7, $P = 0.49$). However, in the rural community, females had significantly greater odds of engaging in the act compared to males (OR = 25.7, 95% CI 6.0-109.9, $P < 0.001$).

[¶] There was no significant difference in the odds of engaging in the act between males and females who were living in the urban community (OR = 2.3, 95% CI 0.94-5.5, $P = 0.07$). However, in the rural community, females had significantly greater odds of engaging in the act compared to males (OR = 21.4, 95% CI 5.0-91.6, $P < 0.001$).