Trends and Inequalities in Young Child Nutrition in Rwanda

Further Analysis of the 2014-15 Demographic and Health Survey

Republic of Rwanda

Trends and Inequalities in Young Child Nutrition in Rwanda:

Further Analysis of the 2014-15 Demographic and Health Survey

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ABSTRACT

This report documents trends in key child nutrition indicators in Rwanda. Data from the Demographic and Health Surveys (DHS) in 2005, 2010, and 2014-15 were analyzed, disaggregated by selected equity-related variables, and tested for trends. Over the survey period, Rwanda had high rates of exclusive breastfeeding, with regional variation. Rates of continued breastfeeding were also high but generally decreased as mother's education and household wealth increased in all survey years. Complementary feeding practices varied by region, mother's education, household wealth, urban-rural residence, and sex of the child. Generally, consumption of vitamin A-rich foods was high but consumption of iron-rich foods was low, with differences by household wealth. Consumption of iron-rich foods also varied by region, urban-rural residence, and mother's education. There were substantial differences in the prevalence of stunting by urban-rural residence, region, and household wealth, and between boys and girls. These findings suggest that strategies are warranted to increase the prevalence of optimal breastfeeding in urban areas and among the wealthier and more educated. Urgent efforts to improve appropriate complementary feeding practices are needed, and these practices should be monitored by socioeconomic characteristics, residential status, and region in order to focus on groups and areas most in need. Strategies to improve complementary feeding practices among rural residents, poor households, and mothers with less education should be tested, along with specific regional strategies.

SUMMARY

Poor nutrition is associated with nearly half of child mortality worldwide. This report presents an analysis of key infant and young child nutrition indicators in Rwanda and an examination of nutrition inequalities among different groups by selected equity-related variables (sex, residence, region, mother's education, and household wealth status). Demographic Health Survey (DHS) data from 2005, 2010, and 2014-15 were analyzed, disaggregated by equity-related variables, and tested for trends over time. The main findings include:

- The prevalence of exclusive breastfeeding remained near 90% between 2005 and 2014-15. Prevalence increased significantly among infants (under age 6 months) whose mothers had a secondary or higher education, but decreased among infants in South region.

- The prevalence of continued breastfeeding among children age 20-23 months increased by survey year in a statistically significant trend for both girls and boys. Prevalence increased in both urban and rural areas between 2005 and 2010. In rural areas it continued to increase in 2014-15. Regional differences narrowed somewhat between 2005 and 2014-15. In all survey years the lowest prevalence of continued breastfeeding was for mothers with secondary or higher education. In general, the prevalence of continued breastfeeding was lower with higher levels of household wealth.

- Consumption of the recommended minimum number of meals increased from 47% in 2005 to 51% in 2010 but fell back to 47% in 2014-15, with differences by region. For all years the percentage increased as household wealth increased overall, but there was a difference of 20 percentage points between the lowest and highest wealth quintiles in 2014-15.

- The percentage of children consuming four or more food groups significantly increased between surveys in 2010 and 2014-15, from 25% to 30%, while in both years a greater percentage of girls than boys consumed four or more food groups. Data from 2005 could not be compared due differences in measurement compared with the two more recent surveys. The increase between 2010 and 2014-15 was statistically significant for rural areas, but prevalence remained twice as high in urban areas as in rural areas. Consumption of four or more food groups varied by region, with the highest percentage in Kigali city in both survey years. Percentages increased significantly in most regions. In both 2010 and 2014-15 there were substantial differences between children whose mothers had a secondary or higher education and other mothers. Similarly, the percentage of children consuming four or more food groups was higher in wealthier households.

- Consumption of vitamin A-rich foods remained high between 2005 and 2014-15, at nearly three-fourths of children. A greater percentage of urban than rural children consumed vitamin A-rich foods. Also, the percentage was higher for children whose mothers had higher levels of education, and for wealthier households.

- Consumption of iron-rich foods nearly doubled between 2005 and 2010, from 12% to 20%, and then remained stable in 2014-2015. A greater percentage of urban children consumed iron-rich foods compared with rural children. In all three survey years the percentage of children consuming

iron-rich foods was higher with higher levels of mother's education, and in 2014-15 consumption was higher with higher household wealth.

- Stunting prevalence decreased between 2010 and 2014-15, with a higher percentage of boys stunted than girls in both years. In both surveys stunting prevalence generally was lower as household wealth was higher. Data on stunting, wasting, and underweight were not comparable for 2005 because of a change in the global standard reference population made in 2006.

- Wasting prevalence decreased between 2010 and 2014-15 but remained higher for boys than girls, with wide variation by region. There were mixed associations between wasting prevalence and mother's education and between wasting prevalence and wealth, with no clear patterns, although in both survey years the prevalence of wasting was higher among children in the lower household wealth quintiles.

- Underweight prevalence, a composite measure of stunting and wasting, decreased between 2010 and 2014-15 but was higher among boys than girls. In both survey years studied, urban areas had lower prevalence than rural areas, while Kigali city recorded the lowest underweight prevalence, at about half that of the region with the highest prevalence (East region in 2010 and North region in 2014-15). Underweight prevalence was lower as mother's education was higher; it increased substantially for children of mothers with secondary or higher education between the surveys. In 2014-15, underweight prevalence among households in the lowest wealth quintile was nearly four times the prevalence in the highest wealth quintile.

1   INTRODUCTION

Undernutrition causes an estimated 3.1 million child deaths annually and, in 2011, accounted for 45% of child deaths (Black et al. 2013). In response, the World Health Assembly named 2016-2025 the "decade of nutrition" and set global targets that were integrated into the Sustainable Development Goals (Bhutta 2017). Increased attention to nutrition in recent years has resulted in the Scaling Up Nutrition Movement, the Global Nutrition Reports, and growing recognition of nutrition inequity and the importance of using measurement techniques to reveal it (Bhutta 2017; Gillespie et al. 2013; IFPRI 2015).

Rwanda prioritized child nutrition in its National Food and Nutrition Policy, 2014-2018, focusing on a "national resolve" to substantially reduce stunting among children under age 2 (Ministry of Local Government et al. 2014). The government recognized the achievements made, while acknowledging the problem of persistent high levels of malnutrition, and provided a multisectoral framework to address nutrition challenges (Ministry of Local Government et al. 2014).

This report updates trend analyses of key infant and young child nutrition indicators in Rwanda, including disaggregations by selected equity-related variables (sex, urban-rural residence, region, mother's education, and household wealth quintile), to provide information for directing resources where they are most needed.

1.1   Background

Adequate nutrition is essential for child health and development, and for optimal growth and disease prevention (Black et al. 2013). Evidence-based interventions to address undernutrition and micronutrient deficiencies have been documented and costed (Bhutta et al. 2013). However, there are gaps in evidence for some interventions (e.g., complementary feeding), and for effective intervention delivery modalities (Bhutta et al. 2013). Further, "nutrition-sensitive" interventions, i.e., programs that address underlying determinants, such as education and agriculture, have been deemed critical for accelerating progress toward nutrition goals (Ruel et al. 2013).

Sustainable Development Goal (SDG) 2.2 calls for ending malnutrition by 2030. Globally, however, progress to improve nutrition is not on track to meet the SDG targets, and multiple famines around the world are further jeopardizing progress toward the goals (Development Initiatives 2017). Currently, wasting affects an estimated 52 million children under age 5, while 155 million children are stunted (Development Initiatives 2017).

Rwanda for many years has had a high rate of stunting, at more than a third of children under age 5 (NISR and ICF 2015). The government has documented poor complementary feeding practices and serious challenges with food security (Ministry of Local Government et al. 2014). Recognizing the gravity of this problem, Rwanda has renewed an emphasis on commitments to nutrition, including several policy actions (Ministry of Local Government et al. 2014):

- The Economic Development and Poverty Reduction Strategy for 2013-2018: Recognizes the problem of chronic malnutrition in children under age 2.

- Presidential Initiative: Emergency action to identify and manage all acute malnutrition in children (2009).

- Multisectoral participation in Rwanda's first National Nutrition Summit (2009) and second National Nutrition Summit (2011): Followed up with efforts to decentralize approaches to address the problem.

- Production of facility and community tools to promote maternal infant and young child nutrition: National multisectoral strategy to eliminate malnutrition (2010); national Joint Action Plan to eliminate malnutrition (2012); district plans to eliminate malnutrition in every district (2011).

Despite the need and Rwanda's national commitments, the country experienced an 82% decrease in nutrition aid ($23.9 million) in 2015 compared with 2014 (Development Initiatives 2017), which has likely slowed progress.

1.2 Nutrition, equity, and the Sustainable Development Goals

More than a decade ago it was recognized that attaining health goals could actually lead to more inequity if coverage of health interventions increased only for those who were relatively privileged (Gwatkin 2002). Monitoring key indicators among subgroups has become increasingly important to identify health inequity (Barros and Victora 2013). To achieve the SDGs, which explicitly focus on universal progress and leaving no one behind, redressing inequity must be a focus (Development Initiatives 2017).

Early childhood presents a window of opportunity to address health inequity. Breastfeeding, for example, has been cited as an equalizer because it conveys immediate and lifelong health benefits for children (Victora et al. 2016), is recommended for all children (WHO 2006), and requires little health infrastructure (Roberts et al. 2013). When complementary feeding begins and access to food takes on a larger role in determining child nutrition, however, resource inequality leads to health inequity.

This report analyzes nutrition among young children according to commonly selected equity-related variables (Barros and Victora 2013) to examine trends for population subgroups.

2   DATA AND METHODS

2.1   Data

DHS surveys in Rwanda conducted in 2005, 2010, and 2014-15 provided the data for this analysis. The DHS surveys are nationally representative, population-based household surveys that monitor demographic trends, infant and child mortality, child and reproductive health, nutritional status, family planning use, and many other health-related issues, as well as sociodemographic characteristics of women and men of reproductive age (www.dhsprogram.com). Use of a standard questionnaires enables comparisons of data over time. The surveys employed a two-stage cluster sampling strategy. In the first stage, clusters, based on the most recent national census, were identified using probability proportional to population size. Second, roughly 30 households were randomly selected per cluster. All women age 15-49 were eligible for interview in selected households. The numbers of women interviewed varied among the three surveys: 11,321 in 2005; 13,671 in 2010; and 13,497 in 2014-15. The numbers of children in each survey varied from one indicator to another, and are provided in Table 1.

2.2   Methods

2.2.1   Indicators

This study examines trends in key child nutrition indicators (Table 1). These include exclusive breastfeeding, continued breastfeeding, meal frequency, diet diversity, and consumption of foods containing vitamin A and iron. These indicators focus on modifiable caregiver behaviors that can have a health impact, although they can also represent larger issues related to inequitable access to appropriate foods for complementary feeding or to support for breastfeeding. In addition, the analysis examines three indicators of nutrition status among children—stunting, wasting, and underweight. The analysis focuses on children in the first two years of life, a sensitive developmental period when the nutrition a child receives can have lifelong consequences, and when nutrition interventions could potentially have a great impact on individual and public health.

To examine levels and trends in nutrition inequality, the analysis stratified the nutrition indicators by several equity-related variables, as shown in Table 2—mother's education, household wealth quintile, urban-rural residence, region, and sex of child).

Table 1. Selected nutrition indicators and definitions

Indicator	Definition*	Evidence and relevance	2005 n	2010 n	2014-15 n
Breastfeeding					
Exclusive breastfeeding	Percentage of youngest children age 0-5 months living with the mother who are exclusively breastfed	Exclusive breastfeeding is recommended for six months (WHO 2013), reduces infant morbidity and mortality, and contributes to lifelong health (Victora et al. 2016).	885	718	714
Continued breastfeeding at 2 years	Proportion of children age 20-23 months who are fed breast milk	Breastfeeding is recommended for at least 2 years (WHO 2013). Suboptimal breastfeeding contributes to higher morbidity and mortality risks (Bhutta et al. 2013; WHO 2013; Victora et al. 2016). Longer duration of breastfeeding is associated with greater linear growth (WHO 2013).	446	519	456
Complementary feeding					
Meal frequency	Percentage of youngest children age 6-23 months fed the minimum meal frequency, defined as receiving solid or semi-solid food at least twice a day for breastfed infants age 6-8 months; at least three times a day for breastfed infants age 9-23 months; and at least four times a day for non-breastfed infants	Breastfed children age 6-8 months should receive two meals per day; age 9-23 months should receive three meals per day. Non-breastfed children age 6-23 months should receive four meals per day (WHO 2010). Successful complementary feeding is needed to prevent malnutrition; growth faltering becomes evident at age 6-12 months (WHO 2013).	2356	2372	2409
Diet diversity	Percentage of children age 6-23 months fed four or more food groups. The food groups are a. infant formula, milk other than breast milk, cheese or yogurt or other milk products; b. foods made from grains, roots, and tubers, including porridge and fortified baby food from grains; c. vitamin A-rich fruits and vegetables (and red palm oil); d. other fruits and vegetables; e. eggs; f. meat, poultry, fish, and shellfish (and organ meats); g. legumes and nuts.	Feeding practices and diet affect child growth and development (WHO 2013). Successful complementary feeding is needed to prevent malnutrition; growth faltering becomes evident at age 6-12 months (WHO 2013).	X**	2372	2409
Consumption of foods rich in vitamin A in the last 24 hours	Percentage of youngest children age 6-23 months living with the mother who consumed foods rich in vitamin A in the 24 hours preceding the survey. Food rich in vitamin A include meat (and organ meat), fish, poultry, eggs, pumpkin, red or yellow yams or squash, carrots, red sweet potatoes, dark green leafy vegetables, mango, papaya, and other locally grown fruits and vegetables rich in vitamin A.	Vitamin A is a key micronutrient needed for a healthy immune system that protects from disease, and reduces morbidity and mortality (WHO 2013).	2356	2372	2409
Consumption of foods rich in iron in the last 24 hours	Percentage of youngest children age 6-23 months living with the mother who consumed foods rich in vitamin A in the 24 hours preceding the survey. Foods rich in iron include meat (and organ meat), fish, poultry, and eggs.	Iron is a key micronutrient needed for optimal development and prevents anemia (Black et al. 2013; WHO 2013).	2356	2372	2409
Nutrition status					
Stunting	Percentage of children age 0-23 months stunted (below -2 SD of height for age according to the WHO standard, 2006)	Stunting results from inadequate nutrition and repeated infections in utero and during the first 2 years of life. It significantly impedes human development, resulting in diminished capacity and poor health over the life course (WHO 2014).	X***	1572	1527
Wasting	Percentage of children age 0-23 months wasted (below -2 SD of weight for height according to the WHO standard, 2006)	Severe thinness is usually caused by a recent event, associated with acute starvation or severe disease, but could also be caused by a chronic condition (WHO 2017(a)).	X	1572	1527
Underweight	Percentage of children age 0-23 months underweight (below -2 SD of weight for age according to the WHO standard, 2006)	A composite measure of stunting and wasting; if there is no significant wasting in an area, then underweight reflects long-term health and nutritional experience, similarly to stunting (WHO 2017(a)).	X	1572	1527

*All definitions except continued breastfeeding at age 2 are from DHS Statcompiler https://www.statcompiler.com/en/. Anthropometric indicator denominators adjusted to match Rwanda's national goals. Continued breastfeeding at age 2 definition is from WHO (2010).
**Cannot use due to different global standard for this indicator calculation
***Cannot use due to different reference population

Table 2. **Selected equity-related variables and definitions**

Indicator	Definition	Evidence and relevance
Mother's education	None, primary, or secondary and higher	Higher maternal education is associated with lower child mortality (Gakidou et al. 2010).
Wealth quintile (household)	Economic status of household based on material assets and constructed via principal components analysis	Poverty creates ill health (WHO 2017b), and wealth inequality is associated with health inequity (Johns et al. 2013).
Residence	Rural or urban	Children's health indicators differ depending on where they live (Fink et al. 2014; Rutstein et al. 2016).
Region	Rwanda has five regions: Kigali city, North, South, East, and West.	DHS surveys have shown differences in child health indicator by region (NISR 2015 and NISR 2012).
Sex of child	Female or male	Sex affects nutrition outcomes (Darnton-Hill et al. 2005).

2.2.2   *Analysis*

For this analysis, data from the 2005, 2010, and 2014-15 Rwanda DHS surveys were re-tabulated with survey weights to present stratifications by equity-related variables and to test for trends within subgroups over time with Pearson's chi-square (association between year and outcome), using a significance threshold of a=0.05. All analyses were performed with Stata 15. Equity dashboards display the estimates of each nutrition indicator for each of the five equity-related variables.

3   RESULTS

3.1   Breastfeeding

3.1.1   Exclusive breastfeeding

Exclusive breastfeeding is recommended for the first six months of life (WHO 2006). Overall, the prevalence of exclusive breastfeeding decreased slightly over the study period, from 88% in 2005 to 87% in 2014-15 (Table 3 and Figure 1). Prevalence was lower among girls than boys, at 86% versus 89% in the 2014-15 survey. It remained higher in rural than urban areas over the study period. There were regional differences. In North and East regions prevalence increased slightly and steadily over the study period, while in Kigali city, South, and West regions it decreased between 2005 and 2010 and then increased between 2010 and 2014-15. Kigali city had a substantial increase over the study period, from 76% to 86%. South and West regions had decreases overall, and the trend in South region was statistically significant. In 2005 and 2010 prevalence of exclusive breastfeeding was higher among less educated mothers; in 2014-15 the highest prevalence was among mothers with primary education (88%), followed by mothers with secondary or higher education (87%) and mothers with no education (83%). Prevalence decreased over time for mothers with no education, stayed relatively constant for mothers with primary education, and increased for mothers with secondary or higher education, the latter with a statistically significant trend. There was little variability by household wealth. Prevalence of exclusive breastfeeding was highest for households in the fourth wealth quintile in all survey years (89% in 2014-15), followed by those in lower wealth quintiles. The lowest exclusive breastfeeding prevalence was consistently found for households in the highest wealth quintile, at 85% in 2014-15.

Table 3. Exclusive breastfeeding prevalence for infants under age 6 months, by equity-related variables, 2005-2015

	2005	2010	2014-15
Sex			
Female	87.3	86.9	85.7
Male	89.6	82.8	88.8
Residence			
Rural	89.2	87.3	88.3
Urban	83.0	69.5	82.9
Region			
Kigali city	76.1	70.3	86.4
South*	94.6	81.7	84.8
West	85.0	79.6	79.8
North	91.4	95.6	95.7
East	87.5	92.3	92.0
Mother's education			
No education	89.7	82.8	83.4
Primary	89.7	86.3	88.1
Secondary and higher*	71.9	78.5	86.5
Wealth quintile			
Lowest	88.3	86.6	88.4
Second	89.5	85.8	87.2
Middle	88.6	84.8	86.7
Fourth	92.0	86.7	88.9
Highest	82.7	80.3	85.2
Total	88.4	84.9	87.3

*Trend is statistically significant (p<0.05).

Figure 1.   **Exclusive breastfeeding equity dashboard**

Total prevalence

Prevalence by sex

Prevalence by residence

Prevalence by region

Prevalence by mother's education

Prevalence by household wealth
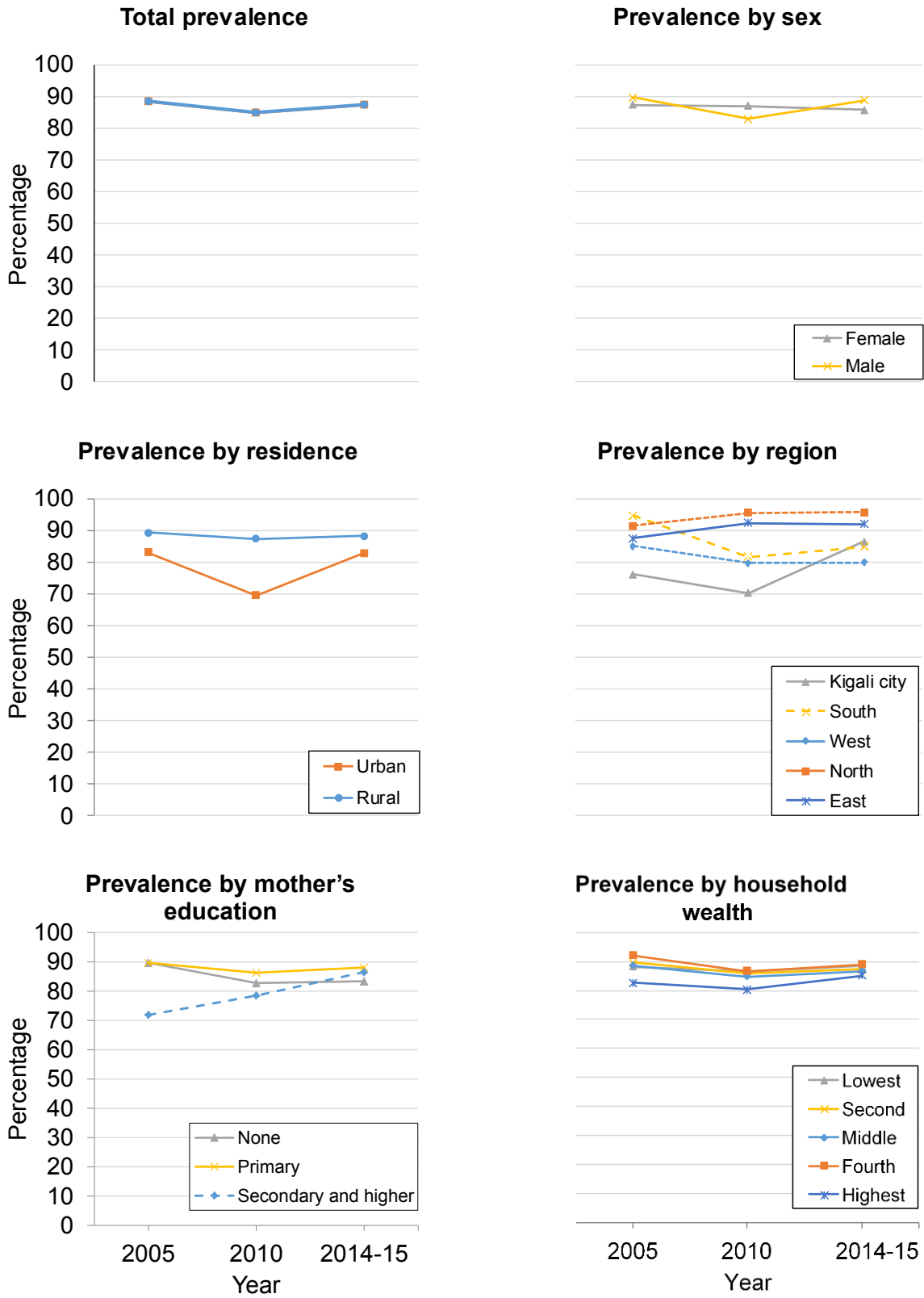
*Dashed line indicates a statistically significant trend (p<0.05).

3.1.2 Continued breastfeeding at 2 years

Breastfeeding is recommended for at least 2 years (WHO 2013). Overall, the prevalence of continued breastfeeding among children age 20-23 months increased in every survey year, from 77% in 2005 to 84% in 2010 and 87% in 2014-15, a statistically significant trend. The prevalence of continued breastfeeding also showed a statistically significant increase among both girls and boys. Prevalence increased in both urban and rural areas between 2005 and 2010 and in rural areas continued to increase in 2014-15 with a statistically significant trend, but in urban areas prevalence decreased between 2010 and 2014-15, from 81% to 77%. Regional differences narrowed somewhat between 2005 and 2014-15. Kigali city had the lowest prevalence of continued breastfeeding in all three survey years. North and East regions showed a statistically significant increase in continued breastfeeding over the survey period. Prevalence increased among mothers with a primary education in a statistically significant trend. In 2014-15 the prevalence of continued breastfeeding was lower with higher levels of mother's education. In all years the lowest prevalence of continued breastfeeding was among mothers with secondary or higher education.

Table 4. Continued breastfeeding prevalence among children age 20-23 months, by equity-related variables, 2005-2015

	2005	2010	2014-15
Sex			
Female*	79.0	81.6	88.1
Male*	75.5	85.3	86.3
Residence			
Rural*	79.4	83.8	89.6
Urban	60.1	81.0	77.0
Region			
Kigali city	59.1	76.2	75.7
South	86.3	91.2	90.1
West	86.4	79.6	86.7
North*	69.3	86.9	86.9
East*	67.9	80.6	91.0
Mother's education			
No education	85.5	82.9	92.2
Primary*	73.5	84.4	88.3
Secondary and higher	76.7	74.3	76.7
Wealth quintile			
Lowest*	74.9	92.1	90.8
Second*	77.9	87.0	88.4
Middle	87.7	78.1	89.0
Fourth*	72.2	83.4	86.4
Highest	71.7	70.9	79.8
Total*	77.1	83.5	87.2

*Trend is statistically significant (p<0.05).

In general, prevalence of continued breastfeeding declined as household wealth increased. Over the study period the prevalence of continued breastfeeding increased for households in the lowest, second, and fourth wealth quintiles in a statistically significant trend, with the largest increases occurring between 2005 and 2010.

Figure 2.   **Continued breastfeeding equity dashboard**
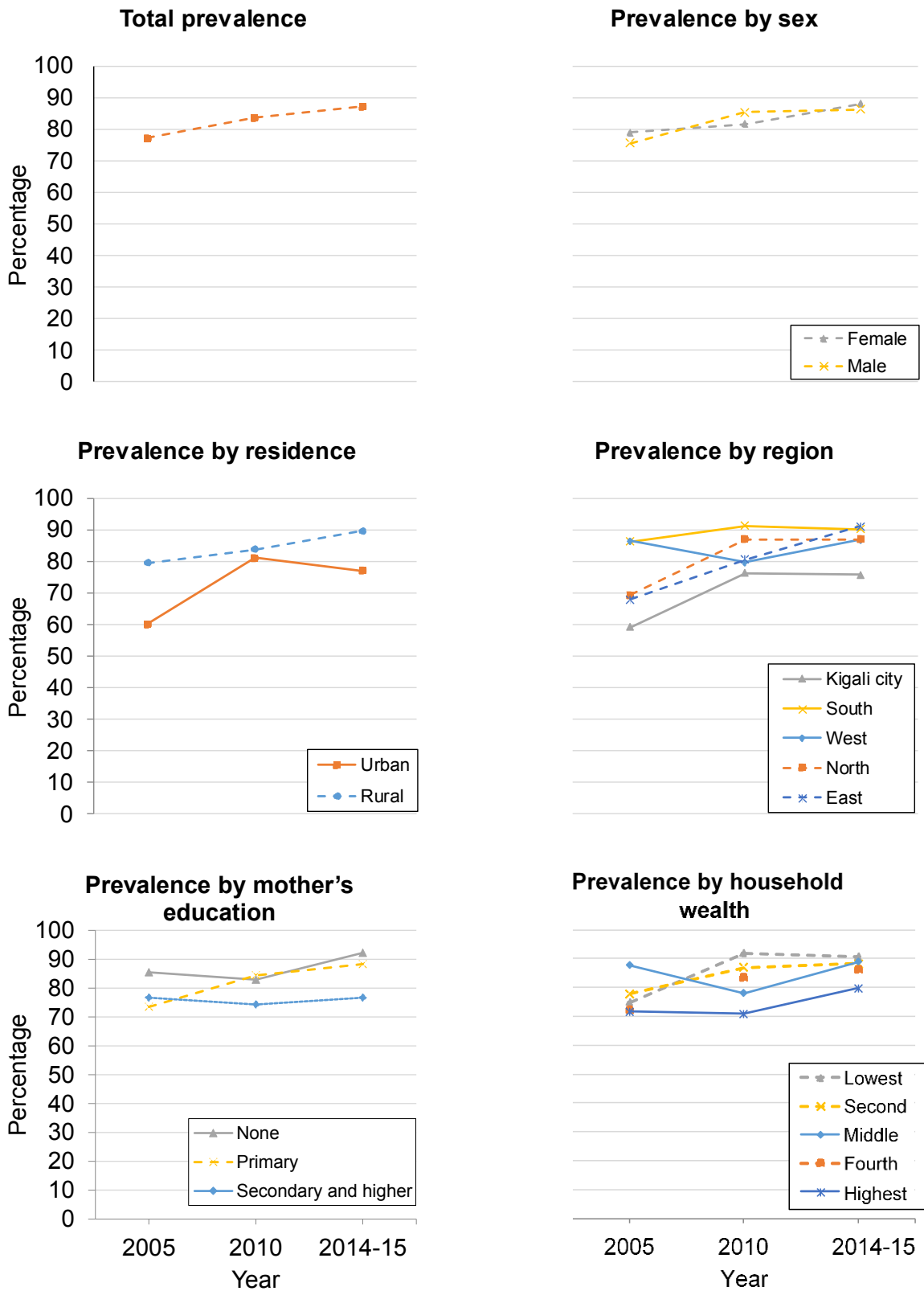
*Dashed line indicates a statistically significant trend (p<0.05).

3.2 Infant and young child feeding practices: complementary feeding
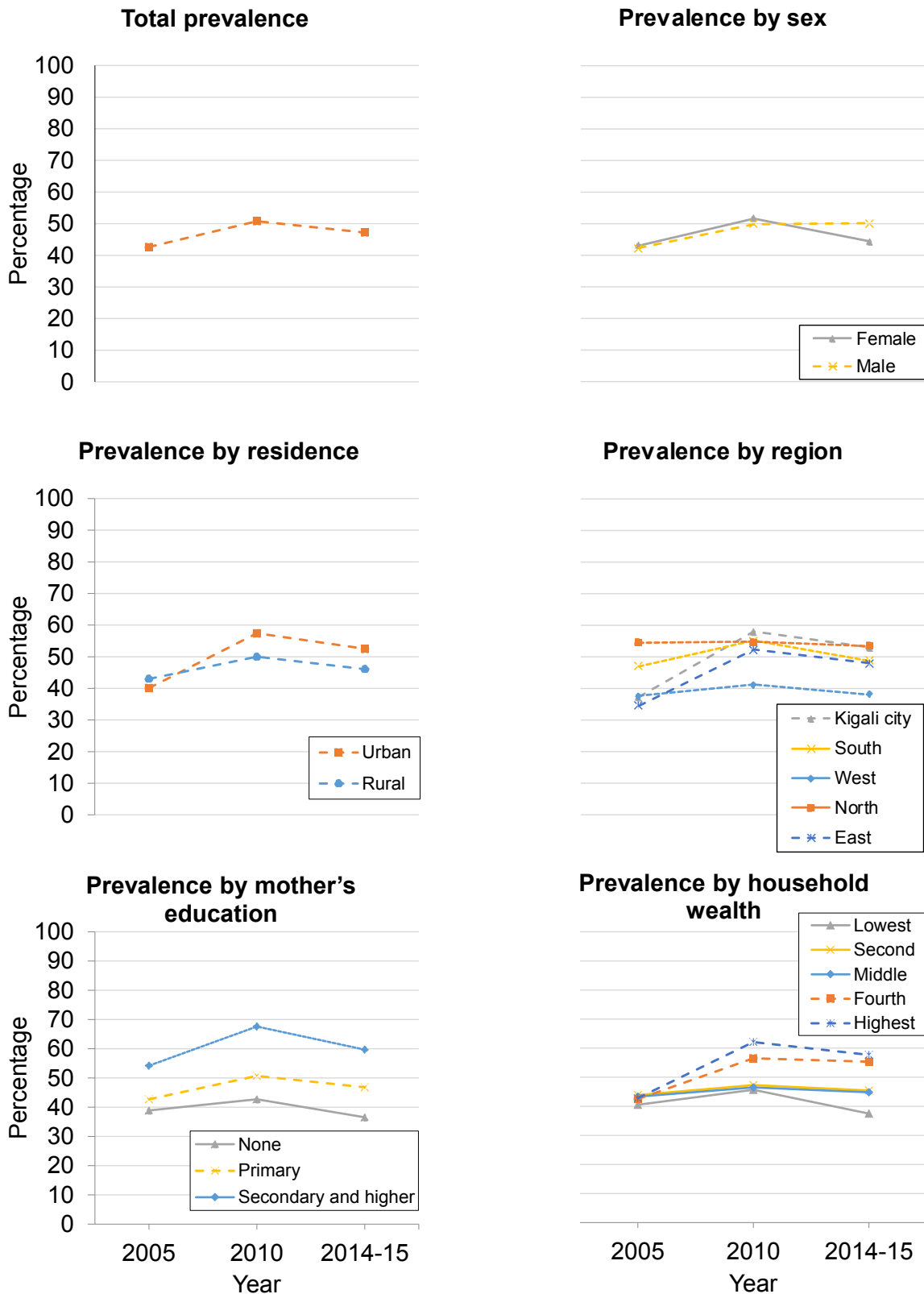
3.2.1 *Meal frequency*

For breastfed children, minimum meal frequency comprises solid or semisolid food at least twice each day for infants age 6-8 months and at least three times each day for children age 9-23 months. For nonbreastfed children age 6-23 months, minimum meal frequency is solid or semisolid food or milk feeds at least four times each day. Table 5 shows the percentage of all children age 6-23 months who consumed the recommended minimum number of meals per day. This percentage increased overall during the study period, with an increase from 47% in 2005 to 51% in 2010, and then a decrease back to 47% in 2014-15 in a statistically significant trend. In 2005 and 2010 a slightly higher percentage of girls than boys consumed the minimum meal frequency, but the trend reversed in 2014-15 and was statistically significant for boys only. In all survey years a greater percentage of urban than rural children consumed the minimum meal frequency, and the trend was statistically significant for both urban and rural children. Percentages of minimum meal consumption varied regionally. There was a substantial increase in Kigali city and in East region between 2005 and 2010, followed by a slight decrease in 2014-15; these trends were statistically significant. West region consistently had among the lowest percentage of children consuming the minimum number of meals daily. In all survey years

Table 5. Children age 6-23 months consuming the minimum meal frequency per day, by equity-related variables, 2005-2015

	2005	2010	2014-15
Sex			
Female	47.4	51.7	44.4
Male*	46.0	49.9	50.0
Residence			
Rural*	46.2	50.0	46.1
Urban*	49.3	57.4	52.5
Region			
Kigali city*	47.9	58.0	53.0
South	49.0	55.0	48.9
West	40.4	41.1	38.2
North	59.7	54.7	53.5
East*	39.3	52.3	47.9
Mother's education			
No education	41.2	42.7	36.5
Primary*	47.1	50.7	46.8
Secondary and higher	61.1	67.6	59.7
Wealth quintile			
Lowest	43.7	45.7	37.5
Second	47.1	47.3	45.4
Middle	46.6	46.5	44.8
Fourth*	46.3	56.5	55.3
Highest*	50.3	62.1	57.7
Total*	46.7	50.8	47.2

*Trend is statistically significant (p<0.05).

the percentage of children with the recommended minimum meal frequency was higher with higher levels of mother's education, but the trend over time was statistically significant only for children of mothers with a primary education. Overall, the percentage of children consuming the minimum meal frequency was higher with higher household wealth in all years, with a difference of 20 percentage points between the lowest and highest wealth quintiles in 2014-15, and statistically significant trends over the study period for the highest two wealth quintiles.

Figure 3.   Meal frequency equity dashboard

Total prevalence

Prevalence by sex

Prevalence by residence

Prevalence by region

Prevalence by mother's education

Prevalence by household wealth

*Dashed line indicates a statistically significant trend.
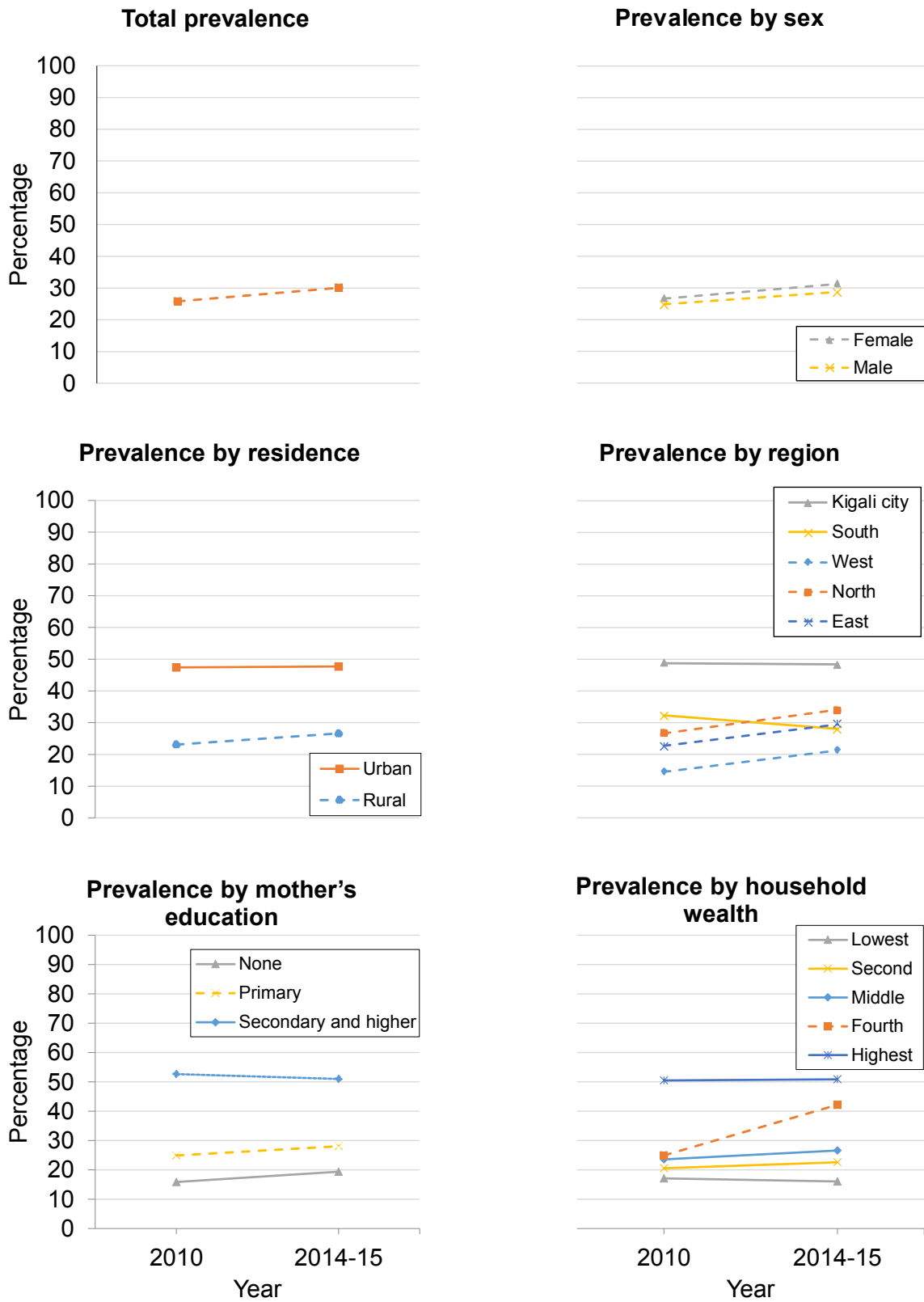
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3.2.2 *Diet diversity*

Consumption of four or more food groups is considered acceptable diet diversity for both breastfed and non-breastfed children age 6-23 months (WHO 2010). The percentage of children consuming four or more food groups increased between 2010 and 2014-15, from 26% to 30% in a statistically significant trend. The percentages significantly increased for both girls and boys, with a higher percentage for girls than boys in both years. A substantially higher percentage of urban than rural residents consumed four or more food groups in both years; in rural areas the increase between 2010 and 2014-15 was statistically significant. Consumption of four or more food groups varied by region. In both survey years the highest percentage of children consuming four or more food groups was in Kigali city, with little change between 2010 and 2014-15. Percentages all increased significantly in West, North, and East regions; there was a slight decrease in South region. The percentage of children consuming four or more food groups was higher with higher levels of mother's education, and there were substantial differences between mothers with a secondary or higher education and all others in both 2010 and 2014-15. There was a statistically significant increase in consumption of four or more food groups between 2010 and 2014-15 among children of mothers with a primary education, though not among other mothers. Also, in both years the percentage of children consuming four or more food groups was higher with higher household wealth. Between 2010 and 2014-15, however, the percentage consuming four or more food groups increased significantly only among children the fourth household wealth quintile.

Table 6. Children age 6-23 months consuming four or more food groups per day, by equity-related variables, 2010-2015

	2010	2014-15
Sex		
Female*	26.8	31.4
Male*	24.7	28.7
Residence		
Rural*	23.1	26.6
Urban	47.4	47.7
Region		
Kigali city	48.8	48.3
South	32.3	27.9
West*	14.6	21.4
North*	26.8	34.0
East*	22.6	29.6
Mother's education		
No education	15.9	19.4
Primary*	24.9	28.1
Secondary and higher	52.7	51.0
Wealth quintile		
Lowest	17.1	16.1
Second	20.6	22.6
Middle	23.6	26.6
Fourth*	24.9	42.2
Highest	50.5	50.9
Total*	25.8	30.1

*Trend is statistically significant (p<0.05).

Figure 4.   Diet diversity equity dashboard

Total prevalence

Prevalence by sex

Prevalence by residence

Prevalence by region

Prevalence by mother's education

Prevalence by household wealth

*Dashed line indicates a statistically significant trend.

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3.2.3 *Micronutrient intake (consumption of vitamin A-rich and iron-rich foods)*

Table 7 shows that consumption of vitamin A-rich foods (fruits or vegetables rich in vitamin A, or meat) increased from 72% in 2005 to 74% in 2014-15. A slightly higher percentage of girls than boys were reported to have consumed vitamin A-rich foods in 2010, but otherwise there was no observed difference between the sexes. A higher percentage of children in urban areas than in rural areas consumed vitamin A-rich foods in all three survey years. Consumption varied slightly by region. Kigali city and North regions recorded the highest percentages, while East and West regions reported the lowest. Percentages were higher among children of mothers with higher levels of education. Similarly, percentages generally were

Table 7. Consumption of vitamin A and iron-rich foods among children age 6-23 months in the previous 24 hours, by equity-related variables, 2005-2015

	Vitamin A			Iron		
	2005	**2010**	**2014-15**	**2005**	**2010**	**2014-15**
Sex						
Female	72.1	74.2	73.6	11.6	21.0	19.8*
Male	71.2	71.1	73.4	12.0	19.1	20.7*
Residence						
Rural	71.0	71.5	72.5	10.1	17.7	17.7*
Urban	75.7	81.6	78.7	22.6	39.4	33.4*
Region						
Kigali city	76.2	79.3	80.4	26.4	38.4	36.9*
South	73.4	71.2	73.9	10.5	21.1	15.5*
West	68.8	72.3	68.3	12.5	17.2	18.7*
North	76.2	74.8	79.7	7.1	13.1	12.9*
East	67.4	70.7	71.7	12.0	19.8	22.2*
Mother's education						
No education	68.4	65.2	67.9	8.3	13.3	13.0*
Primary	72.1	73.3	73.4	11.6	19.8	19.2*
Secondary and higher	78.8	82.0	79.5	25.1	36.0	33.0
Wealth quintile						
Lowest	71.3	66.9	65.6*	8.7	15.1	12.7
Second	71.5	70.8	70.8	10.1	13.8	16.0*
Middle	69.5	72.5	74.8	9.3	18.3	18.1*
Fourth	72.6	74.0	80.9*	11.5	19.6	22.4*
Highest	73.3	83.0	79.3*	21.4	39.8	36.8*
Total	71.7	72.6	73.5	11.8	20.1	20.3*

*Trend is statistically significant (p<0.05).

higher with higher levels of household wealth. Trends for the lowest, fourth, and highest wealth quintiles were statistically significant.
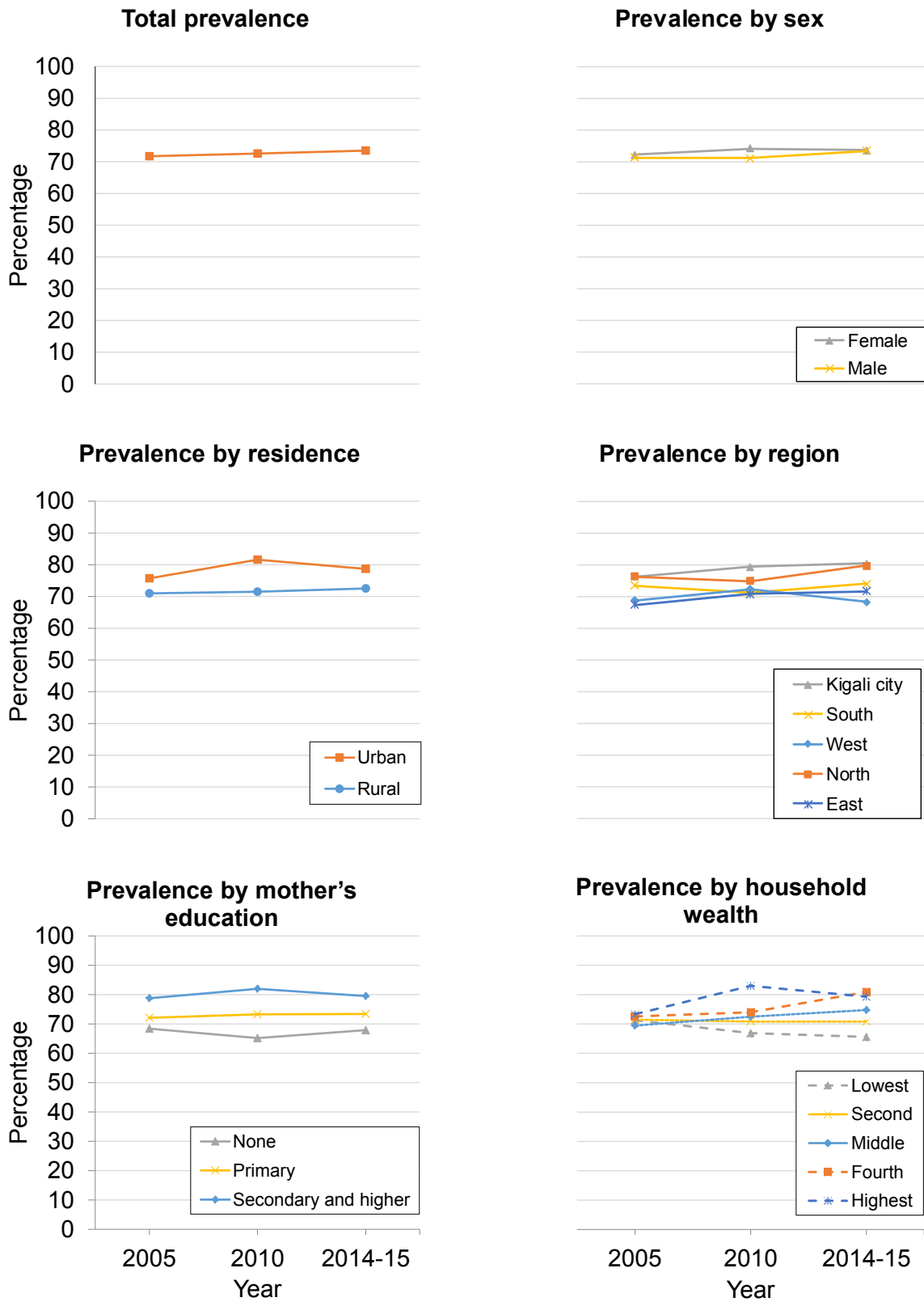
Consumption of iron-rich foods increased substantially between 2005 and 2010, from 12% to 20%, and remained stable in 2014-15 (Table 7). The overall trend was statistically significant, as were the trends for most characteristics. Consumption levels among boys and girls were similar, and there was no clear pattern of differences over time. Greater percentages of urban children consumed iron-rich foods compared with children in rural areas in all three survey years. There was a substantial increase in consumption in urban areas between 2005 and 2010 but a slight decrease between 2010 and 2014-15. In all three years a greater percentage of children in Kigali city consumed iron-rich foods compared with other regions. Percentages increased in West and South regions over the study period; other regions had increases between 2005 and 2010 and then slight decreases between 2010 and 2014-15. In all three survey years the percentage of children consuming iron-rich foods was higher with higher levels of mother's education, and in 2014-15 it was higher with higher household wealth.

Figure 5.   **Consumption of vitamin A-rich foods equity dashboard**

*Dashed line indicates a statistically significant trend.

Figure 6.   **Consumption of iron-rich foods equity dashboard**
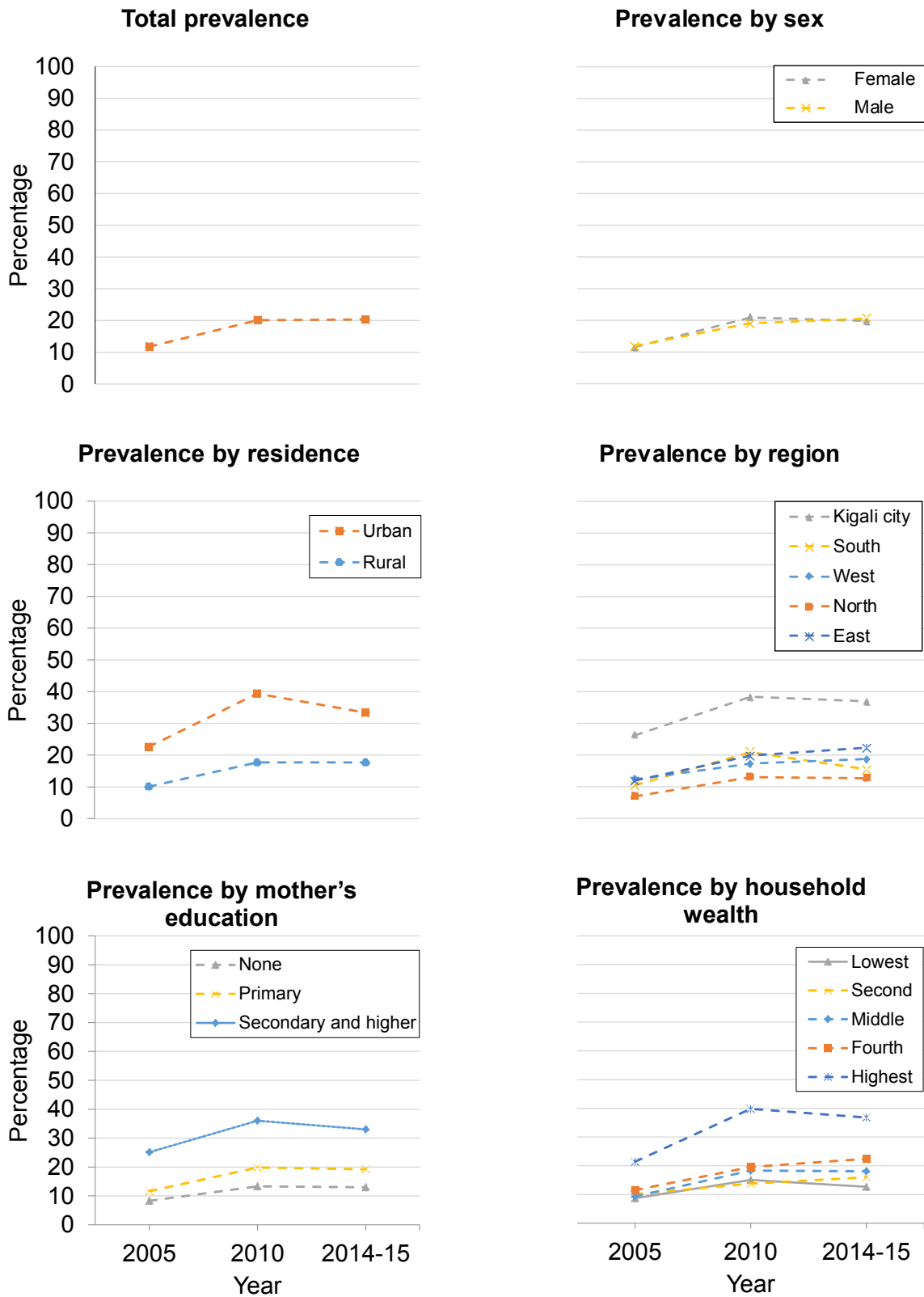
*Dashed line indicates a statistically significant trend.

3.3   Nutritional status of children under age 2

3.3.1   *Stunting*

Stunting prevalence indicates the percentage of children under age 2 whose height-for-age is less than two standard deviations below the mean of the reference population; stunting is a sign of chronic malnutrition (WHO 2014a). For this age group, this estimate indicates stunting *in progress*, given that stunting occurs during the first 1,000 days (pregnancy until age 2) and is irreversible after age 2 (WHO 2013). Table 8 presents stunting prevalence by equity measure only for 2010 and 2014-15, because in 2006 WHO adopted a new global reference population, making estimates for 2005 incomparable (WHO 2006).
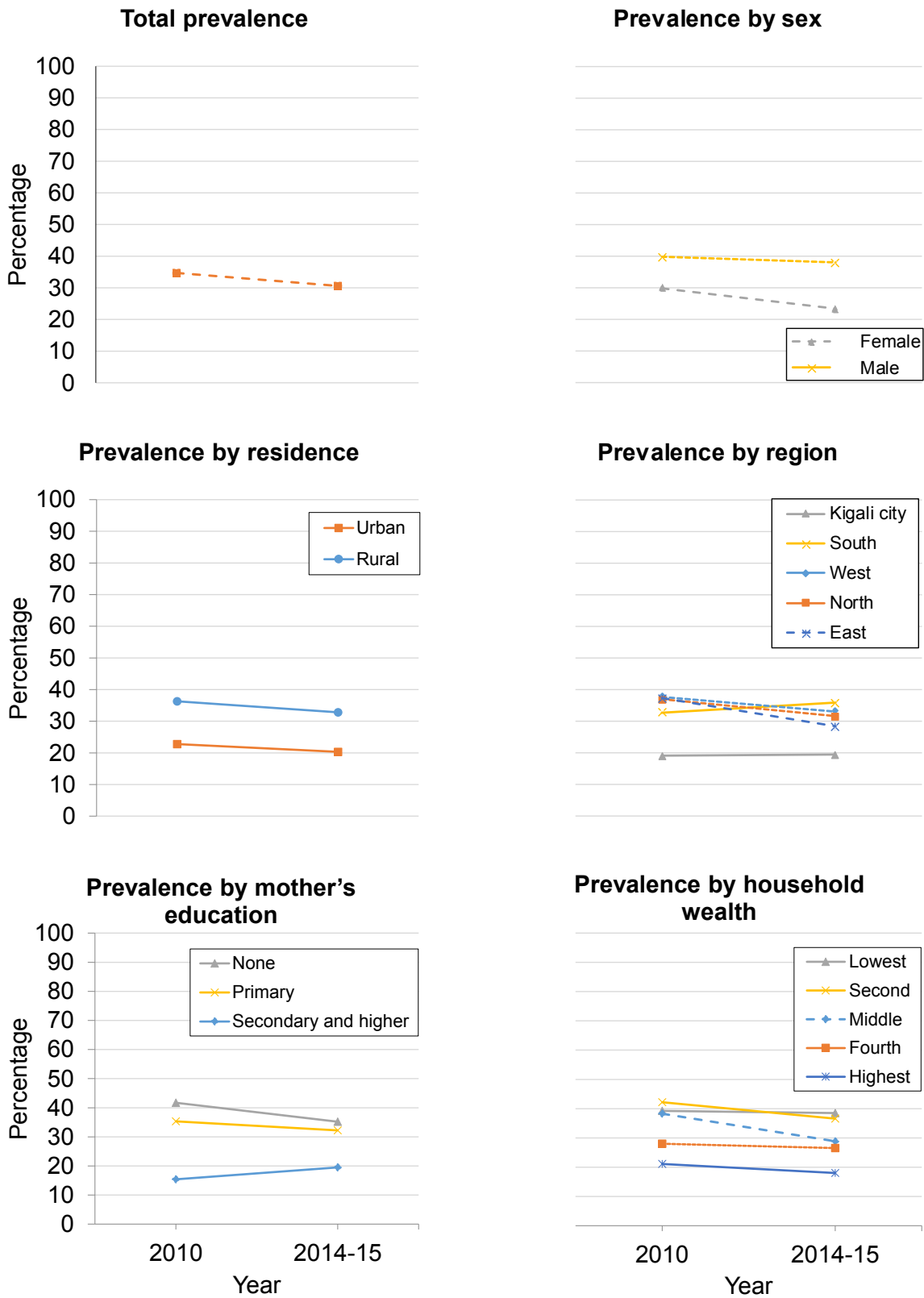
Overall, stunting decreased between 2010 and 2014-15 in a statistically significant trend. In both years a greater percentage of boys were stunted compared with girls. The trend was statistically significant for girls. The difference in stunting prevalence between the sexes increased between the surveys, from 10 percentage points in 2010 to 15 in 2014-15. In both years, prevalence of stunting was higher in rural than urban areas. Among regions, Kigali city had the lowest prevalence of stunting in both years. Prevalence decreased in all regions except Kigali city and South region between 2010 and 2014-15. The trend in East region was statistically significant. In both years stunting prevalence was lower with higher levels of mother's education. The prevalence of stunting increased between surveys among children of mothers with secondary or higher education but not children of mothers with less education. In both years, stunting prevalence was lower with higher household wealth, and decreased between 2010 and 2014-15 for all wealth quintiles. The trend for the middle wealth quintile was statistically significant.

Table 8. Stunting prevalence among children age 0-23 months, by equity-related variables, 2010-2015.

	2010	2014-15
Sex		
Female*	29.9	23.3
Male	39.7	37.9
Residence		
Rural	36.3	32.8
Urban	22.8	20.3
Region		
Kigali city	19.0	19.5
South	32.8	35.7
West	37.8	33.1
North	36.9	31.5
East*	37.3	28.3
Mother's education		
No education	41.7	35.2
Primary	35.3	32.2
Secondary and higher	15.4	19.5
Wealth quintile		
Lowest	39.2	38.5
Second	42.2	36.6
Middle*	38.3	28.8
Fourth	28.0	26.5
Highest	21.1	18.0
Total*	34.7	30.6

Recumbent length was measured for children under age 2.
*Trend is statistically significant (p<0.05).

Figure 7.   **Stunting equity dashboard**

Total prevalence

Prevalence by sex

Prevalence by residence

Prevalence by region

Prevalence by mother's education

Prevalence by household wealth

*Dashed line indicates a statistically significant trend.
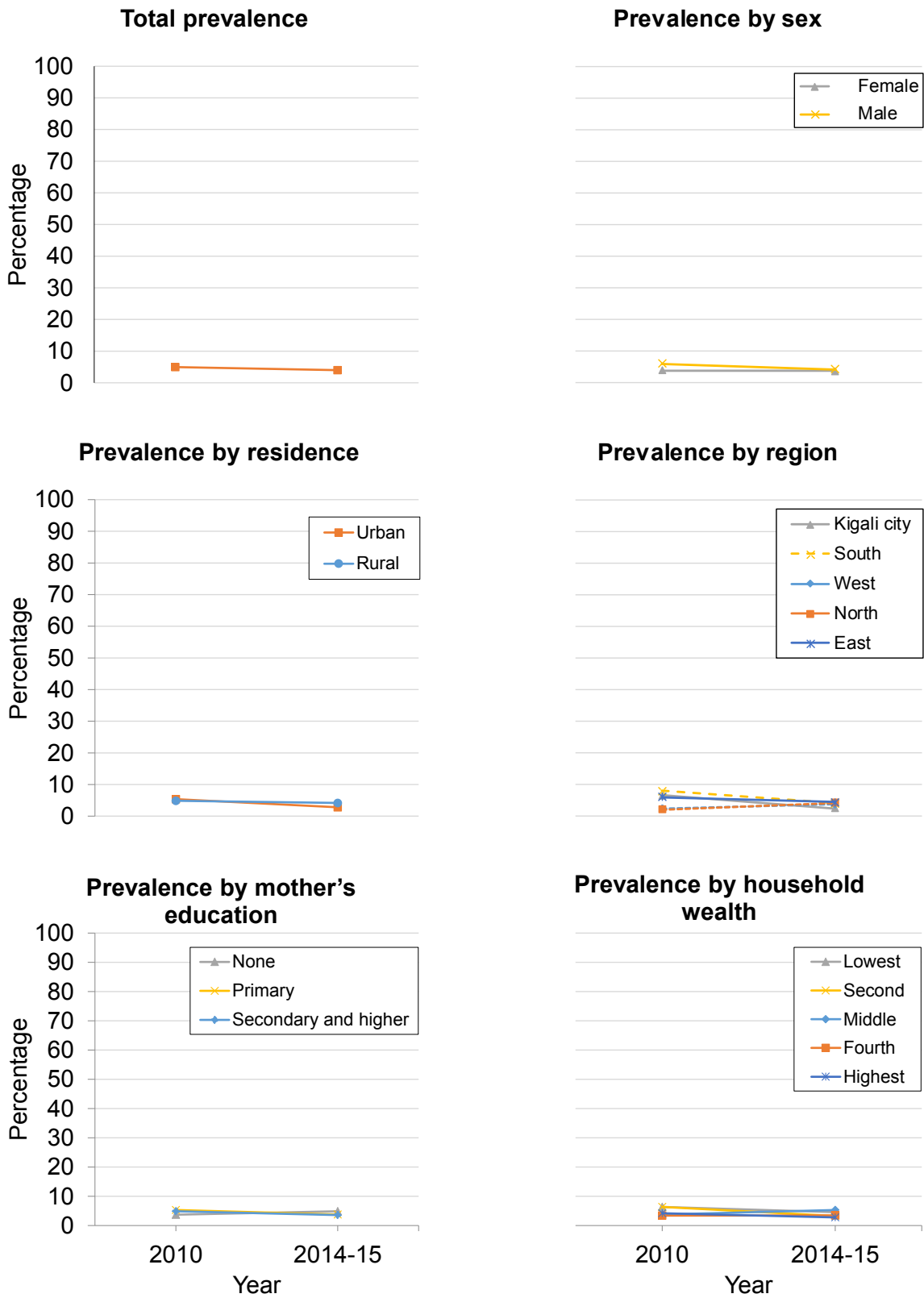
19

3.3.2 *Wasting*

Wasting prevalence indicates the percentage of children under age 2 less than two standard deviations below the mean of the reference population (WHO 2014b); it signifies acute malnutrition (NISR and ICF 2012). Overall, wasting prevalence decreased between the two surveys studied, from 5% in 2010 to 4% in 2014-15 (Table 9). The decrease was greater in urban than rural areas. Prevalence of wasting decreased in three regions but increased in two—West and North regions. The decrease for South region, from 8% to 4%, was statistically significant. Wasting prevalence varied widely by region in 2010, from 2% in North region to 8% in South region, but the differences were smaller in 2014-15. Wasting prevalence was higher among boys than girls in both survey years. In 2014-15, wasting prevalence was lower with higher levels of mother's education, but in 2010 the lowest prevalence was among children whose mothers had no education. The association between wasting prevalence and wealth is mixed, with no clear pattern. In both years, however, prevalence of wasting was higher among all lower household wealth quintiles compared with the highest. Wasting prevalence among children in the bottom two wealth quintiles and in the highest quintile decreased between surveys, but increased for the middle and fourth quintiles.

Table 9. Wasting prevalence among children age 0-23 months, by equity-related variables, 2010-2015

	2010	2014-15
Sex		
Female	3.9	3.7
Male	6.1	4.2
Residence		
Rural	4.9	4.2
Urban	5.4	2.8
Region		
Kigali city	6.6	2.5
South*	8.1	4.1
West	2.5	3.7
North	2.2	4.3
East	6.0	4.4
Mother's education		
No education	3.7	4.9
Primary	5.3	3.8
Secondary and higher	4.9	3.6
Wealth quintile		
Lowest	6.4	4.6
Second	6.4	3.3
Middle	3.8	5.3
Fourth	3.4	3.5
Highest	4.2	2.8
Total	5.0	4.0

*Trend is statistically significant (p<0.05).

Figure 8.   Wasting equity dashboard

Total prevalence

Prevalence by sex

Prevalence by residence

Prevalence by region

Prevalence by mother's education

Prevalence by household wealth

*Dashed line indicates a statistically significant trend.
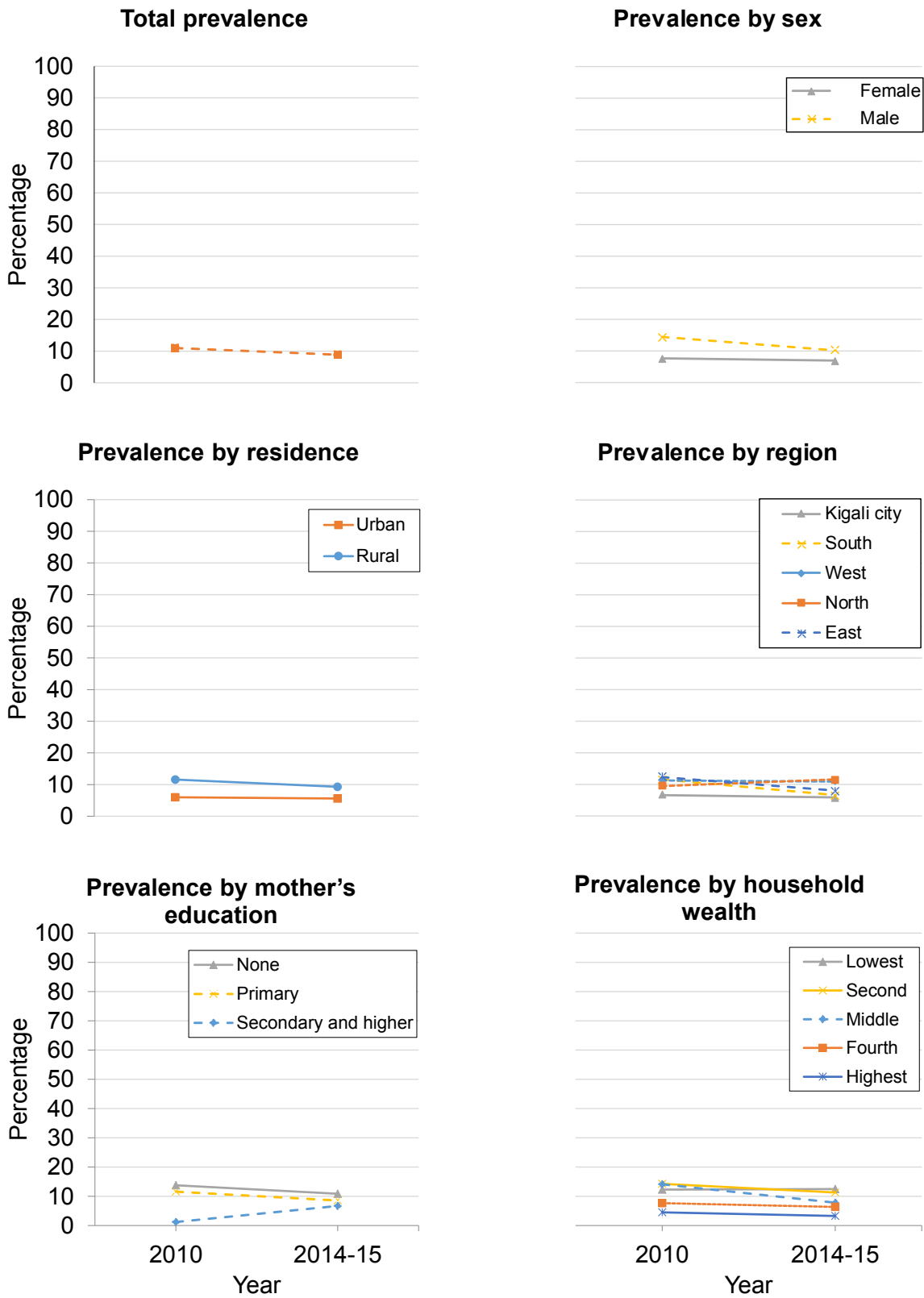
3.3.3 Underweight

Underweight prevalence is a composite measure of stunting and wasting. It indicates the percentage of children under age 2 whose weight-for-age is less than two standard deviations below the mean of the reference population (NISR and ICF 2012; WHO 2006). Overall, underweight prevalence decreased over the study period, from 11% in 2010 to 9% in 2014-15 (Table 10). In both surveys, underweight prevalence was higher among boys than girls, and higher in rural than urban areas. Among regions, underweight prevalence was lowest in Kigali city, about half that in the region with the highest prevalence of underweight children (East in 2010 and North in 2014-15). Underweight prevalence, while remaining lowest among children of mothers with the most education, increased substantially between 2010 and 2014-15 for children of mothers with secondary or higher education, from 1% to 7%. Also, underweight prevalence remained lowest among children in the highest household wealth quintile. Between 2010 and 2014-15, underweight prevalence decreased for all households except those in the lowest wealth quintile. In 2014-15, underweight prevalence in the lowest wealth quintile was nearly four times that in the highest quintile.

Table 10. Underweight prevalence among children age 0-23 months, by equity-related variables, 2010-2015

	2010	2014-15
Sex		
Female	7.6	7.0
Male*	14.5	10.4
Residence		
Rural	11.6	9.3
Urban	6.0	5.6
Region		
Kigali city	6.8	5.9
South*	11.5	6.6
West	11.3	11.1
North	9.6	11.5
East*	12.4	8.1
Mother's education		
No education	13.8	10.9
Primary*	11.6	8.6
Secondary and higher*	1.2	6.7
Wealth quintile		
Lowest	12.3	12.5
Second	14.3	11.3
Middle*	14.1	7.8
Fourth	7.7	6.4
Highest	4.5	3.3
Total*	11.0	8.9

*Trend is statistically significant (p<0.05).

Figure 9.   **Underweight equity dashboard**

Total prevalence

Prevalence by sex

Prevalence by residence

Prevalence by region

Prevalence by mother's education

Prevalence by household wealth

*Dashed line indicates a statistically significant trend.

4 DISCUSSION

4.1 Discussion of findings

4.1.1 *Breastfeeding*

Findings and trends in context

Each year, more than 800,000 child deaths result from suboptimal breastfeeding (Black 2013). The prevalence of exclusive breastfeeding among infants, at nearly 90% in Rwanda in the 2014-2015 DHS survey, contrasts with the much lower averages in Eastern and Southern Africa (57%) and worldwide (43%) (UNICEF 2016). Similarly, in Rwanda the prevalence of continued breastfeeding among children age 20-23 months, at nearly 90% in the 2014-2015 survey, contrasts with the average in Eastern and Southern Africa (59%) and globally (46%) (UNICEF 2016). Rwanda's National Food and Nutrition Policy highlights the importance of exclusive and continued breastfeeding (Ministry of Local Government et al. 2014). One concern is that the national policy on children's health describes breastfeeding as a duty rather than a woman's right, putting women in a vulnerable position (IBFAN 2013). Qualitative research could help provide women's perspectives regarding breastfeeding and could explore typical practices.

Inequalities

While exclusive breastfeeding is widely practiced in Rwanda, regional gaps remain. In the study, West region had the lowest prevalence, while North region had the highest, with a difference of 16 percentage points. The increasing trend among mothers with higher education brought prevalence in that group to a level comparable with other education levels. There were also regional differences in continued breastfeeding, with a difference of 15 percentage points between Kigali city, with the lowest prevalence of continued breastfeeding, and the East region, with the highest prevalence. Similarly, the prevalence of continued breastfeeding differed between urban and rural areas. In rural areas prevalence increased over the study period and in 2014-15 exceeded prevalence in urban areas by 12 percentage points. This finding is consistent with other research showing a negative association between urbanization and breastfeeding in Africa (Lugina et al. 2011). There were also differences in prevalence of continued breastfeeding by mother's education and by household wealth—lower by 15 percentage points among mothers with a secondary or higher education compared with no education—and differences by household wealth status. These results agree with global findings that the poor continue breastfeeding longer than the rich (Victora et al. 2016). The difference also reflects the urban-rural difference noted above, and could be due in part to working women's separation from their infants (Heymann et al. 2013), which may be more common in urban than rural areas.

4.1.2 *Complementary feeding*

Findings and trends in context

After six months, providing nutritionally adequate and safe foods to infants as a complement to continued breastfeeding is critical for optimal growth and development (WHO 2013). When child's length for age is assessed between age 6 and 23 months, growth faltering becomes evident, due to lack of availability of adequate food and exposure to pathogens causing illness (e.g., diarrheal disease) (WHO

2013). Optimal complementary feeding encompasses the appropriate frequency of meal provision, diet diversity, and consumption of key micronutrients to ensure proper development and protection from illness.

In general, prevalence of appropriate meal frequency in Rwanda, at around half of all children, is close to the average for Eastern and Southern Africa, at 45%, and globally, at 52% (UNICEF 2016). Increases in appropriate meal frequency occurred over the study period for households in the highest wealth quintiles, while households in lower wealth quintiles had decreases. Rwanda's National Food and Nutrition Policy cited a national survey from 2012 reporting that 32% of mothers did not introduce foods to children before one year, which might be due to a lack of food at home (Ministry of Local Government et al. 2014).

Consumption of four or more food groups (diet diversity) in Rwanda, at 30% in 2014-15, is higher than the average in Eastern and Southern Africa, at 21%, and on a par with the global average of 29% (UNICEF 2016). The Comprehensive Food Security Vulnerability Analysis and Nutrition Survey in 2012 reported that nutritious food was a problem at different times of the year for more than half of families in Rwanda (Ministry of Local Government et al. 2014). In addition, measurement of this indicator is problematic for breastfed infants because breast milk is not counted as a food group (WHO 2010). With the high prevalence of breastfeeding in Rwanda, diet diversity as measured according to WHO (2010) will most likely seem low, whereas the percentage would be higher in populations with a greater prevalence of formula feeding. Thus it is difficult to draw accurate conclusions about diet diversity among young children in Rwanda.

Consumption of vitamin A-rich foods is relatively prevalent in Rwanda, at over 70% for most groups studied. In addition, Rwanda has addressed vitamin A deficiency through periodic national campaigns to provide high-dose supplements to children under age 5 (Ministry of Local Government et al. 2014). As a result of these campaigns, there may be general public recognition of the importance of vitamin A. While consumption of iron-rich foods increased over the study period, overall consumption remained low, at 20%. The Rwandan government recognizes the serious state of iron deficiency; 25% of pregnant women and more than 70% of children age 6-12 months were anemic in 2010 (Ministry of Local Government et al. 2014). The National Food and Nutrition policy identified a multi-pronged strategy of fortification, supplementation, diversifying diets, and deworming to address the problem (Ministry of Local Government et al. 2014). Multiple consequences of iron deficiency can be severe and irreversible: increased perinatal mortality, delayed development, behavioral challenges, auditory and visual impairments, and physical performance deficits (WHO 2013). Widespread nutritional deficits could substantially impair public health and diminish socioeconomic development.

Inequalities

There was an increasing trend among most groups: male and female; urban and rural; all regions; no education and primary education; and households in all but the lowest wealth quintiles. Appropriate meal frequency increased significantly for boys but not girls during the study period. Fully half of boys received the appropriate number of meals in 2014-15, compared with 44% of girls. This finding contradicts findings from a study in Zambia (Rovin 2015), while the Zambia study provides perspectives on perceived feeding needs of girls and boys, which may be an area for further exploration in Rwanda. There were substantial differences in appropriate meal frequency by mother's education. More than half of children in urban areas received the appropriate number of meals, compared with 46% of rural children. By region, appropriate meal frequency varied from about one-third of children in West region to more than half in

Kigali city and North region. While appropriate meal frequency decreased among children of mothers in all education categories over the study period, prevalence was substantially higher with higher levels of mother's education. Nearly 60% of children of mothers with secondary and higher education received the adequate number of meals, compared with just over a third of children of mothers with no education. This finding aligns with macro-level studies attributing improvements in child survival to women's increased educational attainment (Gakidou et al. 2010).

Diet diversity increased among both boys and girls, and in rural but not urban areas. Still, a substantially higher percentage of urban than rural children consumed four or more food groups per day—a difference of 21 percentage points in 2014-15. Diet diversity also increased in West, North, and East regions, although West region, with the lowest prevalence, was 27 percentage points below Kigali city, with the highest prevalence. Diet diversity increased among children of mothers with a primary education and among children in the fourth household wealth quintile. As with meal frequency, children's diet diversity increases with mother's education and with higher household wealth. Diet diversity for children of mothers with a secondary or higher education is 30 percentage points higher than for children of mothers with no education, while the difference between the richest and poorest households is 34 percentage points. The difference by maternal education is supported by the wide literature on women's education and child survival, possibly reflecting use of health services, greater wealth, women's empowerment and independence, and community effects (Gakidou et al. 2010). This finding is likely related to household food security and access to a variety of nutritious food (Ministry of Local Government et al. 2014).

While consumption of vitamin A-rich foods changed little over the study period, it increased significantly for the two highest household wealth quintiles and decreased significantly for the lowest quintile—widening the gap by household wealth. Although consumption of vitamin A-rich foods is generally high throughout Rwanda, it will be important to continue to monitor differences by household wealth to ensure that all families have access to these foods. Infants require vitamin A to support growth and fight infections (WHO 2013). Vitamin A deficiency in infancy can cause vision problems and anemia; weakened immunity increases risks of morbidity and mortality from diarrhea and measles (WHO 2013).

Consumption of iron-rich foods in urban areas is twice as high as in rural areas. Despite a probably higher ownership of livestock in rural than urban areas, rural households do not appear to provide enough animal-source foods for their children. Among regions, Kigali city has the highest proportion of children consuming iron-rich foods, at more than a third, while North region has the lowest, at about one in 10, Moreover, the percentage of children consuming iron-rich foods whose mothers have a secondary or higher education is three times that of children whose mothers have no education. The difference between children in the poorest and the richest households is similar. Given the importance of consuming iron for children's health, growth, and lifetime potential, and considering the importance of reaching one's potential for both individual and societal health and prosperity, addressing low consumption of iron-rich foods should be further studied and addressed.

4.1.3   Nutritional status

Findings and trends in context

Stunting reflects chronic malnutrition, which can begin in utero and is one of the largest impediments to global health (WHO 2014a). Rwanda's goal is to reduce stunting among children under age

2, through the National 1000 Days campaign. The National Food and Nutrition Policy states that stunting prevention will occur at the community level through interventions in the first 1,000 days of childhood, including breastfeeding promotion, appropriate dietary intake for pregnant and lactating women and for children age 6-23 months, and access to health care for those groups (Ministry of Local Government et al. 2014). About 15% of infants in Rwanda are stunted at 2 months, likely reflecting deprivation in the uterine environment, while 43% are stunted at age 5 (Ministry of Local Government et al. 2014). Given the high prevalence of exclusive breastfeeding and the fact that stunting is irreversible after age 2, the majority of stunting in Rwanda likely occurs during the complementary feeding period, between 6 and 23 months (Ministry of Local Government et al. 2014). In the 2014-15 survey, 31% of children age 0-23 months were stunted, a decrease from 35% in 2010. Stunting decreased slightly for most groups, with significant decreases among girls, children in East region, and the middle household wealth quintile.

Wasting reflects a severe condition characterized by a lack of food consumption or illness (Ministry of Local Government et al. 2014). Wasting prevalence decreased slightly for most groups over the study period and, overall, meets the global target of less than 5% (WHO 2014b). Underweight prevalence, which combines the stunting and wasting measures, decreased significantly between 2010 and 2014-15, overall and for boys, children in South and East regions, children of mothers with a primary education, and the middle household wealth quintile. It increased significantly among children of mothers with secondary and higher education, due to an increase in stunting for this group, although not statistically significant.

Inequalities

The study found a substantial difference in stunting between boys (38%) and girls (23%) and the decreasing trend for girls was statistically significant. This difference aligns with findings from research in Zambia, which reported that caregivers believed that girls had a bigger appetite than boys (Rovin 2015). In addition, the Zambia research noted that girls tended to spend more time than boys with caregivers, and this proximity may have facilitated more frequent feedings for girls (Rovin 2015). In the Rwanda study reported here, there was also a substantial difference between urban children (one in five stunted) and rural children (one in three stunted). By region, the lowest prevalence was for Kigali city and the highest for South region. Only East region had a statistically significant decrease. Stunting prevalence was lower with higher maternal education, with a substantial difference between children of mothers with secondary or higher education compared with no education. Similarly, stunting prevalence for the lowest household wealth quintile was twice that for the highest, a finding that likely reflects an association between wealth and access to nutritious food. Underweight prevalence followed a pattern similar to stunting, as did wasting prevalence except for wealth, where prevalence was highest for the middle household income quintile, suggesting that relatively moderate household wealth might not be sufficient to protect children from food security shocks.

4.2   Limitations

The exclusive breastfeeding indicator measures feeding in the previous 24 hours and, as such, may not be a measure of common practice (Pullum 2014). Nonetheless, the evidence presented in this report indicates that exclusive breastfeeding is a common practice in Rwanda. Diet diversity could not be compared over 10 years due to differences in measurement in the 2005 DHS compared with the two more recent surveys. Similarly, prevalence of underweight, stunting, and wasting could not be included in the study prior to 2010 because of a change in the global standard reference population made in 2006 (WHO 2006). Differences within groups, i.e., between categories of equity-related variables, were not tested.

4.3   Conclusions

Breastfeeding rates are high in Rwanda but inequalities persist, with substantial variation. Exclusive breastfeeding varied by region and urban-rural residence. There was an increasing trend among the most educated mothers. Continued breastfeeding is comparatively lower for mothers with secondary or higher education and for wealthier households. There were increasing trends among boys, girls, rural residents, and some other groups. Complementary feeding practices vary by region, urban-rural residence, mother's education, household wealth, and sex. Significant increases over the study period in meal frequency were observed among boys, the highest wealth quintiles, and some regions. Significant increases in diet diversity were observed for rural areas and most regions. Consumption of vitamin A-rich foods is high in Rwanda but consumption of iron-rich foods is low, and both vary by household wealth status. Consumption of iron-rich foods increased over the survey period for most groups studied, but gaps remain by region, urban-rural residence, and mother's education. There are substantial differences in stunting between boys and girls and by urban-rural residence, region, and household wealth. Significant decreases in stunting between 2010 and 2014-15 were observed only for girls, the middle wealth quintile, and East region.

Strategies to increase optimal breastfeeding in urban areas and among the wealthier and more educated are warranted. Urgent efforts to improve appropriate complementary feeding practices are needed, and practices should be monitored with equity-related variables. Strategies to improve complementary feeding practices among rural residents, poor households, and less educated mothers, along with specific regional strategies, should be tested. Trends should be monitored comparatively to ensure equitable progress.

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