ARTIKEL ASLI/ORIGINAL ARTICLE

Comparison of Breastfeeding Practice Using Deuterium Oxide Dose to Mother Technique with Maternal Recall Breastfeeding Practice Among Mothers in Klang Valley
(Perbandingan Amalan Penyusuan Susu Ibu dengan Kaedah Deuterium Oksida Dos kepada Ibu dan Kaedah Ingatan Semula Amalan Penyusuan Susu Ibu dalam Kalangan Ibu di Lembah Klang)

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ABSTRACT

The assessment of exclusive breastfeeding is important to invest the efforts to promote and support breastfeeding practices. Hence this study was carried out to compare breastfeeding practices among mothers using deuterium dose to mother technique with maternal recall breastfeeding practice. A total of 30 mother-infant pairs from a university hospital and government health clinics in Klang Valley participated and completed the study. Mother-infant pairs were recruited into the study when infants were aged 3 months ± 1 week. Anthropometric measurements (height, weight, waist circumference for mother; length and weight for infant) were carried out. Socio-demographic questionnaire was self-administered while breastfeeding practices were interview administered using maternal recall breastfeeding practice questionnaire (MRBF). This was followed by baseline saliva collection of mother-infant pairs before dose and 6 days after mothers were given 30 ± 0.01 g of D₂O. The post dose saliva sample of mother-infant pairs were collected 6 times at day 1, 2, 3, 4, 13 and 14. The results showed that majority of mothers (57%) were university graduates but majority were stay at home mothers. Meanwhile, mothers had BMI with mean 25 ± 4 kg/m². The results from MRBF questionnaire showed that all mothers were practicing exclusive breastfeeding and their infant never received any water sources other than their breast milk. However, the deuterium dose to mother technique revealed only 3% of mothers were actually practicing exclusive breastfeeding. From the isotopic data, the calculated mean intake of milk was 721 ± 243 g/day while the mean non-milk oral intake of 122 ± 22 g/ day. In contrast exclusive breastfeeding infants received only 10 g/day non milk oral intake, demonstrating exclusive breastfeeding practice of mothers. There were different breastfeeding practice reported from mother using deuterium oxide dose to mother technique with maternal recall breastfeeding practice.

Keywords: Exclusive breastfeeding; breastfeeding practice; deuterium oxide technique; Klang Valley; maternal recall

ABSTRAK

Penilaian penyusuan eksklusif adalah penting supaya dapat mempromosikan dan menyokong amalan penyusuan ibu. Dengan itu, kajian ini dijalankan untuk membanding amalan penyusuan susu ibu di kalangan ibu dengan menggunakan kaedah deuterium oksida dos kepada ibu dan kaedah ingatan semula amalan penyusuan susu. Seramai 30 pasangan ibu dan bayi dari hospital Universiti dan klinik kesihatan kerajaan di Lembah Klang telah menyertai dan menyelidik kajian ini. Pasangan ibu dan bayi telah direkrut dalam kajian semasa bayi berumur 3 bulan ± 1 minggu. Pengukuran tropometri (ketinggian, berat badan dan ukur lilit pinggang untuk ibu; panjang dan berat untuk bayi) telah dijalankan. Borang soal selidik sosio-demografi diisi oleh ibu sementara amalan penyusuan susu ditemu duga oleh penyelidik dengan borang soal selidik ingat semula amalan penyusuan susu. Ini diikuti dengan pengumpulan air liur asas dari pasangan ibu dan bayi sebelum dos diberi kepada ibu dan 6 hari selepas ibu diberi 30 ± 0.01 g D₂O. Sampel air liur dari pasangan ibu dan bayi dikumpul pada hari pertama, ke-2, 3, 4, 13 dan 14 selepas dos D₂O diberi. Hasil menunjukkan majoriti ibu (57%) belajar sehingga universiti dan majoriti ibu tinggal di rumah. Ibu mempunyai BMI dengan purata 25 ± 4 kg/m². Hasil dari borang soal selidik amalan penyusuan susu menunjukkan semua ibu mengamalkan penyusuan susu ibu secara eksklusif dan bayi mereka tidak pernah menerima sebarang sumber air selain susu ibu. Walau bagaimanapun, kaedah deuterium oksida dos kepada ibu menunjukkan hanya 3% ibu sebenarnya mengamalkan penyusuan susu ibu secara eksklusif. Dari data isotop, purata pengambilan susu adalah 721 ± 243 g/hari manakala pengambilan air selain sumber susu ibu sebanyak 122 ± 22 g/hari. Sebaliknya kumpulan penyusuan susu ibu hanya menerima 10 g/hari air selain sumber susu ibu sahaja dan ini memenuhi syarat amalan penyusuan susu. Amalan penyusuan susu yang dilaporkan oleh ibu didapati berbeza jika berbanding kaedah deuterium oksida dos kepada ibu dengan kaedah ingatan semula amalan penyusuan susu.

Kata kunci: Penyusuan susu ibu secara eksklusif; amalan penyusuan susu ibu; teknik deuterium oksida; Lembah Klang; ingatan semula maternal
INTRODUCTION

Breastfeeding is a global policy established by WHO and UNICEF to ensure that optimum nutritional status is achieved among infants from birth until 2 years old (WHO & UNICEF 1989). WHO (2001) recommends exclusive breastfeeding up to six months and to be continued until two years, with the introduction of complementary foods in infant’s life. Exclusive breastfeeding is defined as infants receiving breast milk only without any additional liquids or solid except medication under prescription of doctor (Noel-Weiss et al. 2012). Previous studies demonstrated that exclusive breastfeeding assured the essential nutrients for infants below 6 months and protected infants from diarrhea and respiratory infection (Horta & Victora 2013; Victora et al. 2016). The Malaysian government supports National Breastfeeding Policy and plays a vital role in the promotion of exclusive breastfeeding practices among Malaysian mothers (NCCFN 2013). Despite the intensive promotion of exclusive breastfeeding, some mothers discontinued breastfeeding due to several barries, such as not enough milk, tiredness due to work and infant had trouble sucking or latching on (NHMS 2016). Despite the global increase trend of exclusive breastfeeding from 33% in 1995 to 39% in 2010 in developing country as reported by Cai et al. (2012), the National Health Morbidity Survey IV (NHMS IV) showed that 47.5% of Malaysian mothers practiced exclusive breastfeeding up to 6 month (NHMS 2016). Continuous education and promotion are required to further increase the awareness of the mothers towards the exclusive breastfeeding in Malaysia.

The tool used to identify breast milk intake included test weighing. Test weighing is a convenient instrument to assess human breast milk intake of infant through measured body weight before and after each feeding (WHO 2002). Haase et al. (2009) established the test weighing technique with controlled several confounding variables such as minimizing infant movement, eliminating clothes or blanket from draping over the side of scale and maintaining the consistent position to obtain a more accurate measurement of breast milk during breastfeeding in clinical setting. Savenjie & Brand (2006), however reported the imprecise test-weighing due to the insensitivity of the weighing scale to differentiate the small changes before and after each feeding. Savenjie & Brand (2006) reported that the presence of wire and splints, vomiting or regurgitation did not influence the imprecision of test weighing. However, the milk spill slightly affect the imprecision of test weighing. 95 % of test weighing showed 14 ml difference after excluding the milk spill cases and showed that adjusting for insensible water loss did not improved the precision of test-weighing (Savenjie & Brand 2006).

Deuterium oxide dose-to-mother technique had been introduced by Coward et al. (1982) to differentiate the water sources intake by infants other than breast milk. The theory of deuterium oxide dose-to-mother technique assessed breast milk flow from mother to baby, based on two compartment model, where the first compartment was mother’s body water and the second compartment was baby’s body water (IAEA 2010). Based on 6 assumptions, water input is equal to water output in the steady state and the adjustment of model for water turnover in the mother and baby (IAEA 2010). The breast milk and water sources intake determine by curve fitted using “Solver” function in Microsoft Excel (IAEA 2010). To date, no study had been carried out to determine exclusive breastfeeding practice using deuterium oxide among Malaysian mothers. Hence, this study was carried out to compare breastfeeding practices among mothers using deuterium dose to mother technique with maternal recall breastfeeding practice in Klang Valley, Malaysia.

MATERIALS AND METHODS

The present study is a cross-sectional study (purposive sampling) of 32 mother-infant pairs who were recruited at 1 to 2 months postnatal during their visit to the hospital and government health clinics in Klang Valley. A sample size of 32 mother-infant pairs was calculated by formula $N = \frac{t_{0.05}^2 \times s^2}{\varepsilon^2}$ reported from Singh & Masuku (2014). “s” is the standard deviation of human milk intake at 3 months (135 g/day) as reported by Agne-djigo et al. (2013). ε referred to the permissible in the estimation of mean whereas $t_{0.05}$ is the value of at 5% level of significance (Singh & Masuku 2014). 10% dropout rate was calculated from the total sample size. After initial interview by the researcher to review the inclusion and exclusion criteria of subjects using screening questionnaire, 30 mothers aged between 18 until 40 years old who were planning to exclusive breastfeed until 6 months were eligible to participate in this study. Subjects were excluded from continuing the study due to the changes of exclusive breastfeeding practices to other type of practice through questionnaire, unable to commit their time during data collection and personal issues. Mothers who were healthy without any fluid retention disease, non-smoker, non-alcohol drinker and had less than 4 children were selected. Meanwhile, full term infants (37 to 40 weeks) with normal weight for height z-score (> -2) and normal birth weight (≥ 2.5 kg) were included. Twins infants and those infants with edema problems were excluded in this study. The ethical approval was obtained from Research Ethics Committee of National University Kebangsaan Malaysia (NN-173-2014) and Medical Research & Ethics Committee (NMRR-15-445-25253) before study commencement.

ANTHRPOMETRY MEASUREMENTS

Height of mothers were measured using measuring board (portable height-length measuring board, US) to the nearest to 0.1 cm. Weighing scale (Tanita HD-309 Weight Scale, Tokyo, Japan) was used to measure the weight of mothers. Meanwhile, infant’s weight were measured by baby
sterile cotton wool ball to soak up the saliva for 5 minute. deuterium dose (pairs at baseline, day 1, 2, 3, 4, 13 and 14 after given the bottle contained deuterium dose, followed by drank the infants. 50 ± 0.01 g drinking water added and rinsed the infants mouth until 1 ml saliva sample collected using sterile hand glove. The saliva sample was placed in a cool box with ice pack and transferred to a freezer with temperature −20°C for storage until analysis (IAEA 2010).

All saliva samples were analyzed by Fourier transform infrared spectrophotometer (Agilent® 4500t). The absorption wavelength for deuterium oxide was within 2300 cm⁻¹ and 2800 cm⁻¹ (IAEA 2010). The results were calculated by water turnover in mother and infant using algorithm (2015 excel® spreadsheet portable FTIR) which was developed by Medical Research Council Collaborative Centre for Human Nutrition Research, Cambridge, UK (IAEA 2010). All samples were analyzed at least twice when both readings were different by 3.0 mg/kg. Mothers were categorized as practicing exclusive breastfeeding if the mean non-milk oral intake was ≤ 25 g/day and non-exclusive breastfeeding when non-milk oral intake was more than 25 g/day (Moore et al. 2007). Mothers were classified as predominant breastfeeding if their mean non-milk oral intake was between 25 and 220 g/day meanwhile categorized as partially breastfeeding if mean non-milk oral intake was more than 220 g/day (Moore et al. 2007).

statistical analysis

All data were analyzed using Statistical Product and Service Solution version 22. Descriptive test was used to analyze the socio-demographic data and maternal recall data among subjects. Meanwhile, ANOVA test was used for comparisons among group means. Statistical descriptive analysis test was used to compare maternal recall method against intake by deuterium oxide dose to mother technique.

results

Mean age of mothers was 30 ± 4 years old and majority (57%) were university graduates and the remaining (43%) studied up to secondary or college level (Table 1). 47% of mothers were working, 43% were housewives and most of them had household income RM3000 and above.

Table 2 shows that mother had body mass index (BMI) of 25 ± 4 kg/cm² at 3 months postpartum. Majority of mother had normal BMI (43%). 41% were overweight while 13% were obesity at 3 months postpartum. However, mother had central obesity problem as their waist circumference were 82 ± 10 cm.
From the maternal recall method (Table 3), majority of mothers (70%) had normal delivery, and majority (67%) initiated breastfeeding within 1 hour after delivery. Mothers who were exclusive breastfeeding initiated breastfeeding after 1 hour, while those who were partially breastfeeding initiated breastfeeding within 1 hour. Nevertheless, all mothers reported practicing exclusive breastfeeding and that their infants never received any water source other than breast milk since birth until 3 months and still practising exclusive breastfeeding. 87% mothers received exclusive breastfeeding information before delivery.

| TABLE 1. Socio-demographic characteristics of mother-infant pairs |
|---------------------------------------------------------------|
| **Maternal Characteristics** | n | % | Mean ± SD |
| Age/years (n = 30) | 30 | ± 4 |
| 20-30 | 19 | (64) |
| 31-40 | 11 | (36) |
| Race | | |
| Malay | 29 | (97) |
| Chinese | 1 | (3) |
| Infants | | |
| First | 13 | (44) |
| Second | 7 | (23) |
| Third | 10 | (33) |
| Education Level | | |
| Secondary School | 3 | (10) |
| STPM/College | 10 | (33) |
| University | 17 | (57) |
| Employment Status | | |
| Employed | 14 | (47) |
| Student | 3 | (10) |
| Housewife | 13 | (43) |
| Household Income/RM | | |
| Low (<1000) | 3 | (10) |
| Moderate (1001-3000) | 8 | (27) |
| High (>3000) | 19 | (63) |

| TABLE 2. Anthropometry measurement of mothers |
|------------------------------------------------|
| **Maternal Characteristics** | Mean ± SD | n% |
| Weight/kg (n = 30) | 61 ± 12 | |
| Height/cm | 156 ± 5 | |
| Body mass index/kgm² | 25 ± 4 | |
| Underweight | 1(3) | |
| Normal | 13(43) | |
| Overweight | 12(41) | |
| Obese | 4(13) | |
| Waist circumference/cm | 82 ± 10 | |
| Hip circumference/cm | 99 ± 10 | |

| TABLE 3. Breastfeeding practices using maternal recall method and deuterium dose to mother technique from birth to 3 months |
|---------------------------------------------------------------------------------------------------------------------------|
| **Breastfeeding Practice (n = 30)** | **Maternal recall** | **D₂O Method** |
| - | (n = 30) | Exclusive | Predominant | Partial |
| Initiate breastfeeding | | | | |
| Within 1 hour | 20 (67) | 0 (0) | 17 (65) | 3 (100) |
| After 1 hour | 10 (33) | 1 (100) | 9 (35) | 0 (0) |
| Currently practice exclusive breastfeeding at 3 months | 30 (100) | 1 (100) | 26 (100) | 3 (100) |
| Infant never received any water source other than breast milk since birth at 3 months | 30 (100) | 1 (100) | 26 (100) | 3 (100) |
| Infant received any water sources other than breast milk since birth at 3 months | | | | |
| Plain Water | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Water with Sugar | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Milk Formula | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Cow’s milk or any other animal’s milk | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Juice | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Broth or soup | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| The Herbs | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Other | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Medicine/Vitamin/ Syrup | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Never | 100 (30) | 100 (30) | 100 (30) | 100 (30) |
| Type of delivery | | | | |
| Normal | 21 (70) | 0 (0) | 19 (65) | 2 (67) |
| Caesarean | 9 (30) | 1 (100) | 7 (27) | 1 (33) |
| Period received exclusive breastfeeding information | | | | |
| Before delivery | 26 (87) | 0 (0) | 25 (97) | 2 (67) |
| After delivery | 5 (13) | 1 (100) | 1 (3) | 1 (33) |
Table 4 shows that mean breast milk intake of all infants was 721 ± 243 g/day at 3 months postpartum. The mean non-milk oral intake for exclusive breastfeeding infants was 10 g/day and predominant infants was 94 ± 51 g/day. Meanwhile, partially infants had mean non-milk oral intake 402 ± 223 g/day. There were significant differences in breast milk intake and non-milk oral intake between exclusive, predominant and partially group respectively.

| Results                        | Overall | Exclusive | Predominant | Partially | P value | CI Value |
|-------------------------------|---------|-----------|-------------|-----------|---------|----------|
| Breast Milk Intake (BM)       | 721 ± 243 | 670       | 685 ± 203   | 1051 ± 400 | 0.04*   | 630-812  |
| Non-milk oral Intake (Fs)/gday⁻¹ | 122± 22  | 10        | 94 ± 51     | 402 ± 223 | 0.001** | 76-168   |
| Total Body Water (TBW)/kgday⁻¹ | 24 ± 4   | 27        | 24 ± 4      | 27 ± 0    | 0.295   | 23-26    |

* significant different between group at p < 0.05
** significant different between group at p < 0.001

In Table 5, the prevalence of exclusive breastfeeding practice by mothers using the exclusive breastfeeding questionnaire from maternal recall was 100%. However, deuterium dose to mother technique revealed that only 3% of mothers was actually practicing exclusive breastfeeding at 3 months. This was so much lower than the self-reporting of mothers from maternal recall which showed all mothers claimed to be practicing exclusive breastfeeding at 3 months. In reality, using the deuterium dose to mother technique, the majority of mothers (87%) were predominantly breastfeeding while 10% were partially breastfeeding.

**DISCUSSION**

In the present study, three categories of breastfeeding practices were noted using deuterium dose to mother technique, (Figure 1) ie exclusive, predominant and partial breastfeeding. Deuterium dose to mother technique is a direct method to determine exclusive breastfeeding practices through the water flow from mother to infants (IAEA 2010). If infants received water sources other than breast milk, it will be determined by the flow of water and the non-oral milk intake will be above 25 g/day (Moore et al. 2007), which is categorized as non-exclusive breastfeeding infants.

On the other hand, the maternal recall method was the recall indicator using closed ended questionnaire with certain recall period for subjects. According to Aarts et al. (2000), a single recall indicator was not adequate to determine breastfeeding practice especially exclusive breastfeeding because of the wide discrepancy between the results obtained from current status indicators based on 24 hour period. Therefore, Aarts et al. (2000) suggested the recall period should include 24 hour period and since birth to avoid error found. Motswagole et al. (2015) showed that all Botswana mothers reported practising exclusive breastfeeding by maternal recall method, however only 61.2% were actually exclusive breastfeeding using isotopic data of D₂O at 3 months. A similar result was also shown by Samuel et al. (2012) in India, in which 90% mothers was classified as exclusive breastfeeding using maternal recall method, when only 23% was exclusive breastfeeding using isotopic data of D₂O. In our study, 100% mothers were classified as exclusive breastfeeding by maternal recall method, however only 3% mothers were actually exclusive breastfeeding using deuterium dose to mother technique. In this study, the discrepancies in the prevalence of exclusive breastfeeding between these two methods were due to mothers giving water to the infants occasionally due to haze or hot weather in Malaysia. Many mothers did not know that for exclusive breastfeeding practice, water and other water sources should not be given to infants. For working mothers, while they asked the caregivers to give expressed breast milk to the infants, the caregivers or nannies gave mixed water and other water sources to the infants without the mother’s knowledge. These feedbacks were personal communication with subject when they interviewed.
Using the deuterium dose to mother technique, our study showed that there was significant difference in breast milk intake and non-milk oral intake between exclusive breastfeeding and non-exclusive breastfeeding group (predominant and partially) respectively. Overall the mean breast milk intake by all infants were 721.3 ± 243 g/day at 3 months postpartum. By breastfeeding practice, the partially breastfed infants had the highest intake of breast milk in comparison with predominant breastfed infants or exclusive breastfeeding infants. There were uncertain amount of human milk intake reported by WHO (2001) due to difficulty to assess the human milk intake accurately whether using test-weighing or maternal human milk expression methods (Costa et al. 2010). However, deuterium oxide dose to mother technique resolved the weakness of both methods and directly measure the milk flow through estimation of deuterium enrichment (Costa et al. 2010). Costa et al. (2010) reported mean of human milk intake from 12 countries were 780 g/day during first 3 to 4 months when measured using direct method (deuterium oxide dose to mother technique). The mean of human milk intake from Costa et al. (2010) was almost similar with our current result. However in this study, predominant and partially breastfed infants had more non-milk oral intake (an indicator of non exclusive breastfeeding) than exclusive breastfeeding infants. Hence based on our results, it should not be interpreted that exclusive breastfeeding infants in Malaysia received less breast milk than predominant and partially breastfed infants, as only one infant was categorized as being breastfed exclusively.

In our study, none of the mothers reported giving any syrup, herbal tea, juice, formula milk, water, sweet water or other water source to their infants as shown in maternal recall breastfeeding practice at 3 months postpartum in each breastfeeding group. The maternal recall reflected the definition of exclusive breastfeeding as defined by WHO (2008), where infants received only breast milk and might include ORS, syrup and drops (vitamins, minerals and medicine). Breastfeeding practice was low among Malaysian mothers both in the urban area with end with rural area with 89% population (NHMS 2016). Exclusive breastfeeding was difficult to practise especially among working mothers, due to not enough milk, feel of tiredness after work and the technique of infant sucking and latching (NHMS 2016). However, 46.6% of working mothers were able to practice exclusive breastfeeding based on the current findings. Among those working mothers, they reported that they expressed and stored their breast milk to be given to their infants by the nannies or the caregivers (through personal communication). Maternal education level and household income did not affect their exclusive breastfeeding practice in current study in contrast to the findings of another study by NHMS (2016).

WHO (2003) recommended the initiation of breastfeeding within 1 hour of delivery, as a way of promoting breastfeeding practices longitudinally. This is because early initiation of breastfeeding may stimulate the function of breast to increase breast milk supply and thus maintain or sustain their breastfeeding practices until 6 months (WHO 2002). However, our study showed that the only exclusive breastfeeding infants was breastfed after 1 hour of delivery as she was delivered by cesarean. Despite majority of the infants were delivered normally, their mothers were practising predominant breastfeeding at 3 months postpartum. Although mothers received exclusive breastfeeding information before delivery, hence have knowledge of the benefits of exclusive breastfeeding, it did not necessary translate into the practice of exclusive breastfeeding at 3 months postpartum. This was supported by Regan et al. (2013) who reported that the mode of delivery and timely initiation of breastfeeding were not the major reasons influencing the breastfeeding practices, however the decision of mothers were the main reason of breastfeeding practices.

This study is the first study in Malaysia to use deuterium dose-to-mother technique, which is a gold standard method as reference to determine the breastfeeding practices through estimation of breast milk intake by infants. Deuterium dose-to-mother technique is a direct method to measure the flow of deuterium mixed with breast milk and thus determine the total milk intake by adjusting for insensible and sensible water loss (Costa et al. 2010). It mimics the normal behavior feeding of both mother and infant during small and frequent feeding or nighttime feeding where test weighing and milk expression method could not (Costa et al. 2010). However, there is a precaution to avoid the loss of deuterium enrichment. The cross-contamination of saliva sample with breast milk left over in the mouth of infants should be centrifuged to obtain a clear sample and stable result.

Meanwhile, the limitation of this study was the small sample size and hence was unable to represent the mothers in Malaysia. This study was a part of a larger IAEA validation study that is participated by 8 different countries. Some precaution should be taken when mothers were working and gave expressed milk to the infant. The final reading of deuterium dose to mother technique affected if the mother gave expressed milk to infants without notifying the researcher was give expressed milk that did not contain deuterium dose during the 14 days post dose and this affected the deuterium oxide amount taken by infants.

CONCLUSION

There are different breastfeeding practice reported from mother using deuterium oxide dose to mother technique with maternal recall breastfeeding practice. Deuterium oxide dose to mother technique is a more reliable method in determining exclusive breastfeeding practices as it is able to differentiate the types of breastfeeding practices among mothers.
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REFERENCES

Aarts, C., Kylberg, E., Hornell, A., Hofvander, Y., Gebre-Medhin, M. & Greiner, T. 2000. How exclusive is exclusive breastfeeding? A comparison of data since birth with current status data. International Journal of Epidemiology 29(6): 1041-1046.

Agné-djigo, A., Kwaadjode, K. M., Idohou-dossou, N., Diouf, A., Guiro, A. T. & Wade, S. 2013. Energy intake from human milk covers the requirement of 6-month-old Senegalese exclusively breast-fed infants. British Journal of Nutrition (110): 1849-1855.

Cai, X., Wardlaw, T. & Brown, D. W. 2012. Global trends in exclusive breastfeeding. International Breastfeeding Journal 7(1): 1-5.

Coward, W. A., Cole, T. J., Sawyer, M. N., Prentice, A. M. & Orr-Ewing, A. K. 1982. Breast-milk intake measurement in mixed-fed infants by administration of deuterium oxide to their mothers. Human Nutrition Clinical Nutrition (36C): 141-148.

Costa, T. H. M., Haisma, H., Wells, J. C. K., Mander, A. P., Whitehead, R. G. & Bluck, L. J. C. 2010. How Much Human Milk Do Infants Consume? Data from 12 Countries Using a Standardized Stable Isotope Methodology. Journal of Nutrition 140(12): 2227-2232.

Haase, B., Barreira, J., Murphy, P. K., Mueller, M. & Rhodes, J. 2009. The development of an accurate test weighing technique for preterm and high-risk hospitalized infants. Breastfeeding medicine 4(3): 151-156.

Horta, B. L. & Victora, C. G. 2013. Short-term effects of breastfeeding. Geneva, Switzerland: World Health Organization.

IAEA. 2010. Stable Isotope Technique to Assess Intake of Human Milk in Breastfed Infants. Vienna, Austria: IAEA Human Health Series.

Moore, S. E., Prentice, A. M., Coward, W. A., Wright, A., Frongillo, E. A., Fulford, A. J. C., Mander, A. P. et al. 2007. Use of stable-isotope techniques to validate infant feeding practices reported by Bangladeshi women receiving breastfeeding counseling. American Journal of Clinical Nutrition 85(4): 1075-1082.

Motswagole, B. S., Matenge, S. T. P., Mongwakete, T., Bogopa, J., Kobue-Lekaleke, R., Moselthia, K. & Kwape, L. 2015. Application of the deuterium-oxide dose-to-mother technique to determine the exclusivity of breastfeeding in women in Kanye, Botswana. South African Journal of Clinical Nutrition 28(3): 128-133.

NCCFN. 2013. Malaysian Dietary Guidelines for Children and Adolescents. Putrajaya, Malaysia: National Coordinating Committee on Food and Nutrition.

NHMS. 2016. National Health and Morbidity Survey: Maternal and Child Health. Putrajaya, Malaysia: National Health and Morbidity Survey.

Noel-Weiss, J., Boersma, S. & Kujawa-Myles, S. 2012. Questioning current definitions for breastfeeding research. International Breastfeeding Journal 7(1): 1-9.

Regan, J., Thompson, A. & DeFranco, E. 2013. The Influence of Mode of Delivery on Breastfeeding Initiation in Women with a Prior Cesarean Delivery: A Population-Based Study. Breastfeeding Medicine 8(2): 181-186.

Samuel, T. M., Thomas, T., Bhat, S. & Kurpad, A. V. 2012. Are infants born in baby-friendly hospitals being exclusively breastfed until 6 months of age. European Journal of Clinical Nutrition 66(4): 459-465.

Savenije, O. E. M. & Brand, P. L. P. 2006. Accuracy and precision of test weighing to assess milk intake in newborn infants. Archives of disease in childhood 91(5): F330-F332.

Singh, A. & Masuku, M. 2014. Sampling Techniques & Determination of Sample Size in Applied Statistics Research: An Overview. Ijcem.co.uk.

Victora, C. G., Bahl, R., Barros, A. J. D., França, G. V. A., Horton, S., Krasevec, J., Murch, S. 2016. Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect. Lancet 387(10017): 475-90.

WHO & UNICEF. 1989. Protecting promoting and supporting breastfeeding the special role of maternity services. Geneva, Switzerland: World Health Organization and United Nations Children’s Fund.

WHO. 2001. The Optimal Duration of Exclusive Breastfeeding: Report of An Expert Consultation. Geneva, Switzerland: World Health Organization.

WHO. 2002. Nutrient adequacy of exclusive breastfeeding for the term infant during the first six months of life. Geneva, Switzerland: World Health Organization.

WHO. 2008. Indicators for assessing infant and young child feeding practices, Washington, USA: World Health Organization.
