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**Binns, C., Lee, M.K. and Low, W.Y. (2016) The Long-Term Public Health Benefits of Breastfeeding. Asia-Pacific Journal of Public Health, 28 (1). pp. 7-14.**

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# **The Long Term Public Health Benefits of Breastfeeding**

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## **Abstract**

Breastfeeding has many health benefits, both in the short-term and the longer term to infants and their mothers. There is an increasing number of studies that report on associations between breastfeeding and long-term protection against chronic disease. Recent research evidence is reviewed in this study, building on previous authoritative reviews. The recent WHO reviews of the short and long-term benefits of breastfeeding concluded that there was strong evidence for many public health benefits of breastfeeding. Cognitive development is improved by breastfeeding and infants who are breastfed and mothers who breastfeed have lower rates of obesity. Other chronic diseases that are reduced by breastfeeding include diabetes, both type 1 and 2, obesity, hypertension, cardiovascular disease, hyperlipidemia and some types of cancer.

Keywords: Breastfeeding, benefits, chronic disease, review

## **Main Text.**

### **Introduction**

There is increasing evidence that early development has a long term impact on health outcomes. The first 1000 days following conception is the most important time in programming health for adult life<sup>1,2</sup>. Recent research has highlighted the public health importance of promoting breastfeeding as one of the more important components of life programming. The World Health Organisation (WHO) and the United Nations International Children's Emergency Fund (UNICEF) have promoted breastfeeding as a key strategy in improving short term health, as promoted in the Millennium Development Goals<sup>3,4</sup>. More recently the public health significance of infant feeding and chronic disease has been recognised in several major international reports<sup>5,6</sup>. These have been prepared despite the difficulty of reviewing the literature relating to breastfeeding and infant feeding, as the evidence almost always comes from observational studies. There are ethical issues that usually prevent the use of randomised controlled trials on research using breastfeeding. Generally evidence for breastfeeding must rely on the summation of observational studies.

The evidence for short-term outcomes, such as reduced rates of infection can be classified as strong, but the longer term effects must always be less certain due to our inability to completely account for confounding factors. Often breastfeeding does not reach the highest levels of research quality expected for the development of pharmaceutical interventions or public health strategies and the longer term benefits of breastfeeding are generally regarded as of moderate strength only. However despite these limitations the conclusion of the major reports are all similar in recommending exclusive breastfeeding for six months followed by

continuing breastfeeding as complementary foods are introduced for as long as the mother wishes<sup>3</sup>. The sheer volume of supportive evidence supports the position of UNICEF and WHO, a position that is endorsed by most national Ministries of Health and professional organisations.

The objective of this paper is to update the major reviews of the long-term beneficial effects of breastfeeding, which is beyond the first two years of life with a particular emphasis on the impact of chronic disease in adult. This paper will provide an overview of recent major reviews together with major additional studies.

## **Methodology**

A review of recent major systematic reviews of breastfeeding and early development and long term health was undertaken. The reports reviewed included the WHO reports on the short and long-term benefits, the American Academy of Pediatrics, the USA Technology Assessment Report, the Surgeon Generals Call to Action and the National Health and Medical Research Council (Australia) reports<sup>5-13</sup>. A search of the English language literature was then undertaken to update the findings of the major reports. Additional searches were undertaken for areas where the evidence was less definitive or emerging, including the areas of intellectual development, obesity and resistance to *Helicobacter pylori* infection.

There are a number of specific issues that need to be considered when reviewing the breastfeeding literature:

1. Randomised controls are unethical for infants in involving breastfeeding, as the overwhelming evidence is that breastfeeding is the best method of feeding babies.
2. Breastfeeding reviews predominantly rely on observational studies and despite high standards of research residual confounding may be a problem.
3. Infant feeding is a dynamic process, always changing. The issue of reverse causation must always be considered. For example health practitioners have encouraged infants from families prone to allergies to continue to breastfeed for longer. In recent years when cross-sectional studies are undertaken there is a false association between breastfeeding and allergies<sup>14</sup>.
4. Measurement of breastfeeding is always difficult due to the use of different periods of recall and different definitions<sup>15,16</sup>. Many potentially useful studies of breastfeeding use definitions, such as only recording feeding method in the past 24 hours that do not allow the gathering of accurate data. Many studies used methods such as case reports, cross-sectional studies or long-term recall that do not permit their inclusion in systematic reviews.

The definitions that will be used in this paper are based on the WHO definitions<sup>17,18</sup>.

‘Exclusive breastfeeding’: The infant has received only breastmilk from his or her mother or wet-nurse or expressed breast milk and no other liquids or solids, with the exception of drops or syrups consisting of vitamins, mineral supplements or medicines.

‘Predominant (full) breastfeeding’: Infants who are receiving almost all of the nutrients from breastmilk but take some other liquids such as fluid, water-based drinks, oral rehydration solutions, ritual fluids and drops or syrups.

‘Any breastfeeding’: The infant is receiving some breastmilk during a 24 hour period

## Results

In its landmark study of mortality due to ‘not breastfeeding’, the WHO Collaborative Group, found a substantial increase in infant mortality in the first few years of life in infants who were not breastfed<sup>19</sup>. Breastfeeding promotion became one of the major strategies used to reduce the burden of infant mortality and remains most important in the control of infection, even in modern health care settings. A recent study of 845 infants in Chengdu, PR China, showed a substantial reduction in the prevalence of lower respiratory tract infections in infants less than six months of age where they had been breastfed for at least three months (Odds Ratio 0.329, 95% CI 0.145, 0.792)<sup>20</sup>. Studies have also shown the benefit of the use of breastmilk in reducing the incidence and mortality of necrotising enterocolitis in low birthweight infants treated in neonatal intensive care units (Herman 2014). There is a high level of consensus about the short-term benefits of breastfeeding on reducing morbidity, of which the WHO and the Surgeon General’s reports are good examples<sup>11,13</sup>.

More recently the issue of *Helicobacter pylori* prevention by breastfeeding has been studied because of its role in gastritis, gastric carcinoma, dental caries and as a source of chronic inflammation. Infection is frequently acquired in early childhood<sup>21</sup>. The results of a meta-analysis confirm earlier reviews and suggest a protective effect of breastfeeding in economically less developed settings<sup>22</sup>. Out of the 38 studies included in the meta-analysis only two were from Asia<sup>23</sup>.

The major long-term benefits of breastfeeding listed in the WHO report include<sup>5</sup>.

- breastfeeding was associated with higher performance on intelligence tests and cognitive development
- breastfeeding significantly reduces the risk of obesity in childhood and later in adults
- a reduction in the risk of type II diabetes
- a small protective effect was found against elevated systolic blood pressure

## Cognitive Development

The general consensus of many reports is that IQ is increased in infants who are breastfed for longer than six months by 3 to 5 points<sup>9,24</sup>. The relationship appears to be dose-dependent. However it also needs to be acknowledged that there are many confounding social factors in the determination of cognitive development.

A prospective birth cohort study with a three decade follow-up from Brazil (n = 5914 neonates with 3493 followed up) found an important relationship between breastfeeding for 12 months or more and cognitive development<sup>25</sup>:

- a. higher IQ scores, a difference of 3.76 points (95% CI 2.2, 5.33)
- b. four more years of education, 0.91 years (95% CI .42, 1.40)
- c. higher monthly income of 341 Brazilian reals (95% CI 93.8, 588.3)

A cohort study from Singapore confirms the benefits of breastfeeding on improved cognitive development in Asian infants<sup>26</sup>. Breastfeeding has not been shown to be associated with the prevention of autism<sup>27</sup>.

## Obesity

Most reviews of breastfeeding suggest a protective effect during childhood which persists through to adult life<sup>28</sup>. In the light of the current epidemic of obesity and chronic disease throughout the Asia-Pacific region breastfeeding has the potential to be an important prevention strategy. In China, for example, obesity levels in children in the 1980s were 1 to 2%, but three decades later this has increased to 20% or more in the large cities<sup>29</sup>. Because of the use of different criteria for classification of obesity and the lack of age-adjusted data, it is difficult to quantify the numbers and trends in child obesity for the region, but there is no doubt that obesity in children and adults is on the increase throughout the Asia-Pacific region.

A further difficulty arises in the use of self-reported data. It is widely accepted that weight is commonly under-reported and often height is exaggerated. In a study of Chinese mothers living in Australia and a comparative group living in China it was found that only 10% of children who were actually overweight or obese were correctly identified as being in these categories<sup>30</sup>. Indeed 70% of the overweight or obese children were thought by their mothers to be normal and 18% were considered to be underweight and requiring additional food. The Surgeon General's report considered that exclusive breastfeeding for six months could reduce obesity risk by 30%<sup>11</sup>. In a widely reported meta-analysis Harder reported a 4% decrease in obesity levels up to 9 months and recent report by Woo and Martin suggest that the range of benefit is 10 to 20%<sup>31,32</sup>. In the most recent (2015) meta-analysis of breastfeeding and the prevention of obesity Horta and colleagues updated the previous two WHO reports and included 133 effect estimates<sup>33</sup>. Breastfed subjects were less likely to be classified as obese/overweight, OR 0.74 (95% CI 0.70, 0.78). One possible mechanism is the favourable effect of breastfeeding on the establishment of the human microbiome, which has been linked to obesity<sup>34</sup>. The microbiome may also be altered by the use of antibiotics in infancy and this may be explained by action on the microbiome<sup>35-37</sup>.

The debate on the relationship between breastfeeding and lower rates of obesity continues because of the reliance on observational data. The editor of JAMA Pediatrics summarises the debate and concludes that we should just promote breastfeeding "Should we continue to spend research dollars on the breastfeeding/obesity question? Causality will never be proven, because it is unethical to randomize women to a formula-feeding arm. Regardless, breastfeeding should be promoted<sup>38</sup>." This is a position with which the US Surgeon General agrees 'The first step in an obesity prevention program is to ensure that all mothers have the opportunity to breastfeed their infants, exclusively for six months and then continuing complimentary feeds are introduced. Infants who are not breastfed are 33% more likely become obese children<sup>11</sup>.'

## Diabetes

Breastfeeding protects against the development of type I diabetes in adolescents and young adults and type II diabetes in adults. In a cohort study of infants in Australia at the age of 21 years the odds ratio of developing type I diabetes was 0.45 (95%CI 0.23, 0.87, n = 3959)<sup>39</sup>. Horta developed a new meta-analysis of breastfeeding and diabetes II which included 11 studies<sup>33</sup>. Breastfeeding was associated with a lower odds of type-2 diabetes, OR 0.65 (95% confidence interval: 0.49; 0.86)], using a random-effect model. The most recent systematic review found that breastfeeding reduced the rate of type II diabetes with a pooled odds Ratio of 0.65 (95%CI: 0.49; 0.86)<sup>28</sup>.

## **Breastfeeding also has long-term benefits for mothers**

The long-term benefits to mothers include reduced rates of ovarian cancer, reduced premenopausal breast cancer, reduced obesity, type II diabetes and heart disease. Mothers who breastfed their infants were on average 8kg lighter six years later compared to mothers who had not breastfed their infants<sup>40</sup>. Recent study in the Asia Pacific region also show a reduction in postnatal depression in mothers who continue to breastfeed<sup>41</sup>.

Breastfeeding also reduces the risk of Type II diabetes in mothers. A review by Aune of six cohort studies with 273,961 mothers found that 10,842 developed diabetes and were included in the meta-analysis. The summary RR for the highest duration of breastfeeding vs. the lowest was 0.68 (95% CI: 0.57, 0.82) showing a strong association between breastfeeding and lower rates of diabetes<sup>42</sup>. Jaeger undertook a meta-analysis of women with gestational diabetes mellitus who breastfed for longer than six months and found that they had the lowest risk of continuing with postpartum diabetes<sup>43</sup>. In this meta-analysis the pooled hazard ratio of diabetes and lifetime breast feeding duration of 6-11 months compared with no breastfeeding was 0.89; (95% CI 0.82, 0.97)<sup>43</sup>. This meta-analysis included a nested case control study within the Potsdam EPIC cohort. A recent cohort from the Kaiser Permanente group has confirmed that mothers with gestational diabetes who breastfeeding are less likely to have diabetes two years post-partum<sup>44</sup>.

For other chronic conditions and protective associations with breastfeeding the Women's health initiative study (n= 139681) found that a lifetime history of more than 12 months lactation resulted in:

- hypertension reduction (odds ratio 0.88)
- diabetes reduced (odds ratio 0.80)
- hyperlipidaemia reduced (odds ratio 0.81)
- cardiovascular disease reduced (odds ratio 0.91)

In this study the results were compared to women who never breastfed and dose-response relationships were observed in the fully adjusted models<sup>45,46</sup>.

A follow up of the European Investigation into Cancer and Nutrition prospective cohort (n= 322,972) found that mothers who had breastfed an infant had a reduced risk of dying over the following decade (OR 0.80; 0.76–0.84)<sup>47</sup>.

## **Discussion**

The mechanism of action of many of the long-term effects may be similar for several conditions. For example breastfeeding modifies the development and maintenance of the human microbiome<sup>48</sup>. It is now thought that the composition of the microbiome is important in the development of a number of chronic diseases, including diabetes and obesity<sup>49</sup>. Obesity in infants may be related to the lower protein levels found in breastmilk compared to infant formula<sup>50</sup>. Obesity is also a risk factor for many chronic diseases, including diabetes, heart disease and cancer. The World Cancer Research Foundation report recommends that all infants be breastfed and suggests that at least part of protective effects of breastfeeding against cancers may be due to the lower rates of obesity<sup>51</sup>. Breastfeeding may have a beneficial effect on maternal cancers because of the suppression of ovulation<sup>52</sup>.

Both WHO and UNICEF recommend that to optimise benefits to both mothers and infants that breastfeeding is initiated within 1 hour of birth; that infants be breastfed exclusively for

the first 6 months of life; and breastfeeding should be continued (for 2 years or more) while complementary foods are introduced<sup>53</sup>.

There are a number of limitations that need to be considered when interpreting the results of this and other reviews of the relationships between breastfeeding and long-term morbidity. They are related to the lack of interventional studies for ethical reasons. Instead we rely on the accumulation of evidence from observational studies. However since breastfeeding has very few contraindications it can be safely promoted for almost all infants<sup>54</sup>.

Fifty years ago the US Surgeon General released his first report on Smoking and Health which changed the direction of public health. It was the first report to use a major meta-analysis of a public health issue and to adopt Koch's postulates to chronic disease aetiology. Since the release of the report, the level of smoking in adults in Western countries has declined dramatically resulting in considerable public health benefits. More recently the Surgeon General has released a report on breastfeeding and it is hoped that it will have the same level of impact on infant feeding and resultant public health benefits as the original report on smoking<sup>11</sup>.

## Conclusion

The current evidence suggests many beneficial effects for mothers who breastfeed and infants who are breastfed. These benefits will make a substantial contribution to the control of chronic disease in our region. The management of chronic disease should start with an emphasis on breastfeeding, particularly an extended duration of breastfeeding following exclusive breastfeeding for the first six months of life.

## References

1. Barker DJ. The developmental origins of adult disease. *Journal of the American College of Nutrition*. 2004;23(6 Suppl):588S-595S.
2. Binns CW, Lee M, Scott JA. The fetal origins of disease hypothesis: public health implications for the Asia-Pacific region. *Asia Pac J Public Health*. 2001;13(2):68-73.
3. Binns CW, Lee MK. Exclusive breastfeeding for six months: the WHO six months recommendation in the Asia Pacific Region. *Asia Pac J Clin Nutr*. 2014;23(3):344-350.
4. WHO. *Global strategy for infant and young child feeding*. Geneva:: World Health Organization; 2003.
5. Horta B, Victora C. *The long-term effects of breastfeeding: a systematic review*. Geneva: WHO; 2013.
6. Ip S, Chung M, Raman G, et al. Breastfeeding and maternal and infant health outcomes in developed countries. *Evid Rep Technol Assess (Full Rep)*. 2007(153):1-186.
7. Nutrition ECo, Agostoni C, Braegger C, et al. Breast-feeding: A commentary by the ESPGHAN Committee on Nutrition. *J Pediatr Gastroenterol Nutr*. 2009;49(1):112-125.
8. Kramer MS, Kakuma R. Optimal duration of exclusive breastfeeding. *Cochrane Database Syst Rev*. 2012;8:CD003517.
9. National Health and Medical Research Council. *Infant Feeding Guidelines for Health Workers*. [www.nhmrc.gov.au](http://www.nhmrc.gov.au). Canberra: NHMRC; 2012.
10. National Health and Medical Research Council. *Infant Feeding Guidelines for Health Workers Evidence Review*. [www.nhmrc.gov.au](http://www.nhmrc.gov.au) Canberra: NHMRC; 2012.
11. U.S. Department of Health and Human Services. *The Surgeon General's Call to Action to Support Breastfeeding*. Washington, DC: Department of Health and Human Services Office of the Surgeon General;; 2011.

12. American Academy of Pediatrics. Breastfeeding and the use of human milk. *Pediatrics*. 2012;129(3):e827-841.
13. Horta B, Victora C. *The short term effects of breastfeeding: a systematic review*. Geneva: WHO; 2013.
14. Binns C, James J, Lee MK. Trends in asthma, allergy and breastfeeding in Australia. *Breastfeeding review : professional publication of the Nursing Mothers' Association of Australia*. 2013;21(1):7-8.
15. Burnham L, Buczek M, Braun N, Feldman-Winter L, Chen N, Merewood A. Determining length of breastfeeding exclusivity: validity of maternal report 2 years after birth. *J Hum Lact*. 2014;30(2):190-194.
16. Binns CW, Fraser ML, Lee AH, Scott J. Defining exclusive breastfeeding in Australia. *J Paediatr Child Health*. 2009;45(4):174-180.
17. Binns C, Lee MK. Definitions of breastfeeding. *Breastfeeding medicine : the official journal of the Academy of Breastfeeding Medicine*. 2013;8(3):333.
18. World Health Organization. *Exclusive breastfeeding definition* [http://www.who.int/elena/titles/exclusive\\_breastfeeding/en/](http://www.who.int/elena/titles/exclusive_breastfeeding/en/) accessed 9 June 2015. Geneva: WHO; 2015.
19. WHO Collaborative Group. Effect of breastfeeding on infant and child mortality due to infectious diseases in less developed countries: a pooled analysis. WHO Collaborative Study Team on the Role of Breastfeeding on the Prevention of Infant Mortality. *Lancet*. 2000;355(9202):451-455.
20. Yu C, Binns CW, Lee AH. Comparison of breastfeeding rates and health outcomes for infants receiving care from hospital outpatient clinic and community health centres in China. *Journal of Child Health Care*. 2015; Accepted 5 Jan 2015.
21. O'Ryan ML, Lucero Y, Rabello M, et al. Persistent and Transient *Helicobacter pylori* Infections in Early Childhood. *Clin Infect Dis*. 2015;61(2):211-218.
22. Chak E, Rutherford GW, Steinmaus C. The role of breast-feeding in the prevention of *Helicobacter pylori* infection: a systematic review. *Clin Infect Dis*. 2009;48(4):430-437.
23. Carreira H, Bastos A, Peleteiro B, Lunet N. Breast-feeding and *Helicobacter pylori* infection: systematic review and meta-analysis. *Public Health Nutr*. 2015;18(3):500-520.
24. Horta BL, Loret de Mola C, Victora CG. Breastfeeding and intelligence: a systematic review and meta-analysis. *Acta Paediatr Suppl*. 2015;104(467):14-19.
25. Victora CG, Horta BL, Loret de Mola C, et al. Association between breastfeeding and intelligence, educational attainment, and income at 30 years of age: a prospective birth cohort study from Brazil. *Lancet Glob Health*. 2015;3(4):e199-205.
26. Cai S, Pang WW, Low YL, et al. Infant feeding effects on early neurocognitive development in Asian children. *Am J Clin Nutr*. 2015;101(2):326-336.
27. Husk JS, Keim SA. Breastfeeding and Autism Spectrum Disorder in the National Survey of Children's Health. *Epidemiology*. 2015;26(4):451-457.
28. Horta BL, Loret de Mola C, Victora CG. Long-term consequences of breastfeeding on cholesterol, obesity, systolic blood pressure and type 2 diabetes: a systematic review and meta-analysis. *Acta Paediatr Suppl*. 2015;104(467):30-37.
29. Chen S, Binns CW, Zhang Y. The importance of definition in diagnosing obesity: a review of studies of children in China. *Asia Pac J Public Health*. 2012;24(2):248-262.
30. Yu C, Binns CW, Lee AH. Comparison of breastfeeding rates and health outcomes for infants receiving care from hospital outpatient clinic and community health centres in China. *J Child Health Care*. 2015.
31. Woo JG, Martin LJ. Does Breastfeeding Protect Against Childhood Obesity? Moving Beyond Observational Evidence. *Curr Obes Rep*. 2015; Online Early, :1-11.
32. Harder T, Bergmann R, Kallischnigg G, Plagemann A. Duration of breastfeeding and risk of overweight: a meta-analysis. *Am J Epidemiol*. 2005;162(5):397-403.

33. Horta BL, de Mola CL, Victora CG. Long-term consequences of breastfeeding on cholesterol, obesity, systolic blood pressure, and type-2 diabetes: systematic review and meta-analysis. *Acta Paediatr*. 2015.
34. Lu CY, Ni YH. Gut microbiota and the development of pediatric diseases. *J Gastroenterol*. 2015;50(7):720-726.
35. Saari A, Virta LJ, Sankilampi U, Dunkel L, Saxen H. Antibiotic exposure in infancy and risk of being overweight in the first 24 months of life. *Pediatrics*. 2015;135(4):617-626.
36. Bailey LC, Forrest CB, Zhang P, Richards TM, Livshits A, DeRusso PA. Association of antibiotics in infancy with early childhood obesity. *JAMA pediatrics*. 2014;168(11):1063-1069.
37. Murphy R, Stewart AW, Braithwaite I, et al. Antibiotic treatment during infancy and increased body mass index in boys: an international cross-sectional study. *Int J Obes (Lond)*. 2014;38(8):1115-1119.
38. Bovbjerg ML, Amador C, Uphoff AE. Breastfeeding and childhood obesity: where do we go from here? *JAMA pediatrics*. 2013;167(10):894-895.
39. Mamun AA, O'Callaghan MJ, Williams GM, Najman JM, Callaway L, McIntyre HD. Breastfeeding is protective to diabetes risk in young adults: a longitudinal study. *Acta diabetologica*. 2015.
40. Sharma AJ, Dee DL, Harden SM. Adherence to breastfeeding guidelines and maternal weight 6 years after delivery. *Pediatrics*. 2014;134 Suppl 1:S42-49.
41. Mohamad Yusuff AS, Tang L, Binns CW, Lee AH. Prevalence and risk factors for postnatal depression in Sabah, Malaysia: a cohort study. *Women Birth*. 2015;28(1):25-29.
42. Aune D, Norat T, Romundstad P, Vatten LJ. Breastfeeding and the maternal risk of type 2 diabetes: a systematic review and dose-response meta-analysis of cohort studies. *Nutr Metab Cardiovasc Dis*. 2014;24(2):107-115.
43. Jager S, Jacobs S, Kroger J, et al. Breast-feeding and maternal risk of type 2 diabetes: a prospective study and meta-analysis. *Diabetologia*. 2014;57(7):1355-1365.
44. Gunderson EP, Hurston SR, Ning X, et al. Lactation and Progression to Type 2 Diabetes Mellitus After Gestational Diabetes Mellitus: A Prospective Cohort Study. *Ann Intern Med*. 2015:889-898.
45. Schwarz EB. Invited Commentary: Breastfeeding and Maternal Cardiovascular Health--Weighing the Evidence. *Am J Epidemiol*. 2015;181(12):940-943.
46. Schwarz EB, Ray RM, Stuebe AM, et al. Duration of lactation and risk factors for maternal cardiovascular disease. *Obstet Gynecol*. 2009;113(5):974-982.
47. Merritt MA, Riboli E, Murphy N, et al. Reproductive factors and risk of mortality in the European Prospective Investigation into Cancer and Nutrition; a cohort study. *BMC Med*. 2015;13:252.
48. Houghteling PD, Walker WA. Why is Initial Bacterial Colonization of the Intestine Important to the Infant's and Child's Health? *J Pediatr Gastroenterol Nutr*. 2014.
49. Gargano LM, Hughes JM. Microbial origins of chronic diseases. *Annual review of public health*. 2014;35:65-82.
50. Weber M, Grote V, Closa-Monasterolo R, et al. Lower protein content in infant formula reduces BMI and obesity risk at school age: follow-up of a randomized trial. *Am J Clin Nutr*. 2014;99(5):1041-1051.
51. World Cancer Research Fund and American Institute for Cancer Research. *Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective*. Washington DC: : AICR, ; 2007.
52. Su D, Pasalich M, Lee AH, Binns CW. Ovarian cancer risk is reduced by prolonged lactation: a case-control study in southern China. *Am J Clin Nutr*. 2013;97(2):354-359.
53. UNICEF Nutrition. *Breastfeeding*. [http://www.unicef.org/nutrition/index\\_24824.html](http://www.unicef.org/nutrition/index_24824.html) Accessed 10 Nov 2015 New York: UNICEF; 2015.
54. WHO. *Acceptable medical reasons for use of breastmilk substitutes*. Geneva: WHO; 2009.

