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Global Public Health

An International Journal for Research, Policy and Practice

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/rgph20

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To cite this article: Dominic Bukenya, Vickie A. Marshall, Georgina Nabaggala, Wendell Miley, Miriam Mirembe, Denise Whitby, Janet Seeley, Robert Newton, Rosemary Rochford & Katherine R. Sabourin (2024) Infant feeding and treatment practices could lead to enhanced transmission of Kaposi's sarcoma-associated herpesvirus (KSHV) and other orally shed infections via saliva, in rural south-western Uganda, Global Public Health, 19:1, 2418594, DOI: 10.1080/17441692.2024.2418594

To link to this article: https://doi.org/10.1080/17441692.2024.2418594

GLOBAL PUBLIC HEALTH
2024, VOL. 19, NO. 1, 2418594
https://doi.org/10.1080/17441692.2024.2418594

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Infant feeding and treatment practices could lead to enhanced transmission of Kaposi's sarcoma-associated herpesvirus (KSHV) and other orally shed infections via saliva, in rural south-western Uganda

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ABSTRACT

This qualitative sub-study investigated household practices affecting orally shed infections using Kaposi's sarcoma-associated herpesvirus (KSHV) as a focus. Participants enrolled from 50 households in rural south-western Uganda were followed monthly up to three times. At enrolment, in-depth interviews were completed, and venous blood collected. KSHV seropositivity was defined as anti-KSHV antibody detection to any of 25 antigens by multiplex bead-based assay. Mouthwash samples from every visit were tested by qPCR and KSHV shedders defined as individuals with KSHV DNA detected. At least one KSHV seropositive person was in 48/49(98%) households. Among those, 79% had 1+ KSHV shedders including 45% with 1+ always shedders and 92% with 1+ intermittent shedders, not mutually exclusively. All respondents reported feeding infants with pre-masticated hard food/fruits and testing food/tea temperature. Temperature was tested by tasting, pouring tea on their hand, or touching the cup to their cheek. Some cooled food/tea using a utensil or blowing over it. Food sharing amongst children and adults and using the same dish was common practice. To treat colic pain, carers/mothers reported chewing herbs and spitting into the child's mouth. Feeding and treatment practices did not vary by KSHV status. We identified potential KSHV transmission modes in rural Ugandan households.

ARTICLE HISTORY
Received 27 March 2024
Accepted 11 October 2024

KEYWORDS
SDG3; good health and well-being; KSHV; HHV-8; shedding; saliva; household behaviours

Introduction

Kaposi's sarcoma (KS) is one of the most common cancers in sub-Saharan Africa and is associated with high mortality (Butler et al., 2009; Feller et al., 2010; Jemal et al., 2012; Mayama et al., 1998; Sabourin et al., 2022; Semeere et al., 2016). This is due to the region having the highest

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Supplemental data for this article can be accessed https://doi.org/10.1080/17441692.2024.2418594.

seroprevalence of Kaposi's sarcoma-associated herpesvirus (KSHV), the etiologic agent of KS (Asiimwe et al., 2012). KSHV seroprevalence is reported to differ between countries and within countries between geographically proximate locations, suggesting local risk factors for transmission may be important (Dollard et al., 2010; Martro et al., 2004; Nalwoga et al., 2015, 2018, 2019; Newton et al., 2018; Pfeiffer et al., 2010; Wakeham et al., 2011).

Primary infection with KSHV, in sub-Saharan Africa, occurs during childhood although the initial age of infection differs geographically (Butler et al., 2009; Crabtree et al., 2014, 2017; Mayama et al., 1998; Sabourin et al., 2020). A study in Zambia reported that 40% of children were KSHV seropositive by four years of age (Crabtree et al., 2014) and in Kenya 60% of children living in a malaria endemic region were KSHV seropositive by two years of age (Sabourin et al., 2020). A third of children living in a rural area in Kalungu district in Uganda (the current study area) were KSHV seropositive by age four (Newton et al., 2018) while in the more urban Entebbe region, only 13% were KSHV seropositive at the same age (Nalwoga et al., 2018). These findings suggest that environmental and behavioural factors specific to a region are likely to play a part in transmission. The primary mode of KSHV transmission is through saliva exchange (Butler et al., 2009; Conkle et al., 2018; Crabtree et al., 2014; Martro et al., 2004; Nash et al., 2022; Tolfvenstam et al., 2000). However, the role of sociocultural and environmental factors on KSHV transmission and susceptibility remain largely undefined (Crabtree et al., 2014, 2017). Sociocultural practices associated with saliva exchange among children and their parents/caregivers, potentially increasing KSHV transmission risk, is not well documented in sub-Saharan Africa and even less so in Uganda (Crabtree et al., 2014; Dedicoat et al., 2004; Minhas et al., 2011; Wojcicki, 2003; Wojcicki et al., 2007).

We performed a qualitative study to investigate infant and child feeding and treatment practices that encourage saliva exchange in rural southwestern Uganda. Our study is a first step in identifying potential behavioural risk factors that may promote transmission of pathogens in saliva, including but not limited to KSHV, Epstein-Barr virus (EBV), and cytomegalovirus (CMV) (Nalwoga et al., 2023; Sapuan et al., 2022).

Methods

The setting

The study area is in Kalungu District and begins about 15 miles inland from Lake Victoria shores. The area is predominantly rural, and most people are small-scale farmers who produce maize, cooking bananas [matooke], cassava, beans, and groundnuts as food crops and small amounts of coffee as cash crops (Taylor et al., 2011). Most households occupy less than five acres of land, but few are landless. The population is ethnically Baganda (75%) with a large representation of immigrants from Rwanda and Burundi (19%) and Tanzania (4%). Over half (58%) of the population is Roman Catholic, with substantial minorities of Muslims (28%) and Protestants (12%) (Asiki et al., 2013).

The intensively cultivated land is dotted with rectangular mudbrick or burnt brick houses roofed with corrugated iron sheets or tiles/reeds/grass in fewer cases and, rare nowadays. Cooking is done in a small building away from the main house, using largely firewood or charcoal in fewer cases. Nearly all the houses have an area of well-swept bare earth at the front where most of the activities of daily life take place: drying crops like coffee beans or maize cobs, preparing food, chatting, and, for the children, a place for play (Seeley, 2014).

The preferred staple for the diet is matooke – cooking banana – which is peeled when green and steamed (Gold et al., 1999). Over the past 30 years the diet has moved away from matooke with more maize and cassava being consumed (Taylor et al., 2011). A considerable amount has been published about infant and child feeding practices among the Baganda and neighbouring ethnic groups. (Nankumbi & Muliira, 2015; Nott, 2016; Welbourn, 1955). Attention has not been paid

to the way children are fed, particularly as infants; children who are consuming foods that require chewing.

Study design

This was a qualitative sub-study of a household prospective cohort study which had the primary aim of identifying the effects of HIV infection within a household on KSHV shedding and transmission in rural southwestern Uganda. The household cohort was nested within the General Population Cohort (GPC). The GPC is an open community-based cohort established since 1989 by the UK Medical Research Council/Uganda Virus Research Institute (MRC/UVRI) to study HIV dynamics in rural southwestern Uganda, Kalungu district. From 2010, the GPC's initial aims were widened to include the study of non-communicable diseases. Initially, the GPC comprised residents of 15 neighbouring villages. An additional ten villages were added since 2000 (Asiki et al., 2013).

Sample selection

From 28 July 2021 to 7 October 2021, we enrolled 90 households in a longitudinal cohort study. Households were pre-identified using GPC census data and included 45 households with at least one HIV positive member and 45 households with no HIV positive members. Anyone staying in the home at least 50% of the time was welcome to participate, regardless of age or sex. At enrolment, all participants consented to study participation, a questionnaire was administered, and a venous blood sample and a saliva sample were collected. Participants were then followed for two more visits at one-month intervals where a saliva sample was also collected.

For each participant, up to 5 ml of blood was collected in EDTA tubes, 1.5 ml was removed, and the remaining whole blood was centrifuged at 10,000 rpm for 5 min at room temperature. Plasma was removed and stored at −80°C. For KSHV serology testing, the plasma was diluted 1:200 and tested as described using a multiplex bead-based assay to detect antibodies to 25 KSHV antigens (ORF73, ORF72, K10.5, ORF50, K5, ORF6, ORF11, K3, ORF59, ORF61, K11, ORF19, ORF37, ORF44, ORF60, K14, ORF38, ORF52, ORF65, ORF18, K8.1, ORF55, ORF25, ORF26, and ORF63) (Labo et al., 2014). Plasma from healthy US-based adult blood donors at low risk of KSHV was included as the negative controls. Samples from US-based adults with active or history of KSHV-associated disease and KSH DNA detected in peripheral blood mononuclear cells (PBMC) were included as positive controls. Across all counted beads, the median fluorescence intensity (MFI) was computed by subtracting the background fluorescence. To identify cut-offs for each antigen, a receiver operating curve using negative control sera by plate was used as previously described (Labo et al., 2014). Individuals were considered KSHV seropositive if their plasma blood samples tested seropositive to antibodies to any one of the antigens listed above.

To provide a saliva sample, participants were asked to rinse their mouths with 2.5 ml mouthwash which was spit into a tube. Up to 2 ml of oral fluid was removed and spun at 1500 × g for 10 minutes at room temperature. The supernatant was removed and the supernatant and cell pellet were stored at −80°C until analysis. Saliva cell pellets were tested for the detection of KSHV DNA using previously published qPCR methods (Uldrick et al., 2014). Briefly, DNA was extracted from saliva cell pellets using the Qiagen blood mini kit (Qiagen, Valencia, CA, USA) and the DNA was tested using primers specific to the KSHV K6 gene region and the human endogenous retrovirus 3 (ERV-3) gene which is used for cell quantification determination (Yuan et al., 2001). Each sample was run in triplicate reactions in both assays and the values of the independent reactions were averaged. ERV-3 is a single copy per human genome and is present in two copies for every human cell. The KSHV viral copies were reported as copies per million cell equivalents calculated as: average KSHV load (average of three independent qPCR reactions) divided by ERV-3 load (average

ERV-3 load from three independent qPCR reactions divided by two to account for # copies in each cell). To normalise to copies per million cell equivalents, this result is then multiplied by 1 million. The saliva samples were processed using a workflow to prevent cross-contamination in dedicated laboratory areas. Individuals with KSHV DNA detected in saliva were considered KSHV shedders and those without were considered KSHV non-shedders. For individuals with more than one visit, we also identified participants as always shedders if they had KSHV DNA detected in saliva at every time point or intermittent shedders if they had KSHV DNA detected in saliva at least one but not at all visits.

A qualitative sub study, the results of which are reported in this paper, was nested within this household study and set out to investigate sociocultural and behavioural practices that are associated with saliva exchange, and potential KSHV transmission. To investigate this, a stratified random sample of 50 households was selected, with equal numbers of households with ($n = 25$) and without ($n = 25$) at least one resident living with HIV. Households were stratified by HIV status to fit with the overall study aims although this is not the focus of this manuscript. For each household, we purposely selected the mother or the main caregiver of any child resident in the enrolled household for interview.

Qualitative data collection and analysis

In-depth interviews were conducted with 49 out of the selected 50 participants. One person declined study participation. The in-depth interviews were conducted using a topic guide. Each in-depth interview explored; (a) household membership, joiners, reasons for joining, and visitors if any, (b) household activities at the time of the interview, (c) household food consumption and feeding practices, (d) child-rearing practices, (e) any sickness in the household and the treatment practices and (f) involvement in recent events. The in-depth interviews were conducted in the participants' home on two different occasions by two female Ugandan interviewers both with over five years of experience in qualitative data collection. Interviewers were blinded to the household KSHV and HIV serostatus. The in-depth interviews were conducted in the main local language (Luganda) and lasted a maximum of one hour. Besides audio recording the interviews, the interviewers also took field notes.

Data management

The interviewers wrote full interview transcripts and translated them into English and proofread them to ensure completeness and quality. The interviewers swapped interview scripts to further check for completeness and quality before sharing them with a senior social scientist. The senior social scientist reviewed transcripts throughout the study to ensure high quality and provided continuous feedback on interview content and format.

Data analysis

A thematic content analysis approach was adopted, guided by topics covered in the interviews. The two interviewers and senior social scientist read each of the transcripts and discussed emerging patterns from the data to draw up a broad coding framework. This enabled each interview script to be coded into information on three themes: household feeding, child-rearing, and treatment practices for child illness (S1 Appendix: HAKU Study Feeding Practices). These data were used to prepare a summary of each of the three themes for each script. This was done for the 49 interview scripts. The final data analysis involved a comparison of the information across scripts and the compilation of analytical memos about the households feeding, child-rearing, and treatment practices that could expose infants to saliva exchange with their mother/main caregivers. These were also compared across the KSHV household categories. Summarised research findings

are shared with study participants and with community leaders during regular community engagement sessions.

Ethical consideration

The Uganda Virus Research Institute Research and Ethics Committee (GC/127/19/09/745), the Uganda National Council for Science and Technology (HS-2688), the London School of Hygiene and Tropical Medicine (LSHTM) Ethics Committee (17958-2), and the Colorado Multiple Institutional Review Board (COMIRB) (19-0540) approved the study protocols and the consent forms. All participants included in this study were adults. Written informed consent was obtained from all participants.

We include information on the gender and age of each in-depth interview respondent. We also include information on an informant's KSHV status if known and where the information being reported pertains to their behaviour.

Results

Sociodemographic information

Study participants were primarily female ($n = 44$, 90%) with a mean age of 40 years (Table 1). Most participants had attended primary school with slightly more than a fifth having a secondary

Table 1. Individual respondent sociodemographic information and KSHV sero- and shedding status ($n = 49$).

Variable	*n* (%)
Sex	
Female	44 (89.8)
Age (years)	
Mean (SD)	39.9 (13.8)
Range	18–72
Education	
Nil	8 (16.3)
Primary	27 (55.1)
Secondary or higher	12 (24.5)
Vocational/tertiary	2 (4.1)
Religion	
Christian	42 (85.7)
Other	7 (14.3)
Ethnicity	
Ganda	35 (71.4)
Rwandese/Burundian	12 (24.5)
Other	2 (4.1)
Livelihood source	
Subsistence farming	43 (87.7)
Small scale business	6 (12.3)
Household size	
Mean (SD)	5.7 (3.0)
Range	1–14
Any KSHV seropositive person[a]	48 (98.0)
Any KSHV ever shedder[b]	38 (79.2)
Any intermittent shedder	35 (92.1)
Any always shedder	17 (44.7)
At least one intermittent and always shedder	14 (36.8)

[a]KSHV seropositivity was defined as detectable antibodies in venous blood samples to any of the following antigens: ORF73, ORF72, K10.5, ORF50, K5, ORF6, ORF11, K3, ORF59, ORF61, K11, ORF19, ORF37, ORF44, ORF60, K14, ORF38, ORF52, ORF65, ORF18, K8.1, ORF55, ORF25, ORF26, and ORF63.

[b]Ever shedders were defined as individuals with KSHV DNA detected in saliva samples using qPCR. Always shedders were defined as individuals with KSHV DNA detected at every timepoint. Intermittent shedders were defined as individuals who had at least one visit with and at least one visit without KSHV DNA detected in saliva.

school education. Fifteen per cent had not attended school. Most of the participants were Christians and belonged to the Ganda ethnicity. Small-scale farming was the main livelihood source for the majority of the participants and on average each household had six persons. Household membership ranged between 1 and 14 people. Half of the households had at least one person living with HIV. All but one household (98%) had at least one person who was seropositive for KSHV.

KSHV serostatus and shedding status

Of the 48 households with at least one KSHV seropositive individual, 38 (79%) had someone with KSHV DNA detectable in saliva (KSHV shedders) (Table 1). Among households with at least one KSHV shedder, 17 (45%) had at least one always shedder (KSHV DNA detected at all visits), 35 (92%) households had at least one intermittent shedder (at least one visit with and one without KSHV DNA detected), and 14 (37%) households had at least one always and one intermittent shedder.

Infant and child feeding practices

Almost all respondents reported that they practiced pre-mastication with hard food/fruit for children below three years because they considered them unable to masticate the food by themselves. The respondents also reported that the foods they pre-masticated included cassava, sweet potato, and sugar cane.

> 'When my children are eating sugarcane, they usually bite a piece and give it to their young sibling and even myself in case of a child of two years or less, I bite off a small piece and chew it a little and give it to the child', female 37 years, KSHV seronegative.

Furthermore, a few respondents reported that sometimes sugar cane premastication went as far as juice extraction and spitting into the child's mouth by the caregiver.

> 'It is only for the youngest children, aged one year and below, where a fellow child chews sugar cane fibre for him and spit the juice into his mouth', female 25 years, KSHV seronegative.

> 'When sharing hard food especially sugar cane, an adult chews for the young children who can't chew by themselves and spit the juice into the child's mouth to swallow', female 63 years, KSHV seronegative.

Most respondents reported that they tested the food and hot drinks of the children they were taking care of before they would ask the child to eat or drink. While some respondents explained that they did this to ensure the food or tea was not very hot for the child, others said that tasting the child's food or tea was intended to communicate to the child that it was time to eat or to show the child that something was good to eat. For example, a 23-year-old woman (KSHV positive) said that

> Whenever I give a child ice cream for example, I first take a scoop to make the child aware that it is sweet.

A few in-depth interview respondents reported that they did not taste food or drinks and checked the heat of a child's food/tea by feeling:

> 'If it is tea, I cool it by pouring it from one cup to another and then to find out that it is cool enough, I touch the cup and feel that it is no longer very hot or sometimes I pour the tea on the back of my hand to feel whether it is cool enough', female 31 years, KSHV seronegative.

> 'I taught them [older children] how to know that tea is cool enough by pouring the tea in their palm to find out whether it is cool or by putting the cup on their cheeks and feel that it is cool enough', female 66 years, KSHV not known.

Some reported that they blew on the child's food/tea or spread the food out with a utensil to cool it quickly.

> 'When the child is about three or four months old, I crush the food with my fingers, blow on it to cool it and sometimes I taste it to be sure it is cool enough. Then I feed the child but the food remains on its plate', female 26 years, KSHV seropositive.

> 'When this young child was still six-seven and below, I would put small amount of food in his plate and would use a fork to turn it around to cool but other times I would blow on it to cool', female 30 years, KSHV seropositive.

> 'Each child eats from his /her own plate but I do take a spoon and use it to cool the food by turning it around then I give it to the child to eat', female 31 years, KSHV seronegative.

Some respondents explained that in some circumstances, they just left the child's food/tea to cool by itself. However, this depended on how hungry the child was and how busy the caregiver was at that time.

Most respondents reported that children in their households shared food amongst themselves. For example, a group of three to five children might take bites from the same mango, sugar cane, or jackfruit pieces.

> 'They share so much as children but mostly they share jackfruit. They have a habit of not cutting the jack into pieces and prefer biting from one piece and they claim its better and sweeter that way', female 35 years, KSHV seronegative.

> 'Children bite off from the same fruit like mango, jackfruit or hard passion fruit […]. They share everything they get for eating with others and this can't be avoided and its even taught to them [because] children should learn how to share with others when they are still young', female 28 years, KSHV seronegative.

In addition to sharing fruits, children sometimes also shared sweets. In such incidences, children licked the same sweet or bit a piece off to give to another child. A 26-year-old woman explained that:

> 'Children share sweets because if the young one finishes its sweet, it will cry and its sibling will bite a piece from his/her share and give it to the child' KSHV seropositive.

Some participants reported that their entire family had some meals from the same dish. This was described as a traditional practice to promote togetherness within the family.

> 'When we are going to have a meal, we put a sort of mat (Kawempe) on the floor and we all sit around this mat in a sort of circle and food is put on this mat and each one is served on his/her plate or eats from the same dish as a sign of togetherness', female 53 years, KSHV seropositive.

There was also a tradition of drinking alcoholic beverages using the same straw to drink from a pot. This is reported to be among mainly newcomers in the community. It was also reported that small children in homes that served homemade alcohol were given alcohol from the same glass as adults.

> 'Sometimes some customers give my child a sip of their beer and whatever they are taking or eating because they carry him and love seeing him around them while they enjoy their beers. Sometimes when they don't want to give him he cries and they end up giving him because he likes the taste of beer', female 34 years, KSHV seronegative.

Treatment of child illness

Besides the feeding practices, almost all female respondents reported that traditional colic pain treatment required the caregiver/parent to pre-chew the herbs and spit the herbs-saliva mixture into the child/infant's mouth. The respondents explained that the herbs that treat colic pains must be chewed by an adult before giving to a child.

> 'I normally chew the dry palm leaf and the banana leaf used for cooking and spit the saliva from the chewed leaves into the mouth of the baby to stop the pain of the colic', female 23 years, KSHV positive.

> 'When babies are suffering from Colic pains, I chew peppermint or a piece of sugar cane and spit the juice in the mouth of the child', female 30 years, KSHV seronegative.

The findings reported above indicate that a number of different practices take place in homes which could lead to the sharing of saliva: checking and tasting drinks and food, as well as blowing on items to cool them for a child. We found that there was no difference in the chewing/tasting of food by the KSHV status of the adult who described themselves as performing the practice. This finding was arrived at after comparing KSHV seropositive, KSHV seronegative, and KSHV unknown status household feeding practices described by participants during interviews. We found that respondents in KSHV seropositive, seronegative, and unknown status reported similar feeding practices of pre-chewing the hard food/fruit, tasting the food, and blowing over it before feeding the infant.

Discussion

In this study we found that there were several child/infant feeding and traditional colic pain treatment practices that involved saliva exchange between the infant/child, other children, and their caregivers/parents observed in rural southwestern Uganda. These feeding and treatment practices involved: food and herbs premastication, taking turns to bite from the same fruit or licking on the same sweet or eating or drinking from the same food point. We found that food premastication was a widely observed practice in rural southwestern Uganda.

The reported reasons for food premastication in our study included: encouraging the child to eat and estimating the food temperature among others. Similar results have been reported from urban Zambian and Cape Town, South African lower socio-economic status caregivers (Crabtree et al., 2017; Maritz et al., 2011). Consistent with our findings was a cross-sectional study in rural Gabon that reported close to half of the study population practiced premastication and this was more common with smaller household size (Auer-Hackenberg et al., 2014). Elsewhere prevalence of premastication was reported to be a widespread practice in South African, Zambian, African American, Laos, and Chinese societies (Cao et al., 2014; Conkle et al., 2018; Ivy et al., 2012; Maritz et al., 2011; Zhao et al., 2018). The risk of transmitting saliva born infectious diseases through premastication remains a concern for many (Aggett, 2010; Crabtree et al., 2017; Pelto et al., 2010; Wojcicki, 2003).

Furthermore, this study revealed that saliva exchange occurred between the caregivers/parents and the infant/child in the process of care provision. This finding is consistent with earlier anthropological work in the Bunyoro region of Uganda. These studies reported that caregivers transferred premasticated herbs into the mouth of the child/infant they cared for (Roscoe, 1923; Wojcicki, 2003). Elsewhere in sub-Saharan Africa, the use of premasticated herbs have been widely reported. For example, in Somalia, premasticated herbs are believed to treat unhealing wounds with pus and snake bites. Among the Bena in Tanzania, premasticated herbs were reported to treat boils while among the Igbo in Nigeria, saliva was believed to treat worms in newborn babies (Wojcicki, 2003). It is also worth noting that evidence on colic pain treatment using mainstream medicine remains controversial and research on how caregivers manage colic pain remains almost non-existent (Sung et al., 2014, 2018).

We also found that there was food sharing among family members and fruit sharing among children within the household and the community in ways that allowed saliva exchange but there was no difference in the chewing or tasting of food before giving to a child by a respondent's KSHV serostatus. We also found that many households would share utensils or vesicles for eating and drinking. This finding is consistent with a population-based survey in urban Zambia which reported sharing of utensils between child and caregiver as associated with KSHV incident infection (Crabtree et al., 2017). It is also consistent with a study that identified food and/or sauce plate sharing within households in rural Uganda as a potential risk factor for KSHV transmission, although neither of these practices nor chewing or taste testing food before feeding an infant were associated with time to child KSHV seroconversion (Butler et al., 2011). A study from rural Tanzania reported food-sharing practices among members of different families which potentially exposed the food-sharing members to a risk of KSHV transmission (Mbulaiteye et al., 2003).

To the best of our knowledge, this is the first study to investigate sociocultural roles in the transmission of pathogens spread by saliva in a rural Ugandan population. KSHV shedding in oral fluids is recognised as the primary route of viral transmission. In sub-Saharan Africa, children seroconvert for KSHV at young ages suggesting that the factors that lead to KSHV shedding and therefore those factors within a household affecting transmission may be leading to earlier childhood seroconversion with KSHV. In this paper, we have identified feeding and other practices that may promote saliva transfer and therefore potential viral transmission of KSHV, however, these findings are also applicable to other orally transmitted pathogens. The study was also able to collect detailed qualitative data about the study households through two home visits, which included an initial familiarisation visit and a final data collection visit. This was achieved through the deployment of two experienced research assistants and well-built rapport within the community. Nevertheless, the study had some limitations; for example, we purposely selected half of our households to include people living with HIV. Though the proportion of households with people living with HIV in the GPC are unknown, the overall HIV seroprevalence is ~10% (Kasamba et al., 2023), and so would be expected to be much lower than included in our study. We did not establish explicitly that feeding practices and traditional colic pain treatment were risk factors for KSHV transmission. In this study, we did not identify whether feeding practices were associated with KSHV seropositivity in children as this was outside the scope of this manuscript. However, this study provides insights that support more detailed and generalisable future investigations of risk factors for KSHV transmission. By working with two experienced interviewers and conducting more than one interview we endeavoured to minimise recall bias.

Conclusion

Households' infant feeding practices and child food sharing practices coupled with traditional colic pain treatment potentially present as transmission modes for viruses and other pathogens spread through saliva. These findings should direct the design of future quantitative studies, including large sample sizes and adjustments for confounding, to more finitely identify the risk factors affecting the transmission of KSHV and other orally shed infections via saliva in rural southwestern Uganda.

Acknowledgements

We acknowledge the contributions of the MRC/UVRI and LSHTM Uganda Research Unit Kyamulibwa station team to our research. We are particularly grateful to all the study participants for the time and information they shared with us.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the National Cancer Institute, National Institutes of Health (R01 CA239588, AI141531). It also received support in whole or in part with federal funds from the National Cancer Institute, National Institutes of Health under contract number HHSN261201500003I and NCI contract 75N91019D00024 to DW. The Ugandan General Population Cohort study is funded by the UK Medical Research Council (MRC) and the UK Department for International Development (DFID) under the MRC/DFID Concordant Agreement. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Data availability statement

Data are available within the supplementary materials.

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