Appendices to the guidance for health professionals on feeding twins, triplets and higher order multiples

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Appendix 1: Methods: Identification and assessment of evidence

1.1 The scope of the guidance

The scope of the guidance was developed by and agreed with the Guideline Development Group (GDG) and the Advisory Group.

1.2 Details of electronic searches

All searches were conducted in March 2009. The review included all types of studies of humans (quantitative and qualitative; observational and experimental) and articles describing interventions, risk factors, policies and guidelines. Standard search strategies were employed using The Cochrane Database of Systematic reviews, The Cochrane Central Register of Controlled Trials, and electronic databases such as MEDLINE (1966 - March 2009), EMBASE (1980 - March 2009), and CINAHL (1982 - March 2009).

1.3 Details of other searches (grey literature, other guidance)

A search of other data sources included websites such as the Department of Health, The World Health Organisation, UNICEF, The National Childbirth Trust, and La Leche League. In addition, we obtained relevant information from support organisations for multiple births that are based overseas (e.g. Multiple Births Canada, the Australian Multiple Births Association, and the National Organisation of Mothers of Twins Clubs in the United States).

1.4 Details of search terms

The following search terms were used:

{(twin$ or triplet$ or quads or quadruplet$ or quin$ or sextuplet$)
or
((multiple adj5 birth$) or (multiple adj5 pregnan$) or (multiple adj5 mother))}

and

{(breast fe$ or breastfe$ or bottle fe$ or bottlefe$ or formula fe$ or formulafe$ or formula milk or infant fe$)
or
(enteral fe$ or enteral milk or wean$ or parenteral fe$)}

where $ matches any characters (e.g. twin$ would find the search terms twin, twins, twinned, etc) and adj5 would locate search terms that appear within 5 words of each other

The above search was limited to:

Humans
or
("newborn infant (birth to 1 month)" or "infant (1 to 23 months)" or "preschool child (2 to 5 years)")

1.5 Classification of evidence levels and grades of recommendation

Where appropriate, the articles were assessed for methodological quality in terms of sample size estimation, proportion followed up, blinding of outcome assessment, comparison of baseline variables and assessment of confounding. Trials were also assessed for methodological quality in terms of method of randomisation, allocation concealment, and blinding of intervention. Results are summarised in evidence tables which include outcome measures (e.g. the proportion of infants breastfed for at least 3 months) or effect measures (e.g. an odds ratio for breastfeeding for at least 3 months in twins compared with singletons) with 95% confidence intervals (CIs). Meta-analyses were not conducted because there was not sufficient homogeneous data to justify and allow meta-analysis.

Guideline recommendations were based on informal consensus methods using the GDG members only. The process involved the researchers reviewing the evidence and drafting the summary of evidence and proposed recommendations. This was based on the classification of evidence levels and corresponding grades of recommendation shown in Table 1a, which were adapted from SIGN (SIGN 2009).

Table 1a Classification of evidence levels

Classification of evidence levels		**Grades of recommendation**	
1++	High quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias.	A	At least one meta-analysis, systematic review, or RCT rated as 1++, and directly applicable to the target population; *or* A body of evidence consisting principally of studies rated as 1+, directly applicable to the target population, and demonstrating overall consistency of results.
1+	Well-conducted meta-analyses, systematic reviews, or RCTs with a low risk of bias.		
1-	Meta-analyses, systematic reviews, or RCTs with a high risk of bias.	B	A body of evidence including studies rated as 2++, directly applicable to the target population, and demonstrating overall consistency of results; *or* Extrapolated evidence from studies rated as 1++ or 1+.
2++	High quality systematic reviews of case control or cohort or studies. High quality case control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal.		
2+	Well-conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal.	C	A body of evidence including studies rated as 2+, directly applicable to the target population and demonstrating overall consistency of results; *or* Extrapolated evidence from studies rated as 2++.
2-	Case control, cohort or cross-sectional studies with a high risk of confounding or bias and a significant risk that the relationship is not causal.	D	Evidence level 3 or 4; *or* Extrapolated evidence from studies rated as 2+.
3	Non-analytic studies, e.g. case reports, case series.	E	Recommended best practice based on the clinical experience of the guideline development group.
4	Expert opinion.		

Note that we have slightly amended the original SIGN classification: we have added cross-sectional studies to 2-; and we have relabelled the good practice points as D rather than a tick.

The proposed guideline recommendations were discussed at GDG meetings (four face-to-face meetings held between November 2007 and July 2009) and the GDG members were asked to send us additional comments after each meeting. Consensus was reached after successive iterations of this process.

1.6 Consultation process

The draft documents were sent to relevant professional and voluntary organisations for comment. The list of organisations was agreed with the GDG and the Advisory group and is shown in Table 1b below. These organisations were first approached in writing about the forthcoming documents in July 2008. The draft guidance documents were circulated to these organisations for comment during May-June 2009 (Table 1b). These comments were summarised and discussed with the GDG, and consensus was reached on how to address these comments.

The revised documents were sent for final comments to the GDG, the Advisory Group and these organisations during January-February 2010 (Table 1b). Most of these final comments were minor and were easily addressed. For some topics, we received conflicting comments from different organisations or individuals, and for these we sought consensus from the GDG. The GDG was consulted by email for the last time during March-April 2010. Consensus was reached and the documents were finalised in April 2010. Of the 18 organisations which were consulted, 14 sent comments on the draft documents during the first consultation, the second consultation or both consultations.

Table 1b List of professional and voluntary organisations included in the consultation process.

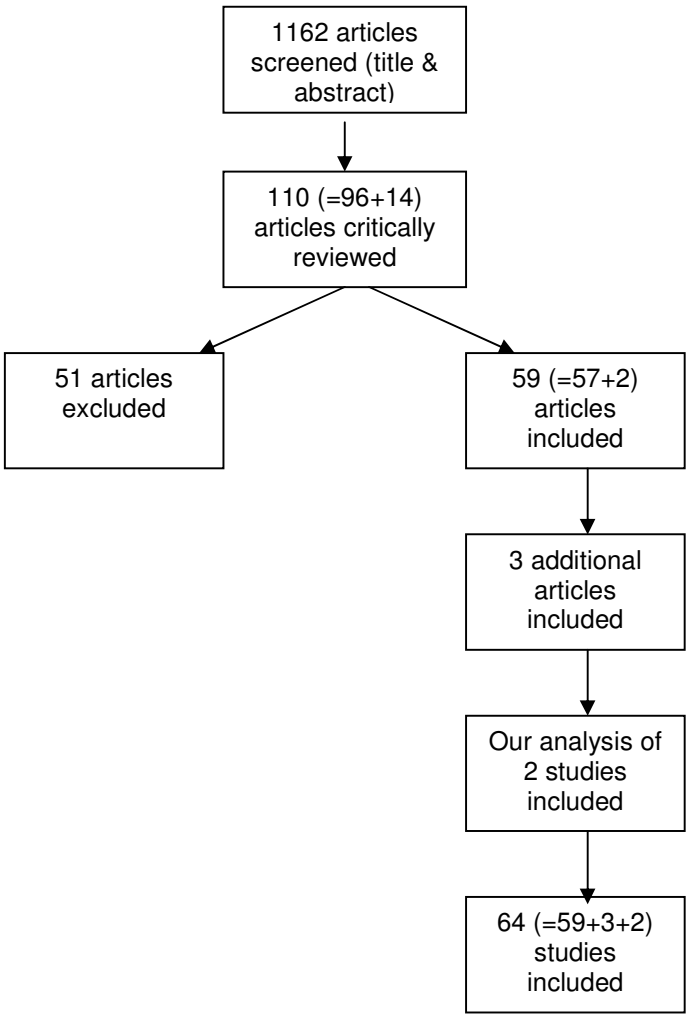
	First consultation May-June 2009		**Second consultation Jan-Feb 2010**	
Organisation	**Was consulted**	**Sent us comments**	**Was consulted**	**Sent us comments**
ABM (Association of breastfeeding mothers)	Y	**Y**	Y	**Y**
BAPM (British Association of Paediatric Medicine)	Y	N	Y	N
BDA (British Dietetic Association)	Y	**Y**	Y	**Y**
BFN (Breastfeeding Network)	Y	**Y**	Y	N
Bliss	Y	**Y**	Y	**Y**
CPHVA	Y	N	Y	N
Department of Health for England	N	-	Y	**Y**
La Leche League GB	Y	N	Y	**Y**
NCT (National Childbirth Trust)	Y	**Y**	Y	N
Neonatal Nurses Association	Y	N	Y	N
RCGP	N	N	Y	N
RCM	Y	N	Y	**Y**
RCN	Y	N	Y	**Y**
RCOG	Y	**Y**	Y	**Y**
RCPCH	Y	**Y**	Y	**Y**
Tamba	Y	**Y**	Y	**Y**
UKAMB (UK Association of Human Milk Banking)	Y	**Y**	Y	N
UNICEF UK BFI (Baby Friendly Initiative)	Y	**Y**	Y	**Y**
Specific health professionals				
Newcastle (for NorSTAMP)	Y	**Y**	Y	**Y**
St Mary's London (for NWLPN)	Y	**Y**	Y	**Y**

Appendix 2: Results of systematic review

2.1 The number of articles identified and included

The Medline search yielded 366 articles which were screened (title and abstract). 96 of these articles potentially addressed the research questions, but on obtaining and reading the articles only 57 papers met the inclusion criteria. The additional searches in Embase and CINAHL yielded 14 additional (non-duplicate) articles which potentially addressed the research questions, but on obtaining and reading the articles only 2 papers met the inclusion criteria (Langkamp 2006, Ooki 2008). On reading the reference lists for these 59 papers, two additional papers (Flacking 2003, Leonard 2002b) were identified which satisfied the inclusion criteria for our review. One additional paper which was published shortly after the search was conducted was added (Szuca 2009). In addition, we used the unpublished results of our own analysis (NPEU and MBF) of the UK Millennium Cohort Study and the 2005 UK Infant Feeding Survey. Hence, 64 studies were included in our evidence tables (see Figure 1).

Figure 1 Results of database searches.



It should be noted that we included papers that described infant feeding experiences (including milk yield) in multiples or gave data on breastfeeding rates in multiples, but we excluded a small number of papers which described biochemical markers (e.g. dioxin levels, selenium, parathyroid hormone levels, etc) in multiples since these were not relevant to the guidelines.

2.2 A summary of the 64 articles included

The evidence tables for these 64 articles are given in **Appendix 3** and are sorted according to publication date. The first two studies are unpublished data which we (NPEU and MBF) have analysed from the Millennium Cohort Study and Infant Feeding Survey. For each study, we have indicated which (if any) of the guideline topics it addresses.

The 64 articles included in the review comprised a variety of study types and methodologies, which are summarised in the box below.

The study type/methodology of the 64 articles:

1	RCT (the study included singletons and twins, but the twins have not been analysed separately).
1	Non-randomised intervention study (n=18 mothers of twins)
23	Epidemiological studies which compared breastfeeding rates in singletons and multiples
1	Epidemiological study which compared weaning in singletons and multiples
10	Epidemiological/qualitative studies of feeding in twins/multiples
3	Studies of milk volume in multiples
10	Case studies of infant feeding in twins (4 studies), conjoined twins (1 study), triplets (1 study), quads (3 studies) and quintuplets (1 study)
2	"Duplicates" (Geraghty has published 3 papers on different topics within the same cohort; one of her papers compares singletons & multiples and is counted above; her other 2 papers are included in the review)
13	Review/opinion articles

There was only one RCT (Gunn 2000), and this compared early versus late discharge of PTB babies on breastfeeding rates. There was no impact of the intervention on breastfeeding. The trial was not specifically a study in multiples, although multiples were included; no results are presented separately in multiples. There was also a non-randomised intervention study specifically in twins (Hattori 1999). The intervention was breastfeeding support in hospital. However, the study was not randomised and was very small (22 mothers in the intervention group and 14 in the control).

There were many epidemiological studies but few of these addressed any of the guideline topics. However, 23 of the epidemiological studies compared breastfeeding rates in multiples and singletons, and 20 of these have been meta-analysed and presented in forest plots. These are labelled in the evidence tables in Appendix 3 as forest-1 to forest-20. There were 3 studies of milk volume in multiples, and some of the other studies also gave data on milk volumes.

The 10 epidemiological/qualitative studies and the 10 case studies included data on infant feeding experiences in multiples from the view of the health professionals and/or the mothers. While these have been referred to in the guidelines where appropriate, it is important to note that they were usually descriptive only. For example, in one study of 13 sets of twins (Nyqvist 2002), 8 mothers preferred simultaneous breastfeeding, 3 preferred separate feeding and 2 did not breastfeed. Finally, there were 13 review/opinion articles which have also been referred to in the guidelines, where appropriate.

2.3 The quality of the 64 articles included

The box below broadly summarises the quality of the evidence for the topics in the scope of the guidelines. There is good quality evidence (IIa, IIb) to determine whether multiples have lower rates of breastfeeding than singletons. However, for most of the guideline topics, the quality of evidence is not good - most of the studies are small, descriptive studies and case reports (IIIb) and occasionally larger descriptive studies (IIIa). Hence, **it was not possible to write the guidance as recommendations based on a specific level of evidence**. Instead, the guidance is written as a summary of the options available, with some recommended good practice points where appropriate.

Topic	Level of evidence for that topic	
Breastfeeding rates in multiples versus singletons	2+	Well-conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal.
	2-	Case control, cohort or cross-sectional studies with a high risk of confounding or bias and a significant risk that the relationship is not causal.
Some of the guideline topics	2-	Case control, cohort or cross-sectional studies with a high risk of confounding or bias and a significant risk that the relationship is not causal.
	3	Non-analytic studies, e.g. case reports, case series.
Most of the guideline topics	3	Non-analytic studies, e.g. case reports, case series.

Note that the 2005 Infant Feeding Survey was classified as 2+ for the topic breastfeeding rates in multiples versus singletons but classified as 2- for "reasons for twins stopping breastfeeding" owing to the poorer data quality for the latter (e.g. a small number of twins stopping breastfeeding at particular time points).

2.4 Meta-analysis of breastmilk feeding rates in multiples compared with singletons

The objective of this review was to compare breastfeeding rates in multiples with singletons.

2.4.1 Inclusion criteria

The box below summarises the inclusion criteria for the review.

Study design
Observational studies

Study population
Singleton or multiple birth babies or their mothers
Any

Stratification of study population
Population-based e.g. from a country, city, region
Hospital based – unmatched
Hospital based – matched
PTB or LBW or special care
Term, not LBW, no special care

Comparison groups
Singleton babies versus twin babies
Singleton babies versus pairs of twins
Singleton babies versus multiple birth babies
Singleton babies versus sets of multiples

Outcomes
Any breastfeeding at any time point from birth to 6 months
Exclusive breastfeeding at any time point from birth to 6 months.

23 articles compared breastfeeding rates in twins (or multiples) and singletons, and 20 of these have been meta-analysed. The three articles which were not meta-analysed were:

- Thorpe 2003 (it says that twins were breastfed for significantly less time than singletons, but no data are given).
- Justesen 2000 (breastfeeding for 6+ months was similar in twins (98.5%) and singletons (98.5%), but the study was conducted in three developing countries (Malawi, Tanzania, Zambia) with infant mortality rates which were high in singletons and extremely high in twins. Hence, breastfeeding at 6 months is in "survivors" – differential loss between twins and singletons, and very different setting to other studies in our review.
- Ooki 2008 (breastfeeding rates in twins were compared with population rates of breastfeeding but no raw data were included for the latter).

A summary of the 20 included studies is given in **Appendix 4**. The study period ranged from the 1980s to 2005. One study was a multi-centre study using data from 17 countries and the remaining studies were conducted in the UK (n=3), Japan (n=3), New Zealand (n=3), US (n=2), Iceland, Greece, Turkey, Canada, Germany, Italy, China and Sweden. Note that for 2 studies (Geraghty 200a and Killersreiter 2001), we used the graphs given in the papers to estimate the breastfeeding rates for the time points we were interested in.

2.4.2 Did the studies use an appropriate comparison group for the multiples?

The study populations varied, with some studies being population-based and others being focussed on a particular subgroup such as preterm babies. Given that having a multiple birth is associated with older maternal age and poorer birth outcomes (e.g. preterm birth, low birth weight and admission into special care), and that these factors may potentially be associated with infant feeding, we tried to include data for which the singletons were an appropriate comparison group for the multiples i.e. so that we were comparing like with like. We sought to do this by grouping the studies into two groups: those restricted to sick or preterm babies (e.g. PTB or LBW or admitted to NICU); those which were population-based or restricted to term or more healthy babies.

2.4.3 Did the studies use the same method for assessing infant feeding?

Infant feeding was usually assessed by maternal report although 4 studies used clinical records or routine data. The questions about infant feeding referred to a variety of time points (from discharge to 6 months) with some studies collecting data at several time points. The recall period for maternal report also varied markedly, with some studies collecting data about current feeding and others asking about feeding several months or even years later. Most studies did not distinguish between breastfeeding directly from the breast and receiving expressed breastmilk via a tube, cup or bottle, nor did they distinguish between mother's own milk and donor breastmilk.

2.4.4 Did the studies use the same definition of multiples?

The studies varied in their inclusion criteria for multiples:

- In 14 studies the inclusion criteria appeared to be all multiples, although in 3 of these, there were no triplets or HOM in the recruited sample.
- In 6 studies, the inclusion criteria were twins only, or we have abstracted the data for twins only.

While there are likely to be differences in infant feeding between twins and HOMs in most populations, the difference is unlikely to affect any results, such as proportion breastfeeding at any time point, because the number of triplets and HOMs is so small. Hence, it is valid to compare data in twins with data in all multiples.

2.4.5 Did the studies analyse the multiples as sets or as individual babies?

8 studies analysed the multiples as sets (e.g. 12 pairs of twins were breastfed for 3 months), 8 studies analysed the multiples as individual babies (e.g. 24 multiples were breastfed for 3 months) and in 4 studies, it was not clear how the multiples were analysed. We analysed the multiples as sets for two reasons:

- It made the analysis simpler (When multiples are analysed as individual babies, it is important to allow for clustered data due to the statistical dependency between twins/multiples)
- It has been shown that there is very little variation in infant feeding patterns within sets of twins or triplets (Geraghty 2004b and our paper).

The data arising from studies which presented their results in individual babies rather than sets has been halved before inclusion in our meta-analysis, in order that all of the data in our meta-analysis is based on sets rather than individual babies.

2.4.6 Results: did multiples receive less breastmilk than singletons?

There were 10 studies which compared rates of breastmilk feeding in multiples and singletons at any time in the first month and these are summarised by type of study in the upper part of Figure 2. Multiples were less likely than singletons to receive breastmilk (pooled odds ratio=0.63, 95% CI: 0.46-0.86). The difference between multiples and singletons was more marked in the 7 studies which were population-based or included term babies (pooled odds ratio=0.51, 95% CI: 0.34-0.76) compared to the 3 studies based on sick/preterm babies (pooled odds ratio=0.92, 95% CI: 0.66-1.28). There was much variation between the 10 studies, and the variation was statistically significant (chi-square for heterogeneity=19.16 with 9 df, p=0.024) although this was reduced when the studies were stratified according to population type.

There were 13 studies which compared rates of breastmilk feeding in multiples and singletons at months 3-6 (lower part of Figure 2). Multiples were less likely than singletons to receive breastmilk (pooled odds ratio=0.53, 95% CI: 0.41-0.69). Again, this effect was slightly stronger in the 7 studies which were population-based or included term babies (pooled odds ratio=0.48, 95% CI: 0.34-0.67) compared to the 6 studies based on sick/preterm babies (pooled odds ratio=0.65, 95% CI: 0.48-0.88). There was much variation between the 13 studies, and the variation was statistically significant (chi-square for heterogeneity=29.64 with 12 df, p=0.003) although this was reduced when the studies were stratified according to population type.

Figure 3 shows the duration of breastmilk feeding in multiples compared with singletons in one of the studies (Millennium Cohort Study) which is included in the meta-analysis. The analysis

was conducted separately for babies who had special care and those that did not have special care. At all time points after one month, the rates of breastmilk feeding are lower in twins compared for singletons. The twins who did not receive special care had the lowest rates of breastmilk feeding initiation and duration.

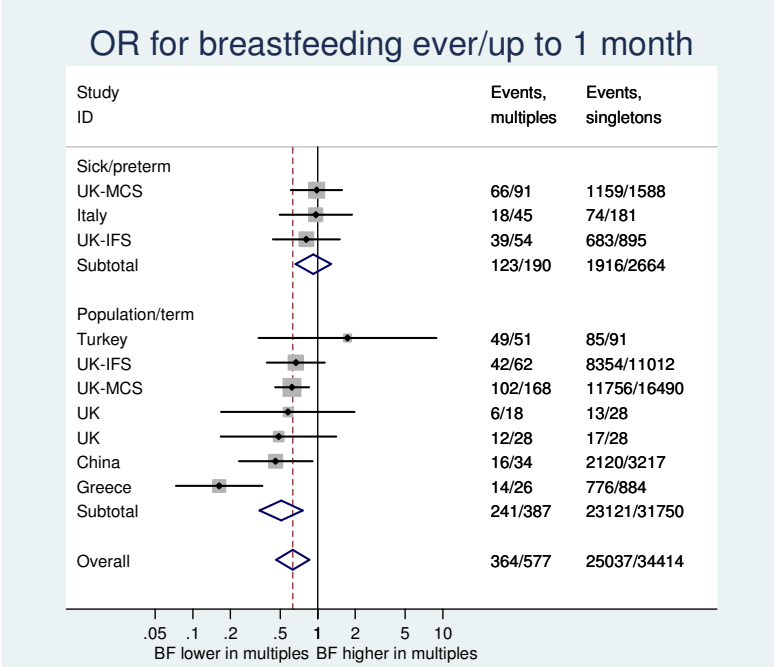
2.4.7 Results: did multiples receive less exclusive breastmilk than singletons?

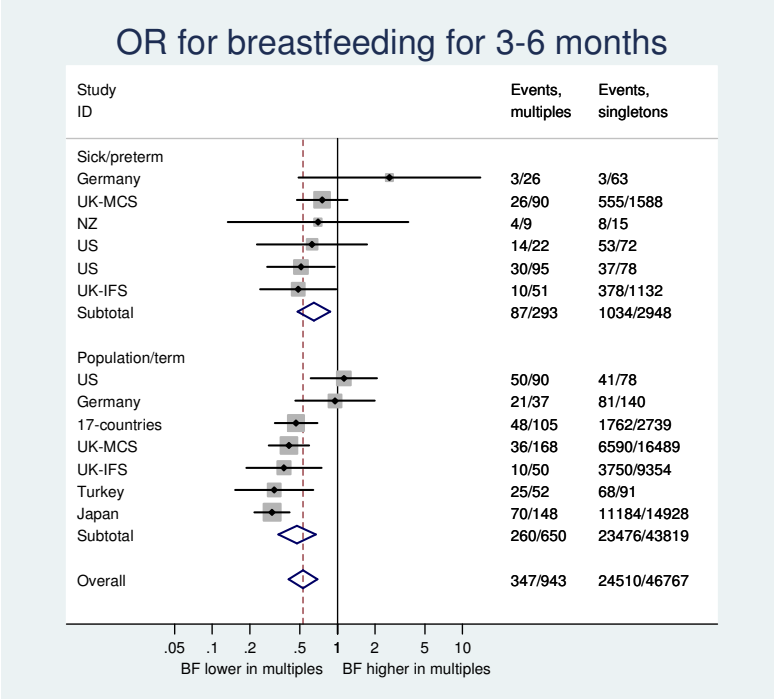
There were 7 studies which compared rates of exclusive breastmilk feeding in multiples and singletons at any time during the first month (upper part of Figure 4). Multiples were substantially less likely to receive exclusive breastmilk than singletons (pooled odds ratio=0.25, 95% CI: 0.14-0.44). Again, this effect was stronger in the 4 studies which were population-based or included term babies (pooled odds ratio=0.18, 95% CI: 0.07-0.47) compared to the 3 studies based on sick/preterm babies (pooled odds ratio=0.38, 95% CI: 0.23-0.64). There was much variation in the effect size between the 7 studies and this was statistically significant (chi-square for heterogeneity=16.20 with 6 df, p=0.013). However, the studies were remarkably consistent in showing that multiples were much more likely to be receiving no breastmilk (all 7 studies had an OR below 1); the studies differed in how large an effect this was (ORs varied between 0.55 and 0.08).

There were 11 studies which compared rates of exclusive breastmilk feeding in multiples and singletons at 3-6 months (lower part of Figure 4). Multiples were substantially less likely to be EBF than singletons (pooled odds ratio=0.16, 95% CI: 0.10-0.24). Again, this effect was stronger in the 8 studies which were population-based or included term babies (pooled odds ratio=0.14, 95% CI: 0.08-0.24) compared to the 3 studies based on PTB/LBW babies (pooled odds ratio=0.20, 95% CI: 0.10-0.42). There was much variation in the effect size between the 11 studies and this was statistically significant (chi-square for heterogeneity=43.7 with 10 df, $p<0.001$). However, the studies were remarkably consistent in showing that multiples were much more likely to be receiving no breastmilk (all 11 studies had an OR below 1); the studies differed in how large an effect this was (ORs varied between 0.42 and 0.05).

These results suggest that multiples are fed breastmilk for significantly shorter periods of time than singletons, and the difference is particularly strong for exclusive breastmilk feeding. These results are remarkably consistent according to preterm birth, country, and duration of breastfeeding.

Figure 2 **Forest plot showing odds ratios for receiving breastmilk in multiples compared with singletons**





Each **dot** in a line represents the odds ratio for a study, the **square box** around the dot represents the weight that this odds ratio has in the meta-analysis and the **line** represents the 95% for the odds ratio (the shorter the line, the more precise is the estimate). The **diamonds** represent the pooled odds ratios (centre of diamond) and 95% CI (width of diamond) in each subgroup and overall. The **numbers** on the side of the graph show the number receiving breastmilk and the denominator in singletons and multiples.

Figure 3 **Duration of breastmilk feeding in the twins compared with singletons in the Millennium Cohort Study**

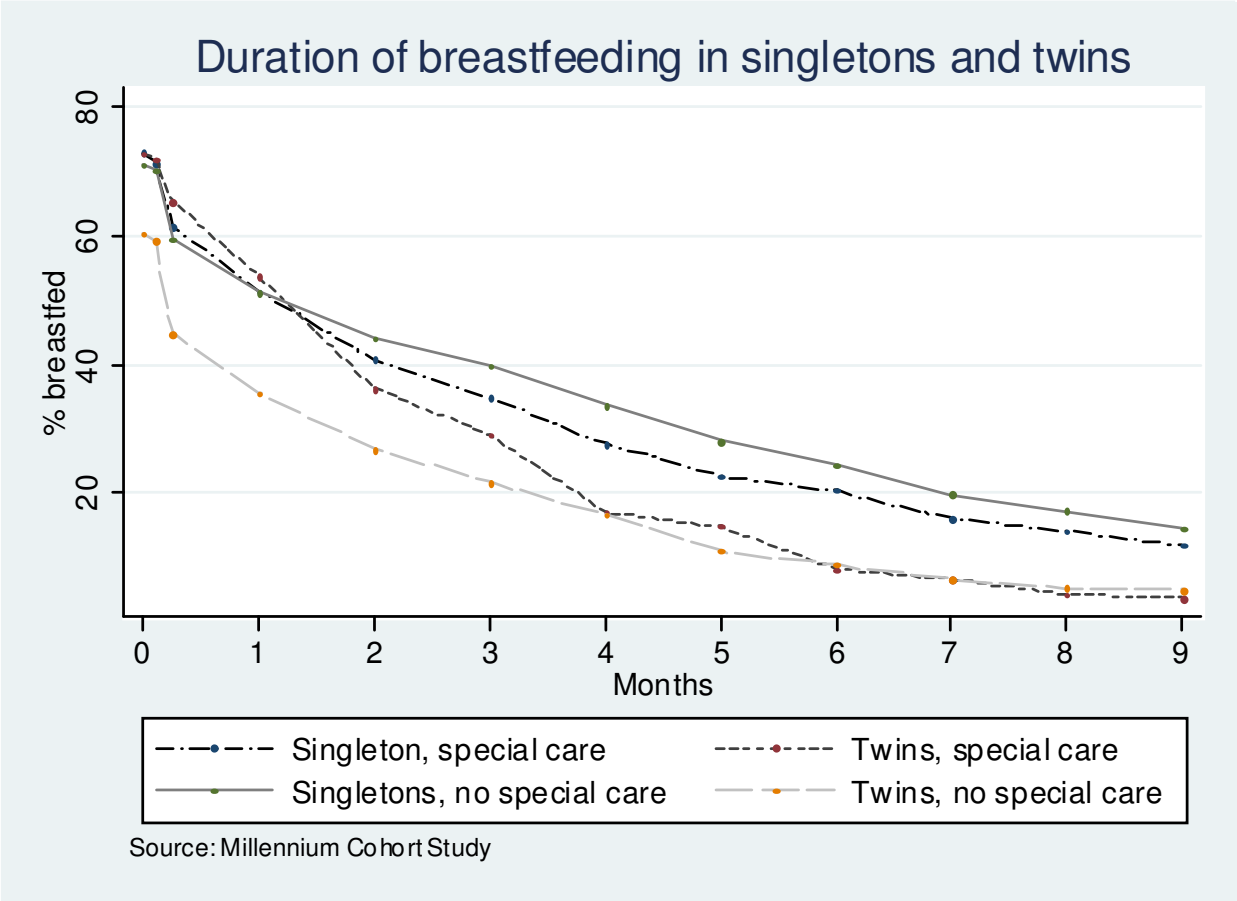
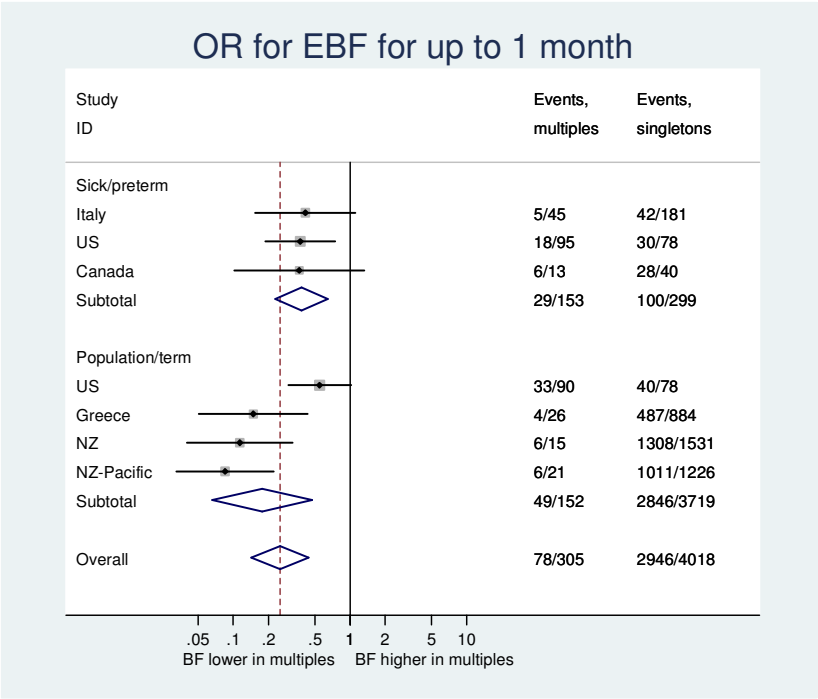
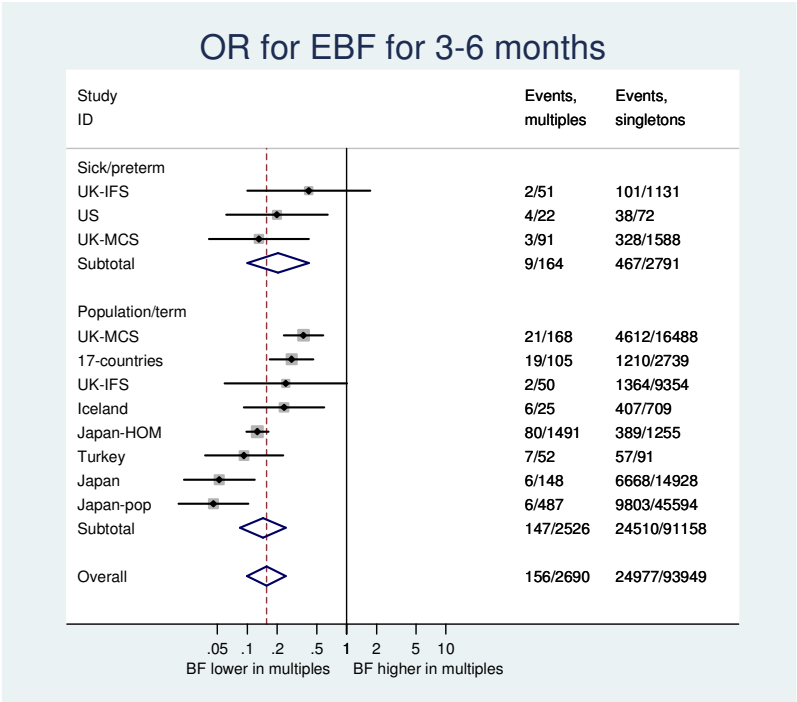


Figure 4 **Forest plot showing odds ratios for receiving exclusive breastmilk in multiples compared with singletons**





Each **dot** in a line represents the odds ratio for a study, the **square box** around the dot represents the weight that this odds ratio has in the meta-analysis and the **line** represents the 95% for the odds ratio (the shorter the line, the more precise is the estimate). The **diamonds** represent the pooled odds ratios (centre of diamond) and 95% CI (width of diamond) in each subgroup and overall. The **numbers** on the side of the graph show the number receiving breastmilk and the denominator in singletons and multiples.

2.5 Summary of breastfeeding rates in sick or preterm multiples

We estimated breastmilk feeding rates in sick or preterm multiples; here, breastmilk feeding is defined as "receiving breastmilk" by direct breastfeeding, or receiving expressed breastmilk via a bottle, cup or tube. There were 9 studies which assessed breastfeeding in sick or preterm multiples and these are summarised in Table 2 below. Breastmilk feeding at one week or at discharge from hospital ranged between 40% and 85% (2 studies), whereas exclusive breastmilk feeding at one week or discharge ranged between 11% and 46% (3 studies). The rate of breastmilk feeding at 3-4 months in 6 studies ranged between 12% and 64%, the latter rate being based on mothers who had planned to exclusively breastfeed for at least 12 weeks. The rate of exclusive breastmilk feeding at 3-4 months in 4 studies ranged between 4% and 18%.

The studies varied between setting and also between the type of babies included, for example, some including preterm and others including VLBW babies. Most studies focussed on breastfeeding rates without giving detail on the feeding process and any complications such as how many babies were tube fed, whether they had skin to skin contact, the use of non-nutritive sucking, cups, etc, and how long the babies received expressed breastmilk rather than being breastfed directly. Hence, these figures show that many sick and preterm multiples receive breastmilk, but they do not indicate whether breastmilk feeding is more likely in a particular group of sick or preterm multiples, or whether it is associated with a particular practice.

Table 2 Breastmilk feeding rates in sick or preterm multiples.

Country and year (Reference)	No. of sets of multiples	Type of babies included	BF at 1 week or discharge		BF at 3-4 months	
			% BF	% EBF	% BF	% EBF
UK 2000-2 (MCS)	120	PTB/LBW/NICU			29%	4%
UK 2005 (IFS)	52	PTB/LBW/NICU			20%	5%
US 2001-03 (Hill 2007)	22	Gestation<31 wks & VLBW Planned EBF >=12 wks & pump dependent at discharge			64%	18%
US 1999 (Geraghty 2004)	95	PTB (27-36 wks) 7 sets receiving no milk at 24 hrs, 2 sets receiving no milk at 3 days.			32%	15%
Canada (Wooldridge 2003)	26	PTB (30-35 wks)		46%		
Germany 1992-4 (Killersreiter 2001)	26	VLBW			12%	
Italy 1987-96 (Colonna 1996)	45	VLBW	40%	11%		
NZ 1996 (Liang 1997)	9	PTB & planned to BF. 17/18 twins needed nasogastric tube feeding.			44%	
Sweden (Nyqvist 2002)	13	PTB	85%	46%		

%BF rate of breastmilk feeding (partial or exclusive)
% EBF rate of exclusive breastmilk feeding
Note that none of the studies mentioned whether the babies received donor breastmilk. Hence these figures are likely to reflect mostly mother's own breastmilk.

2.6 Summary of reasons for breastfeeding cessation

2.6.1 Summary of the studies

There are few data available on the reasons for breastfeeding cessation in multiples. The two studies on this topic which were identified in the systematic review are based on small numbers of multiples. This is partly because multiples are a small group and partly because, by definition, reasons are only studied in those who initiated breastfeeding and then gave up at a particular point in time.

We analysed the reasons for breastfeeding cessation in the first 2 weeks and at 2-6 weeks after birth in the 2005 Infant Feeding Survey (Table 3). The reasons were described separately for singleton babies who were and who were not admitted to special care, although it should be noted that the number of twins is small, particularly when split according to special care. In a US survey of 67 mothers of twins (Damato 2005b), reasons for breastfeeding cessation in the first 9 weeks and at 9-28 weeks were described (Table 4). In both surveys, more than one reason could be given by the mothers.

2.6.2 Results: Most common reasons for breastfeeding cessation

The most common reasons given by the 26 mothers of twins in the Infant Feeding Survey who stopped breastfeeding at 0-2 weeks were *"twins/impossible"* (10 mothers), *"time/burden"* (7 mothers), *"insufficient milk"* (6 mothers), *"mother's illness"* (including caesarean, painful breast/nipples, problems expressing) (6 mothers) and *"baby's health"* (6 mothers). Among the 22 mothers of twins who stopped breastfeeding at 2-6 weeks, the most common reasons give were *"time/burden"* (12 mothers), *"insufficient milk"* (12 mothers), and *"twins/impossible"* (10 mothers).

The most common reasons given by the 30 mothers of twins in the US study who stopped breastfeeding at 0-9 weeks were *"inadequate milk"* (12 mothers), *"babies' health/behaviour"* (12 mothers), *"time/burden"* (9 mothers), *"illness/medication of the mother"* (5 mothers), and *"energy/fatigue of the mother"* (5 mothers). Among the 37 mothers of twins who stopped breastfeeding at 9-28 weeks, the most common reasons given were *"time/burden"* (12 mothers), *"work/employment"* (11 mothers), *"babies' health/behaviour/growth"* (11 mothers), and *"inadequate milk"* (8 mothers).

2.6.3 Results: Comparison with reasons given by mothers of singletons?

- *"Insufficient milk"* was a common reason for stopping in both surveys at all time points, but there was no evidence that it was more common in twins than in singletons. In the Infant Feeding Survey, *"insufficient milk"* was given as a reason for stopping at 0-2 weeks in 23% of twins compared with 21-29% of singletons, and was given as a reason for stopping at 2-6 weeks in 55% of twins compared with 56-60% of singletons. In the US study, *"insufficient milk"* was given as a reason for stopping at 0-9 weeks in 40% of twins and at 9-28 weeks in 22% of twins.

- *"Baby rejected the breast"* was a common reason for stopping in singletons in the Infant Feeding Survey although it was less common in twins at 0-2 weeks (15% in twins compared with 31-36% in singletons) and at 2-6 weeks (5% in twins compared with 18-20% in singletons).

- *"Takes too long/tiring"* was a reason given in the Infant Feeding Survey more often by mothers of twins than mothers of singletons at 0-2 weeks (19% in twins compared with 9-12% in singletons) and at 2-6 weeks (41% compared with 14-23% in singletons). In the US study, *"time/burden"* was a common reason for stopping at 0-9 weeks (30% of mothers) and 9-28 weeks (32% of mothers), and *"energy/fatigue"* was given as a reason at 0-9 weeks (17% of mothers) and 9-28 weeks (8% of mothers).

- *"Babies ill" (including premature and losing weight)* was a relatively common reason for stopping at 0-2 weeks in NICU twins (43%) and NICU singletons (35%) and for stopping at 2-6 weeks in NICU twins (36%) and NICU singletons (29%).

- *"Mother ill"* was a relatively uncommon reason for stopping in twins and singletons in the Infant Feeding Survey at 0-2 weeks (12% in twins compared with 8-15% in singletons) and 2-6 weeks (9% in twins compared with 12-13% in singletons).

- *"Painful breasts/nipples"* was a relatively common reason given in the Infant Feeding Survey for stopping at 0-2 weeks in non-NICU singletons (27%) but was less common in NICU singletons (13%) and twins (8%). The same pattern emerged at 2-6 weeks: 24% in non-NICU singletons, 14% in NICU singletons and 5% in twins. In the US study, "breast/nipple problems" was given by relatively few mothers of twins (10% at 0-9 weeks and 3% at 9-28 weeks).

Table 3 Reasons for stopping breastfeeding given by mothers of singletons and twins in the 2005 Infant Feeding Survey

	Singletons n=11897		Twins N=132		
Reasons for stopping	**Special care** N=905	**No special care** N=10992	**All twins** N=132	**Special care** N=58	**No special care** N=74
Total no. stopping at 0-2 weeks:					
	n=115	**n=1735**	**n=26**	**n=7**	**n=19**
Insufficient milk	**24 (21%)**	**510 (29%)**	**6 (23%)**	**3 (43%)**	**3 (16%)**
Baby behaviour					
Baby rejected breast	**42 (36%)**	**539 (31%)**	**4 (15%)**	**1 (14%)**	**3 (16%)**
Illness/Medication:	**39 (34%)**	**660 (38%)**	**6 (23%)**	**2 (29%)**	**4 (21%)**
Caesarean	3 (3%)	47 (3%)	0 (0%)	0 (0%)	0 (0%)
Mother was ill	17 (15%)	142 (8%)	3 (12%)	1 (14%)	2 (10%)
Painful breast/nipples	15 (13%)	471 (27%)	2 (8%)	0 (0%)	2 (10%)
Problem(s) expressing milk	4 (4%)	0 (0%)	1 (4%)	1 (14%)	0 (0%)
Baby's health:	**40 (35%)**	**111 (6%)**	**6 (23%)**	**3 (43%)**	**3 (16%)**
Baby was premature	5 (4%)	0 (0%)	2 (8%)	1 (14%)	1 (5%)
Baby losing weight	3 (3%)	26 (2%)	0 (0%)	0 (0%)	0 (0%)
Baby was ill	32 (28%)	85 (5%)	4 (15%)	2 (29%)	2 (10%)
Twins / impossible	-	-	**10 (38%)**	**2 (29%)**	**8 (42%)**
Time/burden:	**19 (19%)**	**376 (22%)**	**7 (27%)**	**0 (0%)**	**7 (37%)**
Too stressful/causing distress	9 (8%)	130 (8%)	1 (4%)	0 (0%)	1 (5%)
BF took too long/too tiring	10 (9%)	208 (12%)	5 (19%)	0 (0%)	5 (26%)
Baby could not be fed by others	0 (0%)	38 (2%)	1 (4%)	0 (0%)	1 (5%)
Domestic reasons	**3 (3%)**	**99 (6%)**	**5 (19%)**	**1 (14%)**	**4 (21%)**
Total no. stopping at 2-6 weeks:					
	n=141	**n=1097**	**n=22**	**n=14**	**n=8**
Insufficient milk	**84 (60%)**	**610 (56%)**	**12 (55%)**	**9 (64%)**	**3 (38%)**
Baby behaviour:					
Baby rejected breast	**28 (20%)**	**197 (18%)**	**1 (5%)**	**0 (0%)**	**1 (12%)**
Illness/Medication:	**47 (33%)**	**399 (36%)**	**5 (23%)**	**1 (7%)**	**4 (50%)**
Caesarean	5 (4%)	10 (1%)	1 (5%)	0 (0%)	1 (12%)
Mother was ill	18 (13%)	128 (12%)	2 (9%)	0 (0%)	2 (25%)
Painful breast/nipples	20 (14%)	261 (24%)	1 (5%)	0 (0%)	1 (12%)
Problem(s) expressing milk	4 (3%)	0 (0%)	1 (5%)	1 (7%)	0 (0%)
Baby's health:	**41 (29%)**	**86 (8%)**	**5 (23%)**	**5 (36%)**	**0 (0%)**
Baby was ill	37 (26%)	47 (4%)	5 (23%)	5 (36%)	0 (0%)
Baby losing weight	4 (3%)	39 (4%)	0 (0%)	0 (0%)	0 (0%)
Twins / impossible	**0 (0%)**	**0 (0%)**	**10 (45%)**	**7 (50%)**	**3 (38%)**
Time/burden:	**34 (24%)**	**380 (35%)**	**12 (55%)**	**6 (43%)**	**6 (75%)**
Too stressful/causing distress	9 (6%)	60 (6%)	0 (0%)	0 (0%)	0 (0%)
BF took too long/too tiring	20 (14%)	252 (23%)	9 (41%)	4 (29%)	5 (62%)
Baby could not be fed by others	0 (0%)	47 (4%)	0 (0%)	0 (0%)	0 (0%)
Found breastfeeding difficult	5 (4%)	21 (2%)	3 (14%)	2 (14%)	1 (12%)
Domestic reasons	**11 (8%)**	**113 (10%)**	**5 (23%)**	**3 (21%)**	**2 (25%)**

Table 4 Reasons for stopping breastfeeding given by mothers of twins in a US Survey (Damato 2005b)

Reasons for stopping	**Twins N=67**	**Twins N=67**
	Total no. stopping at 0-9 weeks **n=30**	Total no. stopping at 9-28 weeks **n=37**
Related to BF process:		
Inadequate milk	12 (40%)	8 (22%)
Breast/nipple problems	3 (10%)	1 (3%)
Lack of knowledge	1 (3%)	0 (0%)
Related to mother:		
Time/burden	9 (30%)	12 (32%)
Burden of pumping	3 (10%)	5 (14%)
Older siblings	4 (13%)	3 (8%)
Work/employment	2 (7%)	11 (30%)
Illness/medication	5 (17%)	1 (3%)
Energy/fatigue	5 (17%)	3 (8%)
Emotions/attitudes	0 (0%)	5 (14%)
Related to babies:		
Baby's health	5 (17%)	2 (5%)
Baby behaviours	7 (23%)	6 (16%)
Growth & development	0 (0%)	3 (8%)
Other	2 (7%)	3 (8%))

Appendix 3: Evidence tables - Summary of all included studies

Abbreviations used in tables:
BF breastfed/feeding BM breastmilk EBF exclusive breastfed/feeding HOM higher order multiples LBW low birthweight
LOS length of stay NICU neonatal intensive care unit PTB preterm birth SES socio-economic status VLBW very low birthweight

Author	Setting	Study design	Sample size	Key findings	Guideline topics addressed
NPEU & MBF (in preparation)	UK 2000-2002	Cohort Population-based (Millennium Cohort)	18,239 singletons 246 twin pairs	BF initiation sig lower in twins than in singletons for "no special care" babies (60% vs 71%) but not for "special care" babies (73% vs 73%). In twins, BF initiation was sig associated with LOS>=6 days and higher maternal SES. BF for 3+ mths lower in twins than singletons for "special care" babies (29% vs 35%) and "no special care" babies (22% vs 40%). In twins, BF for 3+ mths sig associated with non-caesarean delivery and higher maternal SES.	Forest-1
NPEU & MBF (in preparation) & Bolling 2007	UK 2005	Cohort Population-based (Infant Feeding survey)	11,896 singletons 132 twins (first twin)	BF initiation lower in twins than in singletons for "no special care" babies (68% vs 76%) & "special care" babies (72% vs 76%). BF for 3+ mths lower in twins than singletons for "special care" babies (20% vs 33%) & "no special care" babies (19% vs 40%). Most common reasons for twin mothers stopping BF at 0-2 weeks were *"twins/impossible"* (n=10), *"time/burden"* (n=7), *"insufficient milk"* (n=6), *"mother's illness"* (n=6) & *"baby's health"* (n=6). Most common reasons for stopping at 2-6 weeks were *"time/burden"* (n=12), *"insufficient milk"* (n=12), & *"twins/impossible"* (n=10).	Forest-2 2.4 Insufficient milk
Addy 1975	US 1970s	Cross-sectional survey	173 mothers of twins	23.7% (41/173) were ever BF. Of these 41, the duration of EBF was <1 mth for 15 (37%), 1-3 mths for 15 (37%), 4-6 mths for 8 (20%) % 7-12 mths for 1 (2.4%). 32 (78%) of the 41 had demand BF & 8 (20%) had scheduled BF.	
Antoniou 2005	Greece 2001	Cohort	884 singletons 27 twin pairs	BF at day 2-3 days postpartum was significantly lower in twins compared with singletons (16.7% EBF, 37.5% mixed, 45.8% formula in twins compared with 52.9% EBF, 32.9% mixed, 14.2% formula in all babies).	Forest-8
Auer 1998	US 1990s	Case report	1 set of quads	All 4 primarily formula-fed at discharge. At home, mother alternated BF and formula during 5 daytime feeds (BF 2 babies & topped up with formula; formula-fed the other 2; she rotated each to BF). All babies were formula-fed at night. At 3.5 months, she EBF baby B (sensitivity to bovine/soy-based formula). One baby weaned abruptly at 12 mths, the others 2-4 times per day until 30 months.	2.10 HOMs
Berlin 2007	US 2005	Case report	1 set of quads	All babies received EBM until started solids. All receiving BM as their only milk at 12 mths. Weights at 12 mths = 16 lb 5 oz – 22 lbs. In NICU, mother pumped 3.24 litres of milk per 24 hrs.	2.4 Insufficient milk

Author	Setting	Study design	Sample size	Key findings	Guideline topics addressed
Biancuzzo 1994	US Early 1990s	Case report	1 set of PTB twins (gestation=35 wks)	Early BF successful through frequent feeding & much support from nurses in hospital. Still BF at 6 months.	2.2 Learning to BF
Blak 1986	Denmark	Opinion	-	Report from a group of mothers of twins.	
Broadbent 1985	UK 1981-82	Qualitative study	28 singletons 27 mothers of twins 1 mother of triplets (singleton & twin mothers matched wrt age, parity & SES)	Twins were more likely to be admitted to SCBU (37%) than singletons (7%). BF initiation was lower in twins (42%) than singletons (61%). At 5 wks, 20% of twins & 46% of singletons were BF. Consistent help from ward staff for feeding was not always forthcoming.	Forest-19
Bryan 1983		Opinion		Useful observations e.g. recommends that a mother expecting twins visits a BF mother of twins at feeding time; if not a film. Mention common, but absurd, assumption that twins will have the same needs at the same time: being hungry together; weaned at same time; start solids on same day.	Antenatal care Individuality of twins
Butler 2004	NZ (Pacific infants) 2000	Cohort (Pacific Infant Family Study)	Mothers: 1226 singletons 21 twins	EBF at 6 weeks sig lower in twins (28.6%) than in singletons (82.5%) & remained strong & sig after adjusting for confounders (OR=11.37, 95% CI: 4.02-32.2 for singleton vs twin after adjusting for mode of delivery, employment, yrs lived in NZ, ANC, smoking.	Forest-10
Chen 1992	China 1980s	Cross-sectional survey	3217 singletons 68 multiples	Multiples less likely to initiate BF (47.1%) than singletons (65.9%) (p=0.001). BF associated with father's education: BF less common in more educated fathers.	Forest-18
Colonna 1996	Italy 1987-96	Cohort VLBW	181 singletons 29 twins 16 HOM	EBF at discharge was lower in twins (11%) than singletons (23%) & any BF was 40% in twins & 41% in singletons. There was a sig increase in BF over the study period (p<0.01 for trend). In the last 2 years, 49% of singletons & 38% of twins were EBF at discharge, and any BF at discharge was 63% in singletons & 62% in twins. No sig differences between singletons & twins.	Forest-15
Damato 2005a	US	Cohort	123 mothers of twins	89% BF ever. 65% still being BF at 1 month post expected delivery date.	Background
Damato 2005b	US Year not stated	Cohort	67 mothers of twins	Most common reasons (not mutually exclusive) for cessation at 9 weeks were inadequate milk (40%), time/burden (30%) & baby behaviours (23%), and at 28 weeks were time/burden (32%), employment (30%) and inadequate milk (22%). Other issues mentioned: pumping; simultaneous BF.	2.2 Simultaneous BF 2.4 Insufficient milk 2.4, 2.8 Time/burden 2.5 Expressed BM
Emsley 1994	UK Early 1990s	Case report	1 set of twins	Experiences & tips from a mother who BF her twins for 11.5 months.	2.2 Learning to BF, Positioning, Simultaneous

Author	Setting	Study design	Sample size	Key findings	Guideline topics addressed
Flacking 2003	Sweden 1996	Cohort of LBW	45 LBW singletons 25 LBW twins	Twins were less likely to be receiving BM 2 mths (p=0.019), 6 mths (p=0.009) & 8 mths (p=0.03) but no results given. Twins had a sig shorter BF duration than singletons (adjusted HR=2.51, 95% CI: 1.35-4.69).	Forest-20
Flidel-Rimon 2002	-	Review	-	Review article.	
Flidel-Rimon 2005	-	Review	-	Review article. Mentions that in simultaneous BF, the more vigorous baby on one side stimulates letdown reflux for other twin.	Background 2.2 Simultaneous BF
Ford 1994	NZ Late 1980s	Controls of a case-control study of SIDS	1531 singletons 30 twins	Twins less likely to be EBF at discharge (40%=12/30) than singletons (85.4%) (adjusted OR=3.02, 95% CI: 1.31-6.96 for singleton vs twin). In those EBF at discharge, twins less likely to be EBF at 4 weeks (27.8%) than singletons (73.1%) (adjusted OR=5.58, 95% CI: 1.92-16.20). Twins were sig more likely to stop BF earlier than singletons (adjusted RR=1.74, 95% CI: 1.00-3.04).	Forest-17
Geraghty 2004a	US 1999	Cohort (same as 56a & 80a; analyses BF rates)	78 term singletons 78 PTB singletons 90 term multiples 95 PTB multiples	PTB multiples had lowest BF at 3 days (57%) compared with PTB singletons (66%), term singletons (69%) & term multiples (73%), and had shortest duration of BF. Note: have used graphs to estimate data for 3 mths in forest plot.	Forest-11
Geraghty 2004b	US 1999	Cohort (same as 56a & 95a, analyses pairs/triplets)	90 term multiples 95 PTB multiples	Within pair (triplet) analysis of multiples. BF rates similar within pairs (triplets).	Background
Geraghty 2005	US 1999	Cohort (same as 80a & 95a, analyses pumping)	78 term singletons 78 PTB singletons 90 term multiples 95 PTB multiples	68% BF ever & 77% of these reported ever pumping milk in first 6 mths. No differences between the 4 groups. BF duration is longer in those "feeding at breast only" compared with "some pumping	2.5 Expressed BM
Gunn 2000	NZ	RCT PTB	Early (n=148, 29 twins) vs late (n=160, 33 twins) discharge of PTB infants	Early versus late discharge of PTB infants had no impact on BF rates. No results separately in twins except one comment – mother of twins unhappy with early discharge at 35 weeks.	2.3 PTB 2.8 Ongoing support
Hartmann 1984	Australia 1980s	Review which includes their own data.	Milk yield in BF mothers of twins & singletons (sample size not given)	In the first 6 mths of lactation, mothers of singletons produced at least 1100 ml/24 h & mothers of twins produced at least 2100 ml/24 h.	2.4 Insufficient milk
Hattori 1999	Japan 1993-94	Cohort (non-randomised intervention study)	18 mothers of twins (11 intervention & 7 control)	BF at discharge was 100% (22/22) in intervention & 79% (11/14) in control. BF at 3 mths was 100% (22/22) in intervention & 29% (4/14) in control. Intervention=BF support in hospital based on breast message, top up with glucose/formula until BF established, simultaneous or consecutive BF, emotional support, etc.	2.2 Learning to BF 2.4 Insufficient milk 2.5 Expressed milk 3. BF support

Author	Setting	Study design	Sample size	Key findings	Guideline topics addressed
Hill 2007	US 2001-2003	Cohort PTB pump dependent at discharge	73 singletons 19 sets of twins 3 sets of triplets	At 12 weeks, multiples less likely to be receiving BM only (18%) compared with singletons (53%) (OR=6.06, 95% CI: 1.64-22.35 for singleton vs twin, adjusted for maternal age & BF intention), and less likely to be receiving any BM (64% vs 74%). Adjusted OR sig. The effect of perceived insufficient milk wk 8-12 & actual expressed milk output were studied wrt BF at 12 weeks, but not separately in multiples.	Forest-3 2.4 Insufficient milk 2.5 Expressed milk (but results not shown separately in multiples)
Justesen 2000	Malawi Tanzania Zambia 1991-92	Demographic & Health Survey	706 twins 18,214 singletons	BF for 6+ mths similar in twins (98.5%) & singletons (98.5%). But BF data only collected at 6 mths & twins have much higher neonatal/infant mortality rate than singletons so may not be comparing like with like. Have not included in forest plot.	Background
Kaneko 2006	Japan 2001	Cross-sectional population-based	45,594 singletons 975 multiples	EBF for 6 mths was 21.5% in singletons & 1.3% in multiples. After adjusting for many variables (e.g. PTB, bwt, maternal age, SES), OR=14.3, 95% CI: 8.3-25 for singleton vs twin).	Forest-5
Killersreiter 2001	Germany 1992-94	Cohort VLBW (<1500g) & matched controls (term, bwt>2500g) matched on gender & multiplicity	63 VLBW singletons 140 control singleton 26 VLBW multiples 37 control multiples	78% of VLBW babies were BF compared with 93.8% of controls (no differences between singletons & multiples). Among those who were BF, duration of BF was sig longer in VLBW multiples vs VLBW singletons, whereas duration of BF was similar in control multiples & control singletons.	Forest-14 2.3 PTB
LaFleur 1996	US 1990s	Case report	1 set of conjoined twins	Mother wanted to BF the omphalopagus conjoined twins (join extends from sternum to umbilicus) & received support from nurses. Used cross-cradle position. Twins could not feed simultaneously – when one twin fed the other twin's head rested on her head. At discharge, twins had mixed feeding (BF, expressed BM & formula). They were successfully separated at 2.5 months; BF continued.	BF conjoined twins
Lau 2004	US	Cross-sectional PTB (<30 wks)	125 mothers: 85 singletons 32 twins 8 triplets	Mean 24 hour milk volume (measured every 2 weeks for 5 visits from 2 weeks postpartum) was sig greater in multiples (599 m/L) than in singletons (430 m/L) despite similar pumping frequency (5.2 times per day in singletons, 5.3 in multiples) & similar maternal age, gestation, bwt, etc. In singletons, milk volume was positively correlated with pumping frequency. In multiples, milk volume was negatively correlated with depression & positively correlated with duration of skin-to-skin contact.	2.3 PTB 2.4 Insufficient milk 2.5 Expressed milk
Langkamp 2006	-	Opinion	-	Includes general information and advice about breastfeeding, formula feeding and mixed feeding.	2.2 leaning to BF 2.7 formula feeding 2.8 ongoing support

Author	Setting	Study design	Sample size	Key findings	Guideline topics addressed
Lederman 2006	US 2004	Case report	1 set of twins	Mother advised to use pumping "to help establish the milk supply" rather than try BF even though the twins were healthy (gestation 37.5 wks, bwt 5 lb 13 oz and 6 lb 7 oz. Mother never established BF, unpleasant experience of pumping.	2.5 Expressed milk
Leonard 1982		Review		Discusses separate vs simultaneous feeding but says that decision may not be entirely the mother's – some infants want to be fed together/separately. Strategies for sore nipples mentioned. Inadequate dietary intake, fatigue & stress can affect milk volume.	2.2 Positioning, Simultaneous, Modified demand feeding 2.4 Sore nipples, Insufficient milk Keeping a feeding record Maternal diet mentioned
Leonard 2000	Canada Year not stated	Qualitative	9 sets of triplets	5 women EBF (1 for 6 mths). Other mothers did varying amounts of BF and pumping. Majority preferred separate to simultaneous feeding, using cradle hold. Each mother fed approx 18-27 times per 24 hr period. Average length of time to feed all 3 was 45 mins – 2 hrs per feeding session.	2.2 learning to BF 2.4 insufficient milk 2.10 HOMs
Leonard 2002a	-	Review	-	Review article.	
Leonard 2002b	-	Opinion	-	7 breastfeeding rights of multiple birth families are presented. Guidelines for each of the rights have been developed to assist health professionals provide "best practices". The rights and guidelines suggest direction for providing assistance, implementing programs and services, conducting research, and evaluating the effectiveness of multiples-specific breastfeeding care.	
Leroen 1984	Norway	Opinion		Breastfeeding twins in hospital.	
Liang 1997	NZ 1996	Cohort PTB	15 singletons 18 twins	BF at discharge similar in twins (89%=16/18) & singletons (93%=14/15). BF at 14-16 wks slightly lower in twins (44%) than in singletons (53%). Most common reasons for BF cessation in twins were "too tired" & "inadequate milk supply".	Forest-16 2.4 Insufficient milk 2.4 Exhaustion
McKenzie 2006	Canada 1999-2000	Qualitative	19 women pregnant with twins	Provides insight into where women sought antenatal information but no data on actual feeding practices. Participants reported receiving inconsistent advice on feeding, often geared for mothers of singletons. Several women viewed pacifier use and mixed feeding as necessary tools in coping with 2 babies. Connections with other mothers of twins were important & hard to come by.	Antenatal information

Author	Setting	Study design	Sample size	Key findings	Guideline topics addressed
Mead 1992	US Early 1990s	Case report	1 set of PTB quads (gestation=34 wks)	Mother wanted to BF. A midwife met with her weekly antenatally to discuss BF strategies & she was referred to a multiples support group. At each feed in hospital, mother started BF 2 babies & expressed up to 240 mls of milk to give to other babies. Soon able to BF all babies & express milk for use as necessary. She preferred feeding babies separately. During the first month after discharge the mother BF 12-34 times per day; mean daily weight gain during this time=30-54g. Much support from father & a homemaker. Babies BF until they weaned themselves off at ages 12, 15, 15 & 18 mths.	2.2 Learning to BF, Positioning, Simultaneous 2.10 HOMs
Mikiel-Kostyra 2000	Poland	Opinion		-	
Mikulska 2001	Poland	Cohort	152 multiples born 1996-98 and 161 multiples born 1990-95	The later group were part of a multidisciplinary care programme and the former group were not. The two groups were compared with respect to health outcomes but data are not presented on infant feeding.	
Moore 2007	-	Review	-	Review on multiple births with some information on feeding.	Background
Nelson 2005	21 centres in 17 countries 1995-7	International Child Care Practice Study (ICCPS)	2739 mothers of singletons 105 mothers of twins	Mothers of twins were sig ($p<0.001$) less likely to EBF at 10-14 wks than mothers of singletons (18% vs 44%, OR=0.28, 95% CI: 0.16-0.47) and more likely to use formula only (54% vs 36%) or mixed feed (28% vs 20%).	Forest-7

Neifert 1990		Opinion/review – old article but very useful		Useful tips & observations. With 2 infants BF often & using different sucking techniques the mother is prone to sore nipples. Explore the mother's personal feeding goals: EBF versus partial BF; nurse one baby at each feed & give the other a bottle. "Early poor emptying of breasts is probably the single leading preventable cause of milk insufficiency. Only by frequent emptying of breasts is the process of lactation maintained." – particularly true in mothers of twins e.g. one baby having trouble latching on may compromise the milk yield. Mothers should be observed in first week postpartum; if either twin can't empty breast sufficiently then mother advised to express to fully empty breasts. Difficult to increase a low milk supply therefore recommend maintaining a generous supply from the start using routine pumping until both twins BF successfully & gaining weight. *Simultaneous feeding* is time efficient & allows more vigorous feeder to stimulate let-down reflux for other baby, but many mothers need both hands to get one baby latched on, may need hands to support breasts, simultaneous difficult to do discreetly in public, & some mothers prefer one-to-one attention in separate feeding. *Modifed demand feeding* works for many mothers – baby who awakens first is fed on demand & then second twin is awakened. Recommends *alternating breasts* so each breast receives balanced stimulation from both babies. Practical tips on *formula feeding* are given.	2.4 Insufficient milk 2.2 Positioning, Simultaneous, Modified demand feeding Alternating breasts 2.7 Formula feeding

Author	Setting	Study design	Sample size	Key findings	Guideline topics addressed
Norris 2002	UK Year not stated	Cohort PTB	196 singletons 34 sets of PTB twins 3 sets of PTB triplets	Mean weaning (intro of solids) age from birth=17.1 weeks (11.5 weeks corrected for prematurity). Triplets were weaned later than twins & singletons, but no differences between singletons & twins.	2.9 Solids
Nyqvist 2002	Sweden Year not stated	Cohort PTB	13 sets of twins	85% (11/13) BF at discharge, 46% (6/13) EBF at discharge. 8 mothers preferred simultaneous feeding & 3 preferred separate. 7 mothers used football, 2 used combination (1 in football & 1 in cradle), 1 had no preference & 1 changed positions before discharge. A few tried double cradle but found it impractical.	Background 2.2 Positioning 2.2 Simultaneous
Ooki 2008	Japan 1968-2003	Cross-sectional (retrospective data)	4023 twins & some population-based comparisons	BF at 3 mths increased over time from 36% in 1968-74, 58% in 1975-84, 68% in 1985-94, and 69% in 1995-2003. EBF at 3 mths increased over time from 6% in 1968-74, 12% in 1975-84, 14% in 1985-94, and 14% in 1995-2003. Feeding was the same within pairs of twins for 95% of pairs.	Background
Ozcakar 2003	Turkey 1996-2001	Twin cohort with controls matched wrt age, sex, gestation & maternal education	52 sets of twins 91 singletons	EBF was at 4 mths was lower in twins (13.7%) than singletons (62.5%). BF>6 mths was lower in twins (48%) than singletons (74.7%).	Forest-12
Pector 2004	US	Cross-sectional	70 bereaved multiple birth parents	A small section on BF. Lactation consultants need to be informed about loss.	Bereavement??
Rozas 2000	Spain 1994-97	Cohort	74 mothers of twins	89% (64/72) BF ever & 58% (37) began EBF. Ever BF was sig associated (p=0.026) with prior counselling. Half of those who started BF were still BF at 2 months (32/72=44% overall) & 26.5% at 4 months (17/71=24% overall). Mean duration of BF was 102 days.	Background
Saint 1986	Australia 1980s	Cohort (study of milk yield & content)	8 mothers of twins 1 mother of triplets	Milk yield was estimated by weighing the mothers. At 6 mths the milk yield *for individual breasts* of 3 mothers EBF was 0.84-2.16 kg/24 h & 4 mothers partially BF was 0.42-1.39 kg/24 h. Mean frequency of BF was 15.4/24 h. In the mother who EBF 2.5 mth old triplets the milk yield for *combined breasts* was 3.08kg/24 h & she BF the babies 27 times/24 h.	2.4 Insufficient milk
Spiro 1992		Opinion including 2 case studies		Describes 2 cases studies. One mother BF her twins until 4 mths & another was still BF at 6 wks.	2.3 Nipple shields
Stables 1980		Case report	1 set of twins (bwt 7lb 12 oz & 6 lb 11 oz)	Experiences & tips from a mother who BF her twins. Tried various BF feeding strategies & ended up demand feeding both; each baby had their own side – despite one baby being bigger the mother did not end up with lopsided breasts. Usually fed them separately.	2.2 Learning to BF, Simultaneous, Demand feeding
Storr 1989	Canada 1980s	Case report	1 set of triplets (gestation 32 wks; bwt 2 lbs – 3 lb 4 oz)	EBF for 6 mths and continued BF until 12 mths. Useful tips. Blocked ducts when started solids & reduced night-time feeds at around 6 mths	2.4 Blocked ducts 2.10 HOMs

Author	Setting	Study design	Sample size	Key findings	Guideline topics addressed
Szucs 2009	US	Case report	1 set of quintuplets (gestation 28 wks; bwt 590-1165g)	All babies receive EBM at 7 mths (approx half mother's own milk % half donor BM covered by health insurance). Initially, babies received mother's own milk and began receiving supplemental donor BM at age 5 wks. At 5-6 mths, a typical day is BF each baby once and 1 baby twice & double pumping 6-7 times per day (collecting an average of 1200 ml per day). Mother receives much support.	2.4 Insufficient milk 2.10 HOMs
Thome 2006	Iceland 1992	Cross-sectional population-based	709 mothers of singletons 25 mothers of twins	Mothers of twins were less likely to EBF at 2-3 months than mothers of singletons (23.3% vs 57.4%, p=0.001). Twin birth was sig associated with EBF after adjusting for maternal education, EPDS depression score & marital status (adjusted OR=8.4, 95% CI: 2.9-24.39, p=0.001 for singleton vs twin).	Forest-6
Thorpe 2003	UK Year not stated	Cohort ALSPAC	96 sets of twins 98 pairs of singletons	Twins were BF for sig less time than singletons but data not shown.	Background
Tomlinson Sollid 1989		Review – useful article		Useful tips & observations. Strategies (on pumping) for: when only one infant can BF; simultaneous vs separate feeding; minimising fatigue; sore nipples.	2.2 Positioning, Simultaneous, Modified demand feeding Alternating breasts 2.4 Sore nipples, Insufficient milk 2.4 Expressed milk
Wooldridge 2003	Canada	Cohort PTB (30-35 weeks) whose mother intended to BF	40 singletons 26 twin pairs	EBF in week 1 following hospitalisation was lower in twins (46%) than in singletons (70%). Most BF in week 1 was expressed milk rather than at the breast. The no. of BM feeds given to twins decreased over time whereas in singletons the no. increased at weeks 3-4	Forest-13 2.3 PTB 2.5 Expressed milk
Yokoyama 2006	Japan 2001-2004	Cross-sectional in Nishinomiya city	14,963 singletons 290 twins 9 triplets	Describes rates of EBF, mixed feeding and bottle feeding, and factors associated with these, but time period varies from 3-6 months (mean=3.8). Rates of BF were 47% in multiples & 75% in singletons, & EBF was 4.1% in multiples & 44.7% in singletons.	Forest-4
Yokoyama 2004	Japan Born 1992-2000 approx	Cross-sectional (data collected from twin register & controls when aged 6 mths – 6 years)	1529 mothers of twins 258 mothers of triplets/higher order 1300 mothers of singletons	EBF sig less likely in twins (5.3%) & HOM (3.6%) than in singletons (31.0%) (have assumed this is at 6 mths, paper unclear). Formula feeding more common in twins (16.0%0 & HOM (21.2%) than in singletons (5.0%). Among those who BF, duration of EBF was significantly shorter in twins (mean=9.1 mths) & HOM (5.4) than in singletons (13.3). Among multiples, formula feeding was sig more likely in those aged <=30, those who were anxious in pregnancy & those who received no cooperation from the husband for childrearing.	Forest-9 Support from husbands.

Appendix 4: Evidence tables for meta-analysis - Summary of all included studies

Abbreviations used in tables:
BF breastfed/feeding BM breastmilk EBF exclusive breastfed/feeding HOM higher order multiples LBW low birth weight
LOS length of stay NICU neonatal intensive care unit PTB preterm birth SES socio-economic status VLBW very low birthweight

Author	Country & year of birth	Study design & inclusion criteria	Matching between singletons & multiples	Stratified results available	Adjustment for confounders	Assessment of infant feeding	Sample size	Definition of multiples
(1) NPEU & MBF (in preparation) (MCS)	UK 2000-2002	Population-based survey • Alive at age 9 mths	No	• Special care • Not spec care	• Maternal age • SES • Others	Maternal report • 9 mths	18,239 singletons 246 twin pairs	Twins only
(2) NPEU & MBF (in preparation) & Bolling 2007 (IFS)	UK 2005	Population-based cohort • Alive at age 9 mths	No	• Special care • Not spec care	• Maternal age • SES • Others	Maternal report • age 4-10 wks • 4-6 mths • 8-10 mths	11,896 singletons 132 twins (first twin)	Twins only
(3) Hill 2007	US 2001-2003	Hospital-based cohort: • PTB (<=31 wks) • LBW (<1500g) • non-smoking • planned EBF >=12 wks • pump dependent at discharge	No	No	• Maternal age • BF intention	Maternal report • diaries for 6 wks • Phone call at 8, 10, 12 wks	73 singletons 19 sets of twins 3 sets of triplets	All multiples
(4) Yokoyama 2006	Japan 2001-2004	Population-based survey in Nishinomiya city	No	No	• Incubator use • Sucking at birth • Baby age • Maternal health	Routine clinical data • 3-6 mth check-up	14,963 singletons 290 twins 9 triplets	All multiples
(5) Kaneko 2006	Japan 2001	Population-based survey	No	No	• PTB • Bwt • Maternal age • SES & others	Maternal report • 6 mths	45,594 singletons 975 multiples	All multiples
(6) Thome 3006	Iceland 1992	Population-based survey	No	No	• Education • Marital status • EPDS	Maternal report • Mean=11.8 wks	709 mothers of singletons 25 mothers of twins	All multiples (but no HOM)
(7) Nelson 2005	17 countries 1995-7	Population-based survey (International Child Care Practice Study (ICCPS))	No	No	No	Maternal report • 12 wks	2739 mothers of singletons 105 mothers of multiples	All multiples
(8) Antoniou 2005	Greece 2001	Cohort recruited randomly from 17 hospitals	No	No	No	Maternal report • 2-3 days • later (NOS)	884 singletons 27 twin pairs	All multiples (but no HOM)

Author	Country & year of birth	Study design & inclusion criteria	Matching between singletons & multiples	Stratified results available	Adjustment for confounders	Assessment of infant feeding	Sample size	Definition of multiples
(9) Yokoyama 2004	Japan Born 1992-2000	Twin/HOM study & singletons controls recruited when aged 6 mths – 6 years)	• Child age (6 mths – 6 yrs)	No	No	Maternal report • 6 mths-6 yrs	1529 mothers of twins 258 mothers of HOM 1300 mothers of singletons	Twins only (we excluded HOM)
(10) Butler 2004	NZ (Pacific infants) 2000	Cohort (Pacific Infant Family Study) • Pacific ethnicity	No	No	No	Maternal report • 6 wks	Mothers: 1226 singletons 21 twins	All multiples
(11) Geraghty 2004a	US 1999	Cohort of 4 groups chosen from birth certificates: Term singletons Term multiples PTB (27-36 wks) sing PTB (27-36 wks) mult	No	• Term • PTB (27-36 wks)	No	Maternal report • 2-3 yrs	78 term singletons 78 PTB singletons 90 term multiples 95 PTB multiples	All multiples
(12) Ozcakar 2003	Turkey 1996-2001	Twin cohort with matched singletons controls	• Child age (1-5 yrs) • Sex • Gestation • Education	No	No	Maternal report • 1-5 yrs	52 sets of twins 91 singletons	Twins only
(13) Wooldridge 2003	Canada	Hospital-based cohort • PTB (30-35 wks) • Planned to BF • Singleton or twin	No	No	No	Maternal report • diaries for 4 wks after discharge	40 singletons 26 twin pairs	Twins only
(14) Killersreiter 2001	Germany 1992-94	Hospital-based cohort VLBW (<1500g) & matched controls (term, bwt>2500g). VLBW & controls matched on sex & multiplicity	No	• VLBW • Term & bwt>2500g	No	Maternal report • 6 & 12 mths corrected age	63 VLBW singletons 140 control singleton 26 VLBW multiples 37 control multiples	All multiples
(15) Colonna 1996	Italy 1987-96	Hospital-based cohort VLBW	No	No	No	Discharge data	181 singletons 45 twins??	All multiples
(16) Liang 1997	NZ 1996	Hospital-based cohort PTB (<37 wks)	No	No	No	Discharge data Maternal report • 3-4 mths	15 singletons 18 twins	All multiples

Author	Country & year of birth	Study design & inclusion criteria	Matching between singletons & multiples	Stratified results available	Adjustment for confounders	Assessment of infant feeding	Sample size	Definition of multiples
(17) Ford 1994	NZ Late 1980s	Controls of a case-control study of SIDS Recruited age 1-52 wks (mean=17.5 wk)	No		• Maternal age • Pacific ethnicity • Bedsharing • Dummy use • LBW • Smoking now • ANC classes	Maternal report • 1-52 wks (mean=17.5 wk)	1531 singletons 30 twins	All multiples
(18) Chen 1992	China 1980s	Epidemiological studies in 2 cities – no other details	??	No	No	??	3217 singletons 68 multiples	All multiples
(19) Broadbent 1985	UK 1981-82	Hospital-based cohort of multiples & singleton controls	• Hospital • Maternal age • Parity • SES	No	No	Maternal report • Several times up to 5 mths	28 singletons 27 mothers of twins 1 mother of triplets	All multiples
(20) Flacking 2006	Sweden 1996	BFI Hospital-based cohort of LBW: • Bwt<2500g • Singleton or twin • Admitted to NICU • Discharged home (not to pediatric or maternity unit) • Resident in Dalarna county until age 8 mths (i.e. survivors)	Normal bwt controls not included in meta-analysis – no data given.	No (not for multiples)	• Maternal age • Parity (adjusted HR given but no crude data on twins vs singletons)	Manual review of hospital records of LBW cases & medical records at local child health centre.	45 LBW singletons 25 LBW twins	Twins only