

Review



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Determinants of Early Weaning and Use of Unmodified Cow's Milk in Infants: A Systematic Review

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ABSTRACT

Introduction of complementary foods (weaning) before 4 to 6 months of age and unmodified cow's milk before age 12 months are associated with several health risks. To develop effective interventions to discourage these practices, evidence of their determinants is needed. This systematic review identified documents from seven electronic databases (database inception 2008) and reference lists, and by contacting authors. Seventy-eight studies in developed countries, published between 1976 and 2008, quantifying the association between either feeding practice and its potential determinants were included. Study quality was systematically assessed in terms of representativeness, sample size, method of outcome ascertainment, and approach to statistical analysis. The distribution of evidence for each determinant was visualized in a harvest plot showing the strength and direction of associations found and the quality of relevant studies. The strength of evidence for each determinant was summarized as strong, moderate, limited, or inconclusive, using an algorithm based on the consistency of the results of studies of the highest available quality. Strong evidence

denoted that the determinant was examined in three or more high-quality studies and $\geq 75\%$ of results were consistent. Strong evidence was found for six determinants of early weaning (ie, young maternal age, low maternal education, low socioeconomic status, absence or short duration of breastfeeding, maternal smoking, and lack of information or advice from health care providers) and for two determinants of early introduction of unmodified cow's milk (ie, low maternal education and low socioeconomic status). Of these determinants, improving advice given by health care providers appears the most tractable area for intervention in the short term.

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The World Health Organization's global public health recommendations on infant feeding state that infants should be exclusively breastfed for the first 6 months of life, and thereafter should receive nutritionally adequate and safe complementary foods to meet their evolving nutritional requirements while breastfeeding continues up to or beyond 2 years of age (1). Timing of the introduction of complementary foods (weaning) is particularly important, given the immaturity of the gastrointestinal, renal, and neurophysiological systems in infants younger than age 4 to 6 months and the health risks associated with early weaning (2). These include excessive protein (3) and total energy intakes (4), excessive infant weight gain (5), increased body fat and body mass index, and respiratory illness during childhood (6), allergies (such as asthma and eczema) (7), iron deficiency, and anemia (8).

Another relevant aspect of infant feeding is the timing of the introduction of unmodified cow's milk. Unlike breast milk, unmodified cow's milk does not provide a balanced diet for children younger than age 12 months, as it contains excessive levels of protein, sodium, potassium, phosphorus, and calcium for human infant requirements, and insufficient levels of iron, vitamin C, and linoleic acid (9-11). Introduction of cow's milk before age 12 months can lead to increased renal solute load; increased blood loss from the gastrointestinal tract, contributing to iron

deficiency and anemia; chronic constipation and anal fissures; and an increased risk for subsequent type 1 and type 2 diabetes (9-11). Accordingly, several authorities, including the American Academy of Pediatrics (12), recommend that unmodified cow's milk should not become part of an infant's diet before age 12 months.

Despite these recommendations and the evidence for an increased risk of multiple adverse health outcomes, the prevalence of early weaning and early introduction of unmodified cow's milk remains high. For example, about one third of American infants are exposed to unmodified cow's milk before 12 months of age and the same proportion is introduced to complementary foods before 4 months of age (13). In the United Kingdom, although the proportion of mothers delaying the introduction of solid foods has increased steadily between 1990 and 2005 following the revision of national guidance in 2001, in 2005 51% of mothers had already introduced solid foods to infants by age 4 months (14).

Developing effective interventions to discourage these infant feeding practices depends on sound evidence of the determinants of both practices. Therefore, the existing literature on potential determinants of the timing of introduction of complementary foods and of unmodified cow's milk to infant diets was systematically reviewed. The aims were to evaluate the strength of evidence for the entire range of potential determinants of these practices and to identify areas in which future research should be concentrated. This systematic review focused on developed countries, as (determinants of) infant feeding practices might differ between developed and emerging or developing countries (15).

METHODS

Search Strategy

Seven electronic literature databases (Medline, Psycinfo, CINAHL, BNI, Embase, ASSIA, and Web of Knowledge) were searched for documents in any language from the year of database inception until April 24, 2008. The search syntax included four key elements: terms for weaning and use of cow's milk (eg, *wean\$* or *cow\$*), terms for the behavior (eg, *earl\$* or *introd\$*), terms for potential determinants (eg, *determin\$* or *factor\$*), and terms for infant (eg, *infant\$* or *baby*). Following a scoping search in Medline, a fifth element was included, using the NOT operator, for exclusion of frequently found concepts not related to the research question, including: weaning from mechanical ventilation (eg, *ventilation*), and studies on infant feeding in patients with human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) (eg, *HIV*). Where possible (in Medline and Embase), the filter for studies in humans was activated. The detailed syntax for each specific database, including database specific thesaurus mapping terms, is available at http://www.mrc-epid.cam.ac.uk/Publications/Supplementary_Material/WijndaeleJADA2009.

In a second step, reference lists of included documents were searched for additional documents of interest. Finally, an interim list of included documents was sent to the corresponding authors of those documents for whom an e-mail address was found (July 30, 2008). This enabled

the identification of additional grey literature (ie, unpublished) and additional peer-reviewed documents.

Inclusion Criteria

Experimental and observational studies in developed countries that quantified the association between either early weaning or early introduction of unmodified cow's milk and one or more potential determinants were included. Studies had to include a measure of the timing of weaning or the introduction of cow's milk, and potential determinants had to be tested for their association with this measure. Studies using the term weaning to refer to discontinuation of breastfeeding in favor of bottle feeding, or weaning from mechanical ventilation, were excluded. Studies in preterm infants, in infants with malnutrition or allergies, in infants or mothers with HIV/AIDS, or in emerging and developing countries (15) were also excluded, given that potential determinants of infant feeding might differ in these contexts. All types of potential determinants (ie, demographic, biological, behavioral, psychosocial, health and social care, community, or public policy) were eligible for inclusion, irrespective of whether they were considered modifiable or nonmodifiable.

All identified documents were assessed against the inclusion criteria by one reviewer (K.W.), first using the titles, then using the abstracts and finally using the full text. Titles, abstracts or full text documents that were doubtful were cross-checked by a second reviewer (R.L.). Any disagreement was resolved by discussion and reexamination of the document. Native speakers translated potentially relevant foreign language documents.

Data Extraction

Data extraction into detailed tables was performed by one reviewer (K.W.) and all extracted data were double-checked by a second reviewer (R.L.). Data extracted included: country; population; study characteristics including study design (cross-sectional vs prospective), number of participants, recruitment strategy and approach to statistical modelling (univariate vs multivariate); potential determinants examined; associations found using univariate and/or multivariate models; and outcome description including definition used for weaning or introduction of cow's milk, whether a categorical or a continuous definition was used, and the approach to ascertainment (retrospective or not). Direction and strength of association were summarized using the following symbols: significant negative association: --, nonsignificant negative association: -, null association: 0, non-significant positive association: +, significant positive association: ++. Results for categorical and continuous outcome variables were consistently recoded so that a single or double + always denoted higher risk for the undesirable behavior (early weaning or early introduction of cow's milk), and a single or double - always denoted a lower risk for the undesirable behavior.

Summary variables were created using the following rules:

Summary Correlates Terms. Conceptually similar variables were recoded to the same summary correlate term. If multiple conceptually similar variables were studied

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