ABSTRACT

Animal milk is an important contributor to women's dietary diversity, especially among pastoral communities where access to diverse diets is limited. While there have been numerous large-scale milk development projects in East Africa, few examples of propoor milk collective action projects exist that focus on expanding milk production and consumption by women. This study reports cross-sectional findings on the association between participation in a pro-poor dairy development project and women's milk consumption in rural Tanzania. Socio-demographic and health-related characteristics associated with milk consumption were assessed as well. The study utilized data from a sample of 272 women who participated in two surveys conducted in the Morogoro and Tanga regions of Tanzania in 2015. Chi-square and Cochran–Mantel–Haenszel analyses identified factors associated with whether milk was consumed in the previous 24-hour period. Analysis of variance (ANOVA) identified factors associated with frequency of milk consumption. Multivariable logistic regression was applied to estimate associations between program participation, socio-demographic, health characteristics, milk consumption behavior. Seventy-six percent of women reported drinking milk in the previous 24-hour period. The mean frequency of milk intake among the control group was 1.61 times 2.15 times among the intervention group. The adjusted odds of consuming any milk in the previous 24 hours were 16.1 (95% CI 1.72-150.44) times greater for Maasai than other tribes. Among Maasai, the adjusted odds of consuming milk 3-4 times per day compared to 1-2 times per day were 9.96 (95% CI 1.03 - 96.09) times greater for those in the dairy development group compared to the control. Among non-Maasai, the adjusted odds of consuming any milk in the prior 24 hours was 3.45 (95% CI 1.07- 11.05) times greater for those in the dairy development group compared to the control. Milk consumption was greatest among Maasai and communities with propoor dairy development programs. Findings suggest that participation in a Pro-poor agricultural intervention to improve milk production may improve women's milk consumption and ultimately help to address rural poverty and improve household nutrition.

Key words: milk project, pastoral women's health, food and nutrition security, Tanzania

INTRODUCTION

In low and middle-income countries, over half of women of reproductive age (WRA) experience nutritional deficiencies, putting themselves and their infants at risk for poor health and development outcomes [1]. In 2010, 11% of WRA in Tanzania, were underweight with a body mass index (BMI) less than 18 kg/m^2, and 22% were overweight (BMI > 25 kg/m^2) [2]. Furthermore, anemia was reported in 40% of nonpregnant women aged 15-49 and 53% of pregnant women; only 35% of women regularly consumed iron-rich foods [2]. In these contexts, animal source foods (ASF) contribute significantly to dietary diversity, protein, and micronutrient adequacy [3, 4]. In pregnancy, milk consumption is associated with healthy weight gain during the third trimester, while increased calcium intake from milk may reduce hypertension and the risk for preeclampsia [5-7]. According to the 2010 National Demographic Health Survey, less

than one quarter (24%) of women reported drinking milk in the prior 24 hours [2]. Understanding the factors associated with milk consumption can provide important insight into potential facilitators and barriers to improving women's nutrition as well as their children's health.

In East Africa, pastoralists rely primarily or exclusively on livestock herding for their livelihoods, and milk often serves as a primary source of nutrients [8]. For example, one study conducted among pastoralists in Kenya demonstrated that over half of vitamins A, B_{12}, and C were obtained from milk [9].

Women living in pastoral communities obtain more nutrients from milk compared to women in more sedentary communities [10]. Furthermore, when comparing pregnant and post-partum health status of pastoral and sedentary women, pastoral women have significantly higher levels of iron and their children have higher birth weights [11]. The Maasai in particular, while increasingly agro-pastoralist, are a traditionally pastoralist tribe that consumes substantially more cow's milk (90%) compared to other ethnic groups (30-70%) [8].

Pastoral communities are gradually adopting agricultural practices as drought plagues areas where they traditionally live, among other factors. As traditionally pastoral nomadic tribes adopt more diverse livelihood strategies, their health outcomes may change as well [12]. However, with these livelihood shifts, some pastoralist communities have begun to supplement their diets with increasing amounts of cereals and grains [12], although milk remains a primary source of nutrients [8].

Existing research on women's milk consumption is primarily from resource wealthy countries [13], and largely focuses on pregnant women [14], the impact of milk on fetal development [14], or women who are older than reproductive age [15]. Research conducted among the Maasai tribe has focused mainly on the consumption habits of children, the household, or how mothers' consumption habits impact children's health [8]. Little research has explored factors associated with women's milk consumption with the aim of understanding its effect on women's own nutrition and health status.

Traditionally, dairy projects in low-resource settings in East Africa have focused on mass production at better-off farms to develop capacity to supply milk to local community members. These projects have had mixed results in the East African markets [16], which may be due to the fact that local communities producing their own milk tend to consume 90% of the milk, so demand for market-bought milk may be missing [17]. Or, it may be related to the fact that men have traditionally had final decision-making power within households, which has contributed to women's poverty [18]. Historically, dairy projects did not incorporate change of social structure as a program strategy, and consequently, some projects further impoverished women when women participated in projects as unpaid laborers [19].

This project approached agricultural development differently in that it targeted smallholder dairying [16] with livestock keepers identifying and guiding priorities at the onset, and involved other stakeholders including local government. This pro-poor approach also engaged women as vital participants in the dairy project.

The objective of the paper is to report findings on the associations between participation in a pro-poor dairy development project, socio-demographic and health-related characteristics and women's milk consumption. Data are from the Irish Aid-funded *More milk by and for the poor: Adapting dairy market hubs for pro-poor smallholder value chains in Tanzania* (MoreMilkiT) study, which was a research-for-development project coordinated by the International Livestock Research Institute (ILRI). The project aims to reduce poverty and vulnerability among dairy-dependent livelihoods through enhanced access to dairy market business services and viable organizational options.

MATERIALS AND METHODS

MoreMilkiT Project Site

The MoreMilkiT project interventions are ongoing since 2013 in two districts in the Morogoro region (Kilosa and Mvomero) in Tanzania's Coastal zone, and two districts in the Tanga region (Handeni and Lushoto) in the Northern zone. These districts were chosen by the MoreMilkiT project for their diverse populations of both pastoralist and sedentary agriculture-based cattle keepers. The sites were selected for the ILRI dairy hubs project because they present contrasting dairy production to consumption value chains. Kilosa and Handeni districts represent mostly pre-commercial rural production for rural consumption, while Mvomero and Lushoto districts represent more commercial rural production for urban consumption.

Site selection and sampling

The four study districts were identified based on a combination of spatial map overlays, stakeholder consultations, scoping visits, and in-country partner preferences. Within these districts, intervention communities were selected using a two-phase process: 1) the development of a village list based on available information on the number and type of cattle keepers and cattle population obtained from the district livestock officials; 2) an in-depth study of villages using participatory scoping and observation. From these two activities, a data summary report with recommendations for 35 intervention communities and type of dairy hub interventions was produced; a final sample of 25 communities was selected based on accessibility and community engagement. Communities included those that practice pastoral, agro-pastoral, and business livelihoods to obtain a wide geographical spread over the study area.

Stratification occurred per participation in a market hub. As part of the evaluation strategy, 500 households were randomly selected from the 25 project communities and in four additional communities (one per district) where no intervention was implemented for longitudinal follow- up of household milk production.

Household monitoring surveys that captured detailed socio-demographic, economic, and milk production data were collected in June / July 2014 and May/June 2015. An additional nutrition survey was implemented in July-August 2015 with 373 of these households; eligible households for the nutrition survey included those with a child less than 24 months or a woman of reproductive age (15-45 years). For the present study, analyses were restricted to women who had data from both the household monitoring survey in 2015 and the nutrition survey, resulting in a final analytic sample of 272 women.

Ethical considerations

Study protocols were approved by ILRI ethics review committee prior to data collection. No risks to participate were identified. Participants were informed about the study, the intention of gathering information, and assurance of confidentiality. Patients who agreed to participate provided verbal informed consent. Emory University approved analysis of de-identified data in December 2015.

Household sociodemographic survey

The May/June 2015 household monitoring survey collected data on each household member including age (categorized in five year increments), religion (Muslim, SeventhDay Adventist (SDA) Christians, non-SDA Christians, others), ethnicity (Maasai, Ziguia, Sambaa, others), marital status (married in polygamous marriage, married in monogamous marriage, single, widow, other), status in the household (head of household, wife of head of household, mother of head of household), livelihood strategy (pastoralist, agricultural, agro pastoralist, farming and business) and intervention status (intervention or control). Household characteristics data included responsibility for chores, cooking fuel, water source, and toilet facilities.

The ethnicity and type of marriage variables were modified to combine people that represented less than 3% of the population into an 'other' category; any values that did not fit a common description were also included in "Other" [1]. Livelihood strategies were classified into agro-pastoral, which included livestock ownership plus crop farming; pastoral; and diversified, which included any combination of salaried work or nonagriculture income such as mechanics, traders, and shop-keepers.

Nutrition and women's empowerment survey

Data for the nutrition survey were collected using both paper-based and electronic (tablet) data capture. Dietary diversity was assessed using an open recall method of all foods consumed in the previous 24 hours with subsequent categorization into food groups using the Food and Agriculture Organization (FAO) approach [20]. Additionally, women were questioned about the number of times milk in any form was consumed in the previous 24 hours. Women were also questioned about the number of days in the past 7 days they

[1] Ethnic groups included in the "Other" category: Pare, Hagga, Mburu, Kaguru, Nguu, Irawq, Muarusha, Mkwizu, Mng'washu, Mklinidi, Nyamwezi, Kinga, Nyaturu, Zigua, Mfipa, Hehe, and Mngoni. Marital status types included in the "Other" category: single and other.

consumed any food items / groups, including milk. These data were used to estimate: a) whether milk was consumed in the previous 24 hours (yes/no), b) frequency of milk consumption in the previous 24 hours (1-2 times/3-4 times), and c) whether milk was consumed in the previous 7 days (yes/no). Food allocation priorities were assessed by asking the respondent to indicate the type of household member who would be prioritized to receive specific foods if these were insufficient. The specific foods were animal source foods, including milk, as well as staples, fruits, and vegetables. Types of potential household members included elder men, elder women, non-pregnant / lactating adult women, pregnant women, lactating women, children under five, school age boys, school age girls, male adults, day laborers, and household visitors. Household food insecurity was assessed using the Household Food Insecurity Access Scale and the months of adequate food provisioning tool [21, 22]. Participants were asked whether they had experienced any of the following illnesses in the previous seven days: diarrhea, fever, vomiting, acute respiratory disease, and other illnesses whose symptomology did not match the four standardized options. Anthropometric measures, including weight and mid-upper arm circumference were collected in duplicate for women, using standardized measurement protocols [23]. Height was measured using an adult Schorr Board, weight using a SECA scale (model 874), and MUAC using a UNICEF non-stretchable tape. Discrepancies of more than 0.5 cm or 0.5 kilograms cued a third measurement.

Statistical Analysis

Descriptive statistics were calculated for all variables. Missing data were handled through listwise deletion. Chi-square, Cochran–Mantel–Haenszel, and ANOVA tests were used to assess bivariate associations for continuous and categorical data. Logistic regression was used to estimate associations between program participation, sociodemographic, health characteristics, and milk consumption behavior. Due to differences in milk consumption by region ($p<0.01$) and ethnic group ($p<0.01$) observed in bivariate analyses, examination of factors associated with milk consumption were stratified by Maasai and non-Maasai. Differences at $p < .05$ were considered significant for all tests. Analyses were conducted using SAS 9.4 (SAS Institute, Cary, NC).

RESULTS AND DISCUSSION

Women were on average 32 years of age. Mean BMI for non-pregnant women was healthy at 23.2 kg/m^2; 13% of the sample was underweight (<18.5 kg/m^2), 60% were healthy (18.6-24.9 kg/m^2), 20% were overweight (25-29.9 kg/m^2), and 8% were obese (> 30 kg/m^2). Most women were either in monogamous (63%) or polygamous partnerships (31%). Thirty-seven percent of participants reported suffering from illness in the previous seven days, most commonly diarrhea and fever. The majority of women (91%) were not pregnant, and among those with children aged 6-24 months (n=92), 86% were breastfeeding. The Masaai comprised the highest proportion of the Morogoro sample (70% in Mvomero and 85% in Kilosa).

Over half of adult women held primary responsibility for collecting cooking fuel (54%), followed by combined responsibility held by adult women and girl children (31%).

Firewood was used as cooking fuel by 86% of participants, and 75% used traditional stone stoves for cooking. For water, participants used a borehole (22%), a well (39%), and a tap/piped water (28%). Nearly half practiced open defecation while 27% used a pit latrine without a slab, and 14% used a pit latrine with a cement or ceramic slab. Among those that shared toilet facilities (22%), 37% shared with one family, 17% with two families, and 13% with three families. A large minority of respondents reported shared housing with other families (37.8%). Food insecurity was highly prevalent with 50% of households reporting severe or moderate food insecurity in the previous 30 days.

Milk consumption by women

Husbands and fathers received first priority for milk (44.5%), followed by young children (29.2%). Equal distribution was reported by 10.7% of households, while 8.6% of households said that school-aged children received first priority. Women, including those pregnant or breastfeeding rarely received first priority (2% of households). Milk prioritization did not appear to differ by religion, district, or ethnic group.

Seventy-six percent of women reported drinking milk in the previous 24-hour period. Milk was most commonly consumed in tea or coffee (52%), followed by fresh milk on its own (33%), mixed with food (22%), and fermented milk on its own (5%). Among the women consuming milk in the previous 24 hours, consumption occurred between one and four times a day: 33% consumed once a day, 28% consumed twice a day, 34% consumed three times a day, and 5% consumed four times a day. Among those reporting consumptions in the previous 7 days (82%), 53% consumed on all 7 days, 22% consumed on 5 days or less. Given the greater variation of milk consumption in the previous 24 hours, subsequent analyses focus on consumption within the previous 24 hours.

Sociodemographic variables associated with milk consumption in the previous 24 hours

In bivariate analyses, there were significant differences in any milk consumption and the frequency of milk consumption in the previous 24 hours by sociodemographic characteristics (Table 1). Notably, milk consumption was associated with region ($p<0.01$), ethnicity ($p<0.01$), religion ($p<0.01$), livelihood strategy ($p<0.01$), household food security ($p=0.02$), intervention participation ($p<0.01$), and breastfeeding status ($p=0.01$). Frequency of consumption in the previous 24 hours was associated with region ($p<0.01$), ethnicity ($p<.01$), household food insecurity status ($p=0.02$), and breastfeeding status ($p=.03$) (Table 1). Milk consumption patterns did not differ by respondents' pregnancy status, household head status, or age.

While any milk consumption in the previous 24 hours was not associated with women's status in the household, women's household status may play a role in frequency of women's milk consumption. Previous studies demonstrated that children living in female-headed households are less likely to be malnourished, if the household has adequate financial resources [24]. Historically, dairy development projects have not focused on women's and consequently, women's impoverishment was a result of some of these projects [19]. This study had very few women household heads (7%); however,

women household heads consumed milk more frequently in the previous 24 hours (2.2 times) than their counterparts although this difference was not statistically significant (p= .61).

In this study, pregnant women consumed similar quantities of milk as non-pregnant women. This lack of difference in frequency of consumption described the Maasai women best in this study. In other research, it is documented that pregnant Maasai women consume a restricted diet compared to non-pregnant and non-breastfeeding women [25]. Milk and food consumption is often limited in late pregnancy to reduce the chance of birthing a large baby and to prevent pregnancy complications [26, 27]. Perhaps the lack of difference between pregnant and non-pregnant women's milk consumption is indicative of the cultural norm of limiting milk in pregnancy.

Factors associated with milk consumption in multivariable analyses - Overall Region was excluded from adjusted analyses due to collinearity with ethnic group. As milk consumption is more likely associated with socio-cultural and livelihood differences between ethnic groups rather than geographic boundaries, region was dropped and ethnic group was retained in the adjusted analysis. Additionally, given the high prevalence of milk consumption among Maasai (96%), stratified analyses were conducted to explore factors associated with any milk consumption among non-Maasai and frequency of milk consumption among Maasai.

In adjusted analyses of the overall sample, identification as Maasai (Odds Ratio (OR) 16.10, 95% Confidence Interval (CI)) 1.72-150.44 was associated with higher odds of consuming any milk in the previous 24 hours (Table 2).

As well, residing in an intervention community (OR 3.14, 95% CI 1.03-3.31) was associated with higher odds of any milk consumption and consuming milk more frequently (3-4 times compared to 1-2 times) in the previous 24 hours (OR 14.44, 95% CI). No other covariates were significantly associated with milk consumption in overall adjusted models. These findings are consistent with previous research documenting that Maasai communities consume more milk, more frequently than other ethnic groups [8].

Factors associated with milk consumption in multivariable analyses – By ethnic group Among Maasai, residing in an intervention community, was associated with 9.96 times higher odds of consuming milk 3-4 times a day compared to 1-2 times a day (95% CI 1.03 - 96.09) (Table 3).

Similarly, residing in an intervention community was associated with increased odds of consuming any milk in the previous 24 hours among non-Maasai (OR: 3.45 (95% CI 1.07-11.05) (Table 4) but not with frequency of consumption. No other factors were associated with any milk consumption among non-Maasai, or frequency of milk consumption among Maasai.

The results show that living in an intervention village is associated with higher odds of consuming milk among non-Maasai, and higher frequency of consumption among Maasai, an ethnic group that traditionally consumes a substantial amount of milk [8]. The findings indicated that the intervention may be improving household nutrition through higher consumption of milk. While previous research indicates that participation in milk collective action initiatives may result in lower milk consumption if milk is sold rather than consumed at home, other research demonstrates that programs that increase access to markets and generate additional disposable income to purchase supplemental food improve diet diversity [28, 29]. Additionally, in East Africa in particular, some milk production projects have failed in part because local communities that produce milk consume 90% of that milk, which has results in low demand for market-bought milk [17]. The study demonstrated that household participation in this pro-poor dairy improvement project is associated with increased milk consumption among both pastoralist and non-pastoralist women. This project also suggests the effectiveness of participating in a pro-poor approach for increased milk consumption.

Milk consumption and associations with health outcomes

Milk consumption patterns were not associated with morbidity or underweight status when examined overall (Table 5).

Limitations

While there was a significant association between milk consumption and residing in dairy hub intervention communities, this finding should be interpreted considering several limitations. Individual milk consumption was not measured at baseline rule out that differences existed at baseline and are not the result of the dairy development intervention. However, household milk production was assessed and did not differ significantly ($p=0.69$) between the intervention and control households (mean 3.78 liters/household/day in intervention versus 3.43 liters/household/day in control). Further, confidence intervals were wide, likely due to the small sample size. This cross-sectional study presents findings from one point in time and does not capture seasonal variation in milk production and consumption or allow for causal inference. The study utilized an open 24-hour recall of foods consumed but did not estimate quantities of food consumed. As such this study cannot estimate the contributions of milk to women's macro- and micronutrient intakes. Furthermore, because the sample is restricted to cattle-keepers across a spectrum of sedentary and nomad, findings are not generalizable to non-cattlekeeping households in Morogoro and Tanga regions.

CONCLUSION

This study aligns with previous work indicating that tribal affiliation is a strong determinant of milk consumption among women. Findings also suggest the importance of pro-poor dairy development interventions for women's milk consumption. The findings suggest that women's nutrition programs and policies should incorporate empowerment strategies and target women as project participants. It is recommended

that similar research be conducted longitudinally, starting with a baseline survey, and on a larger scale, using broader population-based samples.

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Table 1: Sociodemographic characteristics of 269 Tanzanian women aged 15-45 in Tanga and Morogoro regions

Characteristic	*Overall (N= 270)*	*Consumed any milk in previous 24 hours (N= 233)*		*P value*[2]	*Frequency of milk intake in previous 24 hours (N=176)*	*P value*[3]
	N (%)[1]	**No**	**Yes**		**Mean (SD)**	
Village type (N=269)						
Control	41 (15.24%)	15 (50.54%)	22 (59.46%)	p=0.01	1.61± .66	P=0.01
Intervention	228 (84.76%)	41 (21.03%)	154(78.97%)		2.15 ± .93	
District (N=270)						
Mvomero (Morogoro)	65 (24.16%)	4 (7.14%)	50 (92.59%)	P<0.01	2.46 ± .88	P<0.01
Kilosa (Morogoro)	69 (25.65%)	0 (0%)	60 (100%)		2.35 ± .84	
Handeni (Tanga)	58 (21.56%)	15 (28.85%)	37 (71.15%)		1.83 ± .88	
Lushoto (Tanga)	77 (28.62%)	37 (56.06%)	29 (43.94%)		1.23 ± .43	
Ethnic group (N=254)						
Maasai	117 (46.25%)	4 (3.77%)	102(96.23%)	P<0.01	2.44 ± .88	P<0.01
Sambaa	64 (25.31%)	26 (48.15%)	28 (51.85%)		1.43 ±.63	
Ziguia	32 (12.65%)	10 (35.71%)	18 (64.29%)		1.32 ±.47	
Others	40 (15.81%)	10 (30.30%)	23 (69.70%)		1.95 ± .86	
Religion (N= 270)						
Muslim	101 (37.55%)	41 (46.59%)	47 (53.41%)	P<0.01	1.39 ± .60	P<0.01
Non-SDA Christians	152 (56.16%)	11 (8.59%)	117(91.41%)		2.37 ± .88	
Not religious	11 (4.09%)	2 (20.00%)	8 (80.00%)		2.12 ± .99	
Other	6 (2.23%)	2 (33.33%)	4 (66.67%)		2.25 ± .95	
Marital status (N= 270)						
Monogamous	170 (63.20%)	35 (24.14%)	110(75.86%)	P=0.04	1.89 ± .91	P<0.01
Polygamous	84 (30.86%)	15 (19.74%)	61 (80.26%)		2.43 ±.86	
Other	16 (5.95%)	6(54.55%)	5 (45.45%)		2.20 ±. .83	
Status in household (N=270)						
Head	19 (7.06%)	5 (31.25%)	11 (68.75%)	p=0.41	2.27 ± .78	p=0.61
Wife of head	211 (78.44%)	44 (23.78%)	141(76.22%)		2.057 ± .92	
Mother of head	3 (1.12%)	0 (0%)	3 (100%)		2.00 ± 1.00	
Daughter of head	21 (7.81%)	6 (35.29%)	11 (64.71%)		2.00 ± 1.09	
Other	15 (5.58%)	1 (9.09%)	10 (90.91%)		2.5 ± .84	
Age (N=210)						

15-25	118 (56.19%)	30 (28.57%)	75 (71.43%)	P=0.65	2.12 ± .91	p=0.36
26-35	79 (37.62%)	15 (22.06%)	53 (77.97%)		1.98 ± .89	
>35	13 (6.19%)	5 (62.50%)	3 (37.50%)		2.66 ± .57	
Household Food Insecurity Access Category (N=270)						
Secure	86 (31.97%)	20 (27.03%)	54 (72.97%)	P=0.02	1.91 ± .91	P=0.02
Mildly secure	50 (18.59%)	15 (36.59%)	26 (63.41%)		1.77 ± .86	
Moderately secure	72 (26.77%)	16 (24.62%)	49 (75.38%)		2.29 ± .91	
Severely insecure	61 (22.68%)	5 (9.62%)	47 (90.38%)		2.29 ± .91	
Livelihood strategy (N=268)						
Pastoral	63 (14.13%)	0 (0%)	31 (100%)	P<0.01	2.25 ± .91	P=0.21
Agro-pastoral	313 (70.18%)	41 (24.26%)	128(75.74%)		2.11 ± .85	
Diversified[4]	70 (15.70%)	15 (48.39%)	16 (51.61%)		1.68 ± 1.01	
Maternal status (N=266)						
Pregnant	23 (8.65%)	7 (33.33%)	14 (66.67%)	P=0.31	2.23 ± 96	p=0.66
Not pregnant	243 (91.35%)	49 (23.44%)	160(76.56%)		2.23 ± .92	
Breastfeeding status (N= 237)						
Breastfeeding if have a child 6-24 months (n=92)	79 (91.14%)	11 (16.18%)	57 (83.82%)	P=0.01	2.21 ± .83	P=0.03
Not breastfeeding	145 (64.89%)	41 (32.54%)	85 (67.46%)		1.95 ± .92	
BMI (N=194)						
<18	25 (12.89%)	6 (24.00%)	19 (76.00%)	P=0.92	2.47 ± .90	p=0.14
18-25	116 (59.79%)	29 (25.00%)	87 (75.00%)		1.96 ± .92	
26-30	36 (18.56%)	8 (22.22%)	28 (77.78%)		2.21 ± .84	
>30	17 (8.76%)	4 (23.53%)	13 (76.47%)		2.07 ± 1.11	
Morbidity in the previous 7 days (N= 264)						
No	165 (62.50%)	36 (23.84%)	115(76.16%)	P=0.41	2.66 ± .57	P=0.32
Yes	99 (37.22%)	20 (24.69%)	61 (75.31%)		2.10 ± .97	
Diarrhea	6 (6.06%)	3 (60%)	2 (40%)	P=0.05	1 .00 ± 0	
Fever	45 (45.55%)	7 (20%)	28 (80%)	P=0.39	2.29 ± 1.10	
Respiratory infection	23 (23.23%)	7 (36.84%)	12 (63.16%)	P=0.16	2.09 ± 1.04	

[1] Sample is not equal to full sample due to use of listwise deletion

[2] P value estimated from CMH/Chi-square

[3] P value estimated from ANOVA

[4] Diversified livelihoods include any form of livelihood that included salaried work

Table 2: Factors associated with milk consumption among women of reproductive age in Tanzania

Variable	**Adjusted Odds Ratio (95% confidence limit)**	
Overall (n=269)	Any Milk Consumption	Frequency of milk consumption (1-2 times vs. 3-4 times)
Ethnic group (non-Maasai is referent) [+]	**16.10 (1.72-150.44)**	0.53 (0.17-1.68)
Religion (non-SDA is referent) [+]	0.25 (0.08-0.74)	0.14 (0.03-12.75)
Marital status (polygamous is referent) [+]	1.082 (0.35-3.31)	0.53 (0.22-1.28)
Age (15 years is referent) [+]	1.90 (0.32-11.47)	0.14 (0.03-12.75)
Food security status food insecure is referent) [+]	1.23 (0.47-3.19)	0.94 (0.36-2.51)
Livelihood strategy: agro-pastoral (pastoral is referent) [++]		0.51 (0.17-1.90)
Livelihood strategy: diversified (pastoral is referent) [++]		0.38 (0.04-3.06)
Breastfeeding status (breastfeeding is referent)	0.43 (0.15-1.28)	0.63 (0.27-1.44)
Group (control is referent)	**3.14 (1.03-3.31)**	**14.44 (1.60-130.39)**

[+] Ethnic group, religion, marital status, age, and food security status were dichotomized
[++] Livelihood strategy was excluded for any milk consumption due to lack of variability

Table 3: Factors associated with frequency of milk consumption among women of reproductive age in the Maasai ethnic group in Tanzania in multivariable logistic regression

Variable	**Adjusted Odds Ratio (95% confidence limit)**
Among Maasai (n=58) [A]	Frequency of milk consumption (1-2 times vs. 3-4 times)
Group (control is referent)	**9.96 (1.03-96.09)**
Religion (non-SDA is referent)	0.53 (0.04-8.04)
Marital status (polygamous is referent)	0.81 (0.30-2.22)
Food security status (secure is referent)	0.73 (0.22-2.42)
Livelihood strategy (Agro-Pastoral vs. Pastoral)	0.64 (0.19-2.17)
Livelihood strategy (Diversified vs. Pastoral)	0.97 (0.07-14.19)

Breastfeeding status (not breastfeeding is referent)	0.60 (0.22-1.60)

[A]Age, any milk consumption among pastoralists, and any milk consumption among Maasai were excluded due to lack of variability

Table 4: Factors associated with any milk consumption among women of reproductive age in ethnic groups other than the Maasai in Tanzania

Variable	**Adjusted Odds Ratio (95% confidence limit)**
Among non-Maasai (n=100)[B]	Any Milk Consumption
Group (control is referent)	**3.45 (1.07-11.05)**
Religion (non-SDA is referent) [BB]	0.23 (0.07-0.72)
Marital status (polygamous is referent) [BB]	1.41 (0.42-4.66)
Food security status (secure is referent) [BB]	1.40 (0.52-3.78)
Breastfeeding status (not breastfeeding is referent)	0.46 (0.16- 1.37)
Age (15 years is referent) [BB]	1.71 (0.27-10.72)

[B] Livelihood strategy and frequency of milk consumption among non-Maasai were excluded due to lack of variability
[BB] Religion, marital status, age, and food security status were dichotomized

Table 5: Factors associated with being underweight among 272 women in rural Tanzania

Variable	**Adjusted Odds Ratio (95% confidence limit)**
Overall (N=184)	
Ethnic group (non-Maasai is referent)	1.23 (0.48-3.13)
Group (control is referent)	1.95 (0.41-2.13)
Religion (non-SDA is referent)	0.98 (0.41-2.36)
Marital status (polygamous is referent)	2.55 (0.48-12.63)
Food security status (insecure is referent)	0.92 (0.48-1.75)
Livelihood strategy: agro-pastoral (pastoral is referent)	0.46 (0.18-1.19)

Livelihood strategy: diversified (pastoral is referent)	0.51 (0.14-1.85)
Milk consumption (none is referent)	1.03 (0.47-2.24)

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