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Original Article

Determinants of inappropriate timing of introducing solid, semi-solid or soft food to infants in Pakistan: Secondary data analysis of Demographic and Health Survey 2006–2007

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Abstract

Inappropriate timing of introducing complementary food deprives the infant of optimum nutrition, leading to undernutrition, and increased mortality and morbidity. The aim of this analysis was to identify determinants of inappropriate timing of introduction of solid, semi-solid and soft foods in Pakistan.

Data on 941 infants 3.00 to 8.99 months were obtained from the Pakistan Demographic and Health Survey 2006–2007. The prevalence of introduction of foods among infants aged 3.00–5.99 months and 6.00–8.99 months was examined against a set of individual, household and community level variables using univariate analysis. Adjusted odds ratio (AOR) for early introduction in age 3.00–5.99 months and non-introduction in 6.00–8.99 months of age were calculated using backward stepwise logistic regression models. The prevalence of early introduction of complementary foods among 3.00- to 5.99-month-old and timely introduction among 6.00- to 8.99-month-old infants were 10.6% and 39.2%, respectively. Multivariate analyses revealed that mothers who had four or more antenatal clinic visits (AOR = 2.68) and who lived in the provinces of Sindh (AOR = 2.89) and Baluchistan (AOR = 6.75) were more likely to introduce complementary foods early. Mothers from middle-level households (AOR = 7.82), poorer households (AOR = 4.84) and poorest households (AOR = 5.72) were significantly more likely to delay introduction of complementary foods. In conclusion more than half (60.8%) of Pakistani infants do not receive complementary foods at recommended time. Public health interventions to improve the timing of introduction of complementary food are needed at national level with special focus on high risk groups.

Keywords: complementary feeding, infant and young child, weaning, solids, semi-solids or soft food, timeliness.

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Introduction

Complementary feeding is 'the process of introducing other foods and liquids along with breast milk', when breast milk alone is no longer sufficient to meet the nutritional requirements of infants (Pan American Health Organization & World Health Organization 2003). The World Health Organization recommends introducing complementary foods when an infant reaches 6 months of age (WHO 2002). The 'timeliness of introducing complementary feeding' was previously defined as the proportion of infants aged 6 to 8 months who were receiving solids or semi-solid foods and breast milk (WHO 1991). According to the new WHO indicators, the timeliness is assessed by whether infants aged 6 to 8 months are receiving solid, semi-solid or soft food irrespective of being breastfed or not (Daelmans *et al*. 2009; WHO *et al*. 2010).

According to the Pakistan Demographic and Health Survey 2006–2007, only 39% of 6.00- to 8.99-month-old infants received solid, semi-solids or soft food on the day prior to interview (*Pakistan Demographic and Health Survey 2006–2007. Islamabad, Pakistan* 2008). In contrast, prevalence of timely introduction of complementary foods was 55%, 71%, 70% and 84% in India, Bangladesh, Nepal and Sri Lanka, respectively, in 2006 to 2007 (Joshi *et al*. 2011; Kabir *et al*. 2011; Patel *et al*. 2011; Senarath *et al*. 2011). These findings have important public health implications as delayed introduction of complementary foods deprives the infant of receiving a nutritionally optimal diet with adequate protein, energy and micronutrients, and can contribute to undernutrition, increased morbidity and mortality in young children (WHO 1989). Further, it can lead to long-term feeding problems like reduced consumption of important food groups i.e. fruits and vegetables during childhood (Coulthard *et al*. 2009).

On the other hand, complementary foods are also introduced earlier than recommended in a sizeable number of infants, in both developed and developing countries (Schiess *et al*. 2010; WHO *et al*. 2010). Complementary foods offered before 6 months of age tend to displace breast milk and do not confer any growth advantage over exclusive breastfeeding (Dewey 2001). Several studies have highlighted that early introduction of complementary feeding was associated with poor nutritional status, diarrhoea and respiratory infections in infants (Davies-Adetugbo & Adetugbo 1997; Khadivzadeh & Parsai 2004; Kalanda *et al*. 2006; Scott *et al*. 2009). Although there is a decline in infant mortality over the years in Pakistan i.e. 102/1000 live births in 1990 to 73/1000 live births in 2004–2005, we are still a long way from the target of 40/1000 live births by year 2015 as set in Millennium Development Goal (MDG) 4 (Government of Pakistan 2005). Therefore, if the problem of inappropriate timing of introducing complementary foods is addressed in Pakistan, it might contribute to a reduction in undernutrition, morbidity and mortality in children, and thereby help achieve the fourth MDG of child survival. Information regarding the population subgroups that are at a high risk for untimely introduction of complementary feeding is needed in order to make evidence-based recommendations for improving IYCF policies and/or programmes. Such evidence would be useful to target subpopulations with inappropriate practices.

The aim of this analysis was to assess the prevalence of introducing solids, semi-solids and soft food among infants 3.00 to 5.99 and 6.00 to 8.99 months of age and to identify the individual, household and community level determinants of early introduction of solid, semi-solid or soft foods and delayed introduction of solid, semi-solid or soft foods, among Pakistani infants, using the PDHS 2006–2007 data (*Pakistan Demographic and Health Survey 2006–2007. Islamabad, Pakistan* 2008).

Methods

Data source

The present analysis aimed to gather information about introduction of solid/semi-solid and soft foods in infants 3.00 to 8.99 months from the publicly available data set of the PDHS 2006–2007(*Pakistan Demo-*

Key messages

- A significant proportion of infants do not receive complementary foods at recommended age.
- Early introduction of complementary foods was significantly higher among mothers who had four or more Antenatal Care (ANC) visits and lived in Sindh and Balochistan provinces while introduction of complementary foods was significantly delayed among mothers who belonged to middle, poorer and poorest households.
- Health education messages regarding timely introduction of complementary feeding should be emphasised during all antenatal, perinatal and post-natal contacts such as checkups and at vaccination clinics. Lady health workers (LHWs) must be trained to deliver messages regarding infant and young child feeding (IYCF) practices to raise awareness among vulnerable groups about the importance of timely introduction of foods at 6–8 months of age.

graphic and Health Survey 2006–2007. Islamabad, Pakistan 2008). The PDHS survey was conducted by the National Institute of Population Studies which focused on child mortality, and maternal and child health, as well as family planning and other reproductive health issues. The 2006–2007 PDHS is the most recently available source of information on infant and child feeding practices from a representative national sample of 10 023 ever married women.

The survey was conducted in 390 urban and 610 rural areas of Pakistan. Enumeration blocks were used as the primary sampling unit, and the sampling was stratified by urban and rural areas within each sample point (clusters). Probability proportional to size (PPS) was used to select enumeration blocks, followed by a systematic random sampling of households. PPS sampling technique was used in the survey as it has the probability of selecting a sampling unit, e.g. village, zone, district proportional to the size of its population. Further details of the sampling design and survey methodology are available in the PDHS 2006–2007 report (*Pakistan Demographic and Health Survey 2006–2007. Islamabad, Pakistan* 2008).

In the PDHS 2006–2007, 10 601 ever-married women were successfully interviewed with a response rate of 94.5%. The present analysis was restricted to the youngest living child aged 3.00 to 8.99 months, residing with the respondent (ever-married women age 15–49 years), and the total weighted sample size was 941.

Outcome indicators and explanatory variables

Based on a 24-h recall [yesterday or last night, did (name) eat any mushy or solid food?] we used the following two definitions:

- *Early introduction of solid, semi-solid or soft foods*: the proportion of infants 3.00–5.99 months of age (both months included) who received solid, semi-solid or soft foods in the previous 24 h.
- *Non-introduction of solid, semi-solid or soft foods at correct time (delayed introduction)*: the proportion of infants 6.00–8.99 months of age (both months included) who did not receive solid, semi-solid or soft foods in the previous 24 h.

These two indicators were examined according to individual level factors which included the following variables: mother's working status, mothers who worked at home or away, mother's education, partner's education, mother's literacy, mother's age, mother's marital status, birth order, birth interval, sex of infant, age of child, perceived size of baby at birth, place of delivery, type of delivery assistance, antenatal clinic visits, timing of post-natal checkup and mode of delivery. Household level factors included household wealth index. The household wealth index was calculated as score of household assets (radio, television, telephone, refrigerator, room cooler/air conditioner, washing machine, water pump, bed, chair, cabinet, clock, sofa, sewing machine, camera, personal computer, watch, bicycle, motorcycle/scooter, car/truck/tractor, animal-drawn cart, boat with a motor, ownership of agricultural land and ownership of farm animals), which was then weighted using the principal components analysis method (Filmer & Pritchett 2001). Community level factors included place of residence and geographical region.

Statistical analysis

Analyses were performed using Stata version 10.0 (Stata Corp., College Station, TX, USA). 'Svy' commands were used to allow for adjustments for the cluster sampling design, sampling weights and the calculation of standard errors. The Taylor series linearisation method was used in the surveys when estimating confidence intervals around prevalence estimates. Both early and delayed introduction of solid, semi-solid and soft foods were expressed as dichotomous variables. A chi-squared test was used to test the significance of associations. Univariate and multiple regression method were used in a stepwise backward regression model in order to determine the factors significantly associated with early introduction of solid, semi-solid or soft foods indicators and delayed introduction of solid, semi-solid or soft foods indicators. The odds ratios with 95% confidence intervals were calculated in order to assess the adjusted risk of independent variables, and those with $P < 0.05$ were retained in the final model.

Results

Characteristics of the sample

Of the total sample of 941 children aged 3 to 8 months, 0.3% were missing, and the majority lived in rural areas (71.0%). Approximately 24% of the interviewed mothers were employed in the last 12 months, and almost 20% had secondary or higher level of education. Of the total births, more than one-third (39.8%) took place at a health care facility. Only a small proportion of deliveries (9.2%) took place by caesarean section. Male (51.4%) and female (48.6%) children were nearly equally represented in the sample. About 39% of mothers had made at least one to three antenatal clinic visits during pregnancy, and 77.1% of the mothers were within the 20–34 age range.

According to the mothers' perception, 41.0% of children were of average size at birth. The proportion of mothers who could not read a sentence was 64.8%. About 55% of children lived in the Punjab province and 23.6%, 15.7% and 5.6% of children lived in the provinces of Sindh, North West Frontier Province (renamed as Khyber Pakhtunkhwa) and Baluchistan, respectively.

Univariate analysis

Of the 498 children aged 3.00–5.99 months, 10.6% (95% CI = 8.0, 13.9) were receiving solid, semi-solid or soft foods (early introduction). The timely introduction of solid, semi-solid or soft foods among 443 infants aged 6.00–8.99 months was 39.2% (95% CI = 33.8, 44.9).

Table 1 presents the estimated prevalence of infants 3.00–5.99 and 6.00–8.99 months of age, who were receiving solid, semi-solid or soft foods by selected individual, household and community characteristics. The rates of early introduction of complementary foods were significantly higher among mothers who lived in Baluchistan and Sindh regions compared with those who lived in Punjab and NWFP. Mothers who delivered their babies by non-caesarean section were more likely to report early introduction than mothers who delivered their babies by caesarean section. Mothers who perceived their babies to be 'large' or 'average' size at birth reported early introduction of complementary foods than those mothers who perceived their babies to be 'small' at birth, but this association was not statistically significant. Working mothers reported a higher rate of early introduction of complementary foods than non-working mothers (13.5% vs. 9.9%). Mothers who had primary or secondary or higher education were more likely to initiate solid, semi-solid or soft foods at an early age.

Univariate analysis indicated that mothers who were literate 47.1% (95%CI = 38.3, 56.1) and had secondary or higher levels of education 56.0% (95%CI = 43.1, 68.2) were significantly more likely to introduce complementary foods at the recommended age as compared with illiterate mothers and those with no education. Mothers who delivered at a health facility, mothers who delivered by health professionals and mothers who had four or more antenatal visits were significantly more likely to introduce complementary foods at the appropriate age as compared with mothers who were delivered at home, delivered by traditional birth attendants and mothers who had one to three or none antenatal visits. The prevalence of timely introduction of solid, semi-solid or soft foods among infants 6.00–8.99 months were significantly higher in the richer and the richest households than in the middle, the poorer and the poorest households.

Multivariate analysis

As shown in Table 2, mothers who had four or more antenatal visits during pregnancy had higher odds for early introduction of solid, semi-solid or soft foods than those mothers who had no antenatal clinic visits [adjusted odds ratio (AOR) = 2.68, 95%CI = 1.21,5.89]. Early introduction of complementary foods increased as the child's age increased (AOR = 3.00, 95%CI = 2.02, 4.47). Compared with the Punjab region, mothers who lived in the following geographical regions of Pakistan were more likely to report higher early introduction of solid, semi-solid or soft foods: Sindh (AOR = 2.89, 95%CI = 1.33, 6.26) and Baluchistan (AOR = 6.75, 95%CI = 2.39, 19.06).

Of the infants aged 6.00–8.99 months, those from the poorest to the middle household wealth

Table 1. Percentage of infants 3–5 months and 6–8 months who were given solid, semi-solid and soft food in Pakistan 2006–2007

Characteristics	3–5 months (n = 498)			6–8 months (n = 443)		
	N	%	(95% CI)	N	%	(95% CI)
Individual level factors						
Maternal working status						
Non-working	39	9.9	(7.3, 13.4)	127	40.4	(33.6, 47.6)
Working (past 12 months)	14	13.5	(7.6, 22.6)	43	35.9	(26.8, 46.0)
Maternal education						
No education	32	9.7	(6.9, 13.6)	92	34.0	(28.1, 40.5)
Primary	8	11.4	(5.5, 22.2)	28	36.5	(25.2, 49.5)
Secondary and above	12	13.1	(7.2, 22.8)	53	56.0	(43.1, 68.2)
Literacy						
Cannot read at all	32	9.6	(6.7, 13.4)	93	34.1	(28.0, 40.8)
Able to read part of sentence	21	13.0	(8.3, 19.8)	80	47.1	(38.3, 56.1)
Mother's age (years)						
15–19	4	10.6	(4.5, 22.9)	8	28.7	(13.4, 51.1)
20–34	40	10.5	(7.6, 14.5)	138	40.5	(34.3, 47.1)
35–49	8	11.1	(5.7, 20.4)	27	37.2	(26.5, 49.3)
Partner's education						
No education	19	11.0	(7.1, 16.6)	47	31.2	(23.3, 40.4)
Primary	5	6.3	(2.4, 15.6)	22	30.0	(19.4, 43.4)
Secondary and above	29	12.0	(8.2, 17.3)	104	47.4	(38.8, 56.1)
Marital status						
Currently married	53	10.6	(8.0, 13.9)	171	39.1	(33.5, 44.9)
Formerly married*	0	0.0		3	47.6	(12.3, 85.5)
Birth order						
First-born	11	11.1	(5.7, 20.3)	48	52.1	(39.0, 60.0)
Second to fourth	30	11.3	(7.9, 16.1)	87	39.3	(32.2, 47.0)
Five or more	12	8.8	(4.8, 15.5)	38	29.7	(22.0, 38.7)
Preceding birth interval (month)						
No previous birth	11	11.1	(5.7, 20.3)	48	52.1	(39.0, 65.0)
0–14	3	11.2	(3.2, 32.5)	10	65.5	(34.8, 87.1)
14–24	7	5.9	(2.5, 13.5)	28	28.1	(19.6, 38.4)
>25	32	12.3	(8.6, 17.1)	86	36.9	(30.3, 44.0)
Sex of baby						
Male	28	10.8	(7.3, 15.6)	89	40.9	(32.8, 49.8)
Female	25	10.4	(7.1, 15.2)	84	37.5	(30.9, 44.5)
Age of child (months)						
0–5						
3–5	53	10.6	(8.0, 13.9)			
6–8				173	39.2	(33.8, 44.9)
Perceived size of baby at birth						
Small	17	8.5	(5.2, 13.5)	55	36.1	(27.5, 45.6)
Average	21	11.3	(7.2, 17.1)	83	42.1	(33.4, 51.4)
Large	15	13.4	(8.2, 21.1)	35	38.2	(27.7, 50.0)
Place of delivery						
Home	29	9.4	(6.5, 13.4)	79	30.1	(24.4, 36.5)
Health facility	24	12.6	(8.2, 18.7)	94	52.5	(43.2, 61.7)
Mode of delivery						
Non-caesarean	51	11.1	(8.3, 14.6)	148	37.6	(31.8, 43.7)
Caesarean section	2	4.7	(1.2, 16.6)	25	52.2	(35.5, 68.5)
Type of delivery assistance						
Health professional	24	12.3	(8.1, 18.3)	85	47.2	(37.8, 56.8)
Traditional birth attendant	20	11.3	(7.2, 17.4)	42	27.4	(20.6, 35.5)
Other	9	7.2	(3.8, 13.3)	45	41.8	(32.0, 52.2)

Table 1. Continued

Characteristics	3–5 months (n = 498)			6–8 months (n = 443)		
	N	%	(95% CI)	N	%	(95% CI)
Antenatal clinic visits						
None	12	7.4	(4.5, 12.0)	38	26.5	(19.0, 35.6)
1 to 3	21	10.7	(6.8, 16.5)	62	37.3	(29.6, 45.7)
4+	20	14.4	(8.9, 22.4)	72	55.1	(44.7, 65.0)
Time of post-natal checkup						
0–2 h	16	14.7	(8.7, 23.9)	63	50.0	(40.7, 59.3)
1–7 days	0	0.0		4	31.2	(17.9, 48.6)
Missing/no checkup	8	12.7	(6.2, 24.4)	26	32.5	(26.2, 39.6)
Household level factors						
Household Wealth Index						
Poorest	11	8.7	(4.9, 15.2)	32	28.0	(19.5, 38.5)
Poorer	10	10.3	(5.6, 17.9)	29	33.7	(23.7, 45.3)
Middle	13	12.8	(7.2, 21.8)	22	23.1	(14.8, 34.3)
Richer	7	7.4	(3.6, 14.3)	36	51.3	(38.3, 64.1)
Richest	12	14.7	(8.0, 25.5)	54	70.9	(56.7, 81.9)
Community level factors						
Residence						
Urban	22	13.8	(9.0, 20.6)	64	56.6	(44.7, 67.7)
Rural	31	9.1	(6.3, 13.0)	109	33.2	(27.7, 39.1)
Geographical region						
Punjab	19	7.4	(4.3, 12.3)	90	35.4	(27.7, 44.0)
Sindh	19	15.3	(10.0, 22.8)	41	42.7	(33.0, 53.1)
NWFP	7	8.3	(4.1, 15.9)	33	46.5	(34.6, 58.9)
Balochistan	8	25.2	(13.4, 42.4)	9	43.7	(28.9, 59.6)
Overall	53	10.6	(8.0, 13.9)	173	39.2	(33.8, 44.9)

CI, confidence interval; NWFP, North West Frontier Province. *Divorced/separated/widowed.

categories were less likely to introduce solid, semi-solid or soft foods at the recommended age as compared with infants from the richest wealth quintile (AOR for 'middle' = 7.82, 95%CI = 3.49, 17.55, AOR for 'poorer' = 4.84, 95%CI = 2.34, 10.45 and AOR poorest = 5.72, 95%CI = 2.60, 12.57). When the wealth index was replaced with the maternal education in the final model of the multivariate analysis, mothers with secondary or higher education were significantly less likely to delay the initiation of complementary feeding (AOR = 0.46, 95%CI: 0.26, 0.82) as compared with mothers with little or no education indicating that this association was possibly confounded by the stronger influence of wealth index. Compared with first-born infants, the risk for not introducing solid, semi-solid or soft foods at the recommended age was higher in the second to the fourth born infants (AOR = 1.80, 95%CI: 0.99, 3.26) and infants of the fifth or higher birth order (AOR = 2.04, 95%CI: 1.00, 4.14).

Discussion

The present study found that more than half of Pakistani infants do not receive solid, semi-solids or soft food during the recommended time as 60.8% of 6.00- to 8.99-month-old infants were still not receiving complementary foods. Moreover, a sizeable proportion (10.6%) of 3.00- to 5.99-month-old infants had been started with complementary foods earlier than the recommended 6 months of age. Further analysis revealed that infants from the poorest to the middle household wealth categories and of higher birth order in the family (younger siblings) were at the greatest risk for delaying introduction of solids and semi-solids. Those mothers living in the provinces of Sindh

Table 2. Odds ratios for early introduction of solid, semi-solid or soft foods (3–5 months) and not given solid, semi-solid or soft foods (6–8 months): multivariate analysis

Characteristic	Early introduction of solid, semi-solid or soft foods (3–5 months)						Non-introduction of solid, semi-solid or soft foods (6–8 months)					
	Unadjusted			Adjusted			Unadjusted			Adjusted		
	OR	(95% CI)	*P*	OR	(95% CI)	*P*	OR	(95% CI)	*P*	OR	(95% CI)	*P*
Individual level factors												
Maternal working status												
Non-working	1.00						1.00					
Working (past 12 months)	1.40	(0.70, 2.82)	0.333				1.18	(0.69, 2.03)	0.526			
Marital status												
Currently married	1.00						1.00					
Formerly married (div/sep/widow)	1.04	(0.33, 3.27)	0.952				0.70	(0.10, 4.80)	0.724			
Maternal education												
No education	1.00						1.00					
Primary	1.19	(0.49, 2.86)	0.690				0.90	(0.49, 1.64)	0.736			
Secondary and above	1.39	(0.65, 2.99)	0.384				0.40	(0.23, 0.70)	0.002			
Literacy												
Cannot read at all	1.00						1.00					
Able to read only passage	1.41	(0.75, 2.62)	0.274				0.58	(0.37, 0.90)	0.017			
Partner's education												
No education	1.00						1.00					
Primary	0.54	(0.18, 1.63)	0.277				1.05	(0.50, 2.18)	0.885			
Secondary and above	1.10	(0.58, 2.07)	0.755				0.50	(0.28, 0.87)	0.016			
Mother's age												
15–19 years	1.00						1.00					
20–34 years	0.99	(0.36, 2.65)	0.985				0.58	(0.22, 1.57)	0.293			
35–49 years	1.04	(0.32, 3.34)	0.938				0.68	(0.23, 1.98)	0.481			
Birth order												
First-born	1.00						1.00			1.00		
Second to fourth	1.02	(0.44, 2.36)	0.949				1.67	(0.93, 3.00)	0.085	1.80	(0.99, 3.26)	0.051
Five or more	0.77	(0.29, 2.03)	0.602				2.57	(1.30, 5.08)	0.006	2.04	(1.00, 4.14)	0.049
Preceding birth interval												
No previous birth	1.00						1.00					
0–14 months	1.01	(0.22, 4.60)	0.987				0.57	(0.15, 2.07)	0.396			
4–24 months	0.50	(0.15, 1.63)	0.254				2.79	(1.35, 5.76)	0.006			
≥25 months	1.12	(0.49, 2.54)	0.782				1.85	(1.01, 3.39)	0.045			
Sex of baby												
Male	1.00						1.00					
Female	0.96	(0.53, 1.75)	0.913				1.16	(0.74, 1.81)	0.515			
Age of child (months)	2.88	(1.93, 4.31)	<0.001	3.00	(2.02, 4.47)	<0.001	0.61	(0.47, 0.80)	<0.001			

Size of baby												
Average	1.00						1.00					
Large	1.36	(0.67, 2.74)	0.385				0.77	(0.45, 1.33)	0.365			
Small	1.66	(0.79, 3.47)	0.173				0.91	(0.48, 1.73)	0.792			
Place of delivery												
Home	1.00						1.00					
Health facility	1.38	(0.74, 2.58)	0.298				0.39	(0.24, 0.62)	<0.001			
Mode of delivery												
Non-caesarean	1.00						1.00					
Caesarean section	0.39	(0.95, 1.65)	0.206				0.55	(0.26, 1.15)	0.114			
Type of delivery assistance												
Health professional	1.00						1.00					
Traditional birth attendant	0.91	(0.46, 1.79)	0.792				2.35	(1.38, 4.01)	0.002			
Other	0.55	(0.24, 1.27)	0.164				1.24	(0.68, 2.26)	0.470			
Antenatal clinic visits												
None	1.00			1.00			1.00					
1–2	1.51	(0.73, 3.14)	0.269	1.60	(0.73, 3.51)	0.237	0.60	(0.35, 1.05)	0.077			
4+	2.11	(1.01, 4.42)	0.047	2.68	(1.21, 5.89)	0.014	0.29	(0.15, 0.54)	<0.001			
Timing of post-natal checkup												
Immediate (hosp. birth)	1.00						1.00					
0–2 days	1.18	(0.44, 3.16)	0.731				0.76	(0.35, 1.64)	0.489			
3–6 days	1.26	(0.62, 2.57)	0.523				1.65	(0.35, 7.74)	0.523			
Seventh day or later	1.23	(0.32, 4.71)	0.759				3.87	(0.29, 50.59)	0.299			
Household level factors												
Household Wealth Index												
Richest	1.00						1.00			1.00		
Richer	1.19	(0.48, 2.94)	0.701				0.77	(0.39, 1.52)	0.458	2.22	(0.99, 4.94)	0.051
Middle	1.53	(0.64, 3.61)	0.332				1.30	(0.62, 2.73)	0.484	7.82	(3.49, 17.55)	<0.001
Poorer	0.82	(0.31, 2.18)	0.703				0.37	(0.18, 0.75)	0.007	4.84	(2.34, 10.45)	<0.001
Poorest	1.79	(0.70, 4.56)	0.216				0.16	(0.07, 0.35)	<0.001	5.72	(2.60, 12.57)	<0.001
Residence												
Rural	1.00						1.00					
Urban	0.62	(0.33, 1.17)	0.143				2.61	(1.52, 4.48)	0.001			
Geographical region												
Punjab	1.00			1.00			1.00					
Sindh	2.27	(1.07, 4.82)	0.031	2.89	(1.33, 6.26)	0.007	0.73	(0.42, 1.27)	0.272			
NWFP	1.13	(0.44, 2.88)	0.786	1.41	(0.55, 3.61)	0.467	0.63	(0.34, 1.16)	0.140			
Balochistan	4.25	(1.62, 11.16)	0.003	6.75	(2.39, 19.06)	<0.001	0.67	(0.32, 1.42)	0.303			

CI, confidence interval; OR, odds ratio; NWFP, North West Frontier Province.

and Baluchistan were more likely to introduce solid, semi-solid or soft food before 6 months of age. This analysis is important as it has highlighted determinants for both early and delayed introduction of complementary food so that issues related to both aspects of inappropriate feeding practices can be addressed simultaneously by appropriate policies and programmes.

The major strengths of this study are the nationally representative household survey data, and the common survey methodology that supports comparison with DHS surveys of other countries. The lack of data regarding the types of foods given to the infants in the Pakistan DHS poses a major limitation in estimating the new WHO indicators of complementary feeding such as minimum dietary diversity, meal frequency and acceptable diet. This limitation highlights a major information gap in Pakistan about complementary feeding of infants. Another limitation of PDHS data is the type of survey (cross-sectional) and recall bias associated with it. Nevertheless, the detailed investigation on factors for inappropriate timing would be useful in Pakistan in particular because the country has the lowest rate in timely introduction among the South Asian countries (Dibley *et al*. 2010; WHO *et al*. 2010).

In general, the delayed introduction seems to be a common practice among mothers with little or no education across all South Asian countries (Joshi *et al*. 2011; Kabir *et al*. 2011; Patel *et al*. 2011; Senarath *et al*. 2011). For Pakistan, this association was not found in the final model of the multivariate analysis, although the univariate analyses showed statistical significance. This could possibly be due to the confounding effect of wealth where poor wealth categories are associated with both delayed introduction and low maternal education. A previous study conducted at an outpatient paediatric department in Islamabad also found that educated women started complementary feeding of their infants at appropriate ages as compared with those who were uneducated (Liaqat *et al*. 2007).

The predictors for early introduction are inconsistent and vary according to settings. This study did not find any association between early introduction and maternal age or education. Comparison of determinants for early introduction with previous studies was not possible because of lack of consistency in the definition of early introduction and methodological differences. However, an Australian study indicated that the strongest independent predictors of the early introduction of solids were young maternal age, mother smoking prior to pregnancy and not fully breastfeeding at 4 weeks post-partum (Scott *et al*. 2009).

Women in employment outside the home were almost twice as likely to introduce solid foods before the age of 4 months in Lebanon (Batal *et al*. 2010). Our study did not show any significant differences in the rates between working and non-working women.

Based on our study, we recommend that the mothers and caregivers should be educated on correct timing of introducing solid, semi-solid and soft food (just after 6 months) during antenatal visits. There is evidence that educational interventions can effectively improve complementary feeding practices and child nutrition and growth (Imdad *et al*. 2011) (Shi & Zhang 2010). Training of health care workers regarding IYCF practices has proven to be effective in many parts of the world. The health workers should be trained to deliver consistent messages regarding the significance of appropriate timing for the introduction of complementary foods. In Lahore, a controlled trial found that training health workers in nutrition counselling in enhancing their communication skills and performance can improve feeding practices and reduce growth faltering in children aged 6–24 months (Zaman *et al*. 2008). These determinants can be used to target mothers and children who are least likely to receive solid food in time. The health authorities in Sindh and Baluchistan regions should strengthen their programmes to address the problem of introducing complementary food earlier than recommended.

In conclusion, more than half (60.8%) of the Pakistani infants were not receiving solid, semi-solids or soft food during the recommended time, and introduction earlier than 6 months was also observed in some. The study identified higher birth order of child and middle to poorest wealth index as factors associated with delay in introduction of complementary feeds. The factors significantly associated with introduction of complementary foods earlier than recommended were four or more antenatal clinic visits

and geographical differences. Further research on different food groups consumed/given and feeding frequency is required to fully describe infant and young child feeding practices using the new WHO indicators.

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Conflicts of interest

None of the authors have any conflict of interest on the content of this manuscript.

Contributions

TH, NK and SA designed the study, obtained data sets, guided analysis and wrote the manuscript. TH and NK obtained literature, checked results, and reviewed and revised the manuscript. KA wrote the results section and interpreted results, and US wrote and revised the manuscript. KA and SA converted data files, conducted statistical analysis and compiled results tables. MD conceptualised the research question, designed and guided the analysis and edited the manuscript.

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