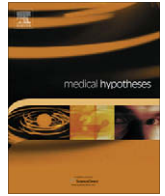




Contents lists available at ScienceDirect

Medical Hypotheses

journal homepage: www.elsevier.com/locate/mehy

Bottle feeding simulates child loss: Postpartum depression and evolutionary medicine

Gordon G. Gallup Jr. *, R. Nathan Pipitone, Kelly J. Carrone, Kevin L. Leadholm

Department of Psychology, University at Albany, State University of New York, Albany, NY 12222, USA

ARTICLE INFO

Article history:
Received 2 July 2009
Accepted 5 July 2009
Available online xxxx

SUMMARY

At the level of a mother's basic biology, the decision to bottle feed unwittingly mimics conditions associated with the death of an infant. Child loss is a well documented trigger for depression particularly in mothers, and growing evidence shows that bottle feeding is a risk factor for postpartum depression. The implications of this hypothesis for infant feeding practices, hospital procedures that lead to intermittent separation between mothers and infants during the immediate postpartum period, parallels between an increased desire to hold infants by mothers who bottle feed and responses to infant death among non-human primates, and the relationship between weaning and depression are discussed in the context of an emerging discipline known as evolutionary medicine.

© 2009 Elsevier Ltd. All rights reserved.

Evolutionary medicine

Growing evidence shows that knowledge of human evolutionary history and mismatches between evolved adaptations and different aspects of our contemporary existence can have important medical and epidemiological implications [1]. For instance, population differences in the susceptibility to lung disease appear to be related to early geographical differences in the reliance on fire for warmth and food preparation and resulting selection due to differences in the inhalation of smoke as a byproduct of combustion [2]. There is also growing evidence that impregnation as a consequence of exposure to unfamiliar semen (i.e., infrequent insemination by the father) increases the risk of preeclampsia and other forms of spontaneous abortion [3].

Evolutionary medicine also applies in the psychological domain. Research on paternal resemblance shows that men are far more likely than women to invest preferentially in children with whom they share common facial features [4,5]. A clear implication of such findings is that matching phenotypic features of children being considered for adoption with those of their adoptive fathers could be used to improve adoption outcomes.

Bottle feeding

The present paper focuses on the decision people make to unwittingly depart from one of the defining features of mammalian evolution: to bottle feed rather than breastfeed their infants. For 99.9% of human evolutionary history the decision not to breast-

feed would have been tantamount to committing infanticide. The technology that lead to bottle feeding as a substitute for the breast (e.g., bottles, rubber nipples, formula) has only become available within the last 100 years. Nowadays, the decision to bottle feed can be made by design (e.g., out of a concern for the effect on the mother's figure, embarrassment about breastfeeding in public, time constraints due to employment) or by default (e.g., physical inability to breastfeed or where the mother produces inadequate breast milk).

With the advent of bottle feeding technology, there was a decline in breastfeeding in this country and elsewhere during the past century [6], but as significant advantages of breastfeeding for both the infant and the mother have become evident [7,8] the pendulum has begun to swing in the opposite direction. The focus of this paper, however, is not on the advantages of breastfeeding *per se*, but rather on the negative psychological consequences of the decision not to breastfeed.

Lactation

Pregnancy triggers a variety of hormonal changes that prepare the mammary glands to produce milk to meet an infant's immunological and nutritional needs. Across the course of pregnancy, the breasts change internally and externally in response to prolactin, lactogen, estrogen, progesterone, ACTH, and growth hormone [9], with lactation kept at bay by high levels of circulating progesterone and oestrogen [10]. Lactation is triggered by the rapid drop in progesterone following placental birth, but other changes including the release of prolactin and oxytocin, along with cortisol, thyroid-stimulating hormone, and additional hormones are implicated in this process [9].

* Corresponding author. Tel.: +1 518 442 4852.
E-mail address: gallup@albany.edu (G.G. Gallup Jr.).

Once begun, lactation is largely maintained by prolactin, although oxytocin is responsible for the milk ejection reflex (MER), and is released into the mother's bloodstream at every feeding [9,11]. After lactation is established, however, prolactin does not dictate milk production volume. Suckling alone removes very little breast milk. Instead, the MER triggered by oxytocin release provides the largest proportion of breast milk consumed [11]. The MER initially requires physical stimulation (suckling) but eventually becomes conditioned, and can be activated or inhibited by various cues [10]. Once conditioned, women can experience milk ejection, and the concomitant release of the lactogenic hormones oxytocin and prolactin, from merely thinking about, smelling, or hearing their baby cry [12].

If the MER is inhibited, milk remains undrained in the breast, and autocrine mechanisms work to inhibit milk secretion [10]. With complete cessation of milk removal, secretory capacity is eventually lost, although relaxation is possible through breast and nipple stimulation [13].

Since milk production is dependent on removal of milk from the breasts when complimentary foods are introduced into the infant's diet, milk production is reduced. This starts the process of weaning, whereby infants move from a diet consisting exclusively of breast milk to one where breast milk becomes a supplement and is eventually no longer consumed. The physiological process that occurs when the breast changes from a milk-producing organ back to one that is largely quiescent is known as involution.

Bottle feeding simulates child loss

Opting not to breastfeed precludes and/or brings all of the processes involved in lactation to a halt. For most of human evolution the absence or early cessation of breastfeeding would have been occasioned by the miscarriage, loss, or death of a child. We contend, therefore, that at the level of her basic biology a mother's decision to bottle feed unknowingly simulates child loss. The death of a child is a well documented trigger for profound parental grief and depression [14], and evidence shows that mothers tend to be more affected than fathers [15]. Suarez and Gallup [16] theorize that depression in response to the death of a child may be an adaptive mechanism that functions to (1) punish instances of inappropriate parenting or neglect, and (2) trigger social and psychological support from close friends and relatives during the particularly difficult period following the loss of an infant (see also [17]). Because bottle feeding simulates child loss at a physiological level it may also play an important role in postpartum depression.

Consistent with this analysis, there is growing evidence that bottle feeding is a significant risk factor for postpartum depression [18–21]. Some claim that breastfeeding can reduce the incidence of postpartum depression by as much as 50% [22]. Additional evidence in support of our hypothesis comes from the fact that postpartum depression is not an uncommon response to weaning [23,24]. Because weaning results in the cessation of milk production in much the same way that bottle feeding does, weaning/involution can also be thought of as mimicking child loss.

We recently completed a study of over 50 mothers recruited through local pediatric offices at 4–6 weeks postpartum [25]. Consistent with previous reports, we found that those who bottle fed their babies scored significantly higher on the Edinburgh Postnatal Depression Scale than those engaged in breastfeeding. The increased risk of depression among mothers who relied on bottle feeding held true even after we controlled for such things as age, education, income, and the mother's relationship with her current partner.

As further support for the idea that bottle feeding activates mechanisms associated with child loss, we discovered that moth-

ers who bottle fed their infants reported wanting to hold their babies significantly more. This parallels findings among nonhuman primates where in response to the death of an infant, mothers of some species have been known to tenaciously hold, cling to, and carry their infants for prolonged periods after they die [26,27].

As noted by Suarez and Gallup [16], the common hospital practice of isolating newborn infants together in a nursery for the first couple of days after birth, and the resulting intermittent separation of the mother from her baby during the initial postpartum period could also serve to simulate child loss and contribute to or prime subsequent postpartum depression.

Conclusion

Bottle feeding practices and hospital procedures that simulate child loss may increase the risk of postpartum depression and fall within a growing number of medical issues that could benefit from an evolutionary perspective.

Conflict of interest statement

None declared.

References

- [1] Trevathan WR. Evolutionary medicine. *Annu Rev Anthropol* 2007;36:139–54.
- [2] Platek SM, Gallup Jr GG, Fryer BD. The fireside hypothesis: was there differential selection to tolerate air pollution during human evolution? *Med Hypotheses* 2002;58:1–5.
- [3] Davis JA, Gallup Jr GG. Preeclampsia and other pregnancy complications as an adaptive response to unfamiliar semen. In: Shackelford P, Platek T, editors. *Female infidelity and paternal uncertainty: evolutionary perspectives on male anti-cuckoldry tactics*. New York: Cambridge University Press; 2006. p. 191–204.
- [4] Burch RL, Gallup Jr GG. Perceptions of paternal resemblance predict family violence. *Evol Hum Behav* 2000;21:429–35.
- [5] Platek SM, Burch RL, Panyavin IS, Wasserman BH, Gallup Jr GG. Reactions to children's faces: resemblance affects males more than females. *Evol Hum Behav* 2002;23:159–66.
- [6] Knodel J. Breast-feeding and population growth. *Science* 1977;198:1111–5.
- [7] Heinig MJ, Dewey KG. Health advantages of breast feeding in infants: a critical review. *Nutr Res Rev* 1996;9:89–110.
- [8] Mezzacappa ES, Kelsey RM, Katkin ES. Breast feeding, bottle feeding, and maternal autonomic responses to stress. *J Psychosom Res* 2005;58:351–65.
- [9] Riordan J. *Breastfeeding and human lactation*. 3rd ed. Sudbury, MA: Jones and Bartlett Publishers; 2005.
- [10] Spencer SA. The physiology of lactation. *Pediatr Child Health* 2007;17:244–8.
- [11] Kent JC. How breastfeeding works. *J Midwifery Women Health* 2007;56:564–70.
- [12] Hurst NM. Recognizing and treating delayed or failed lactogenesis II. *J Midwifery Women Health* 2007;56:588–94.
- [13] Brown RE. Relactation: an overview. *Pediatrics* 1977;60(1):116–20.
- [14] Bowlby J. *The making and breaking of affectional bonds*. London: Tavistock Publications; 1979.
- [15] Vance JC, Najman JM, Thearle MJ, Embelton G, Foster WJ, Boyle FM. Psychological changes in parents eight months after the loss of an infant from stillbirth, neonatal death, or sudden infant death syndrome – a longitudinal study. *Pediatrics* 1995;96:933–8.
- [16] Suarez SD, Gallup Jr GG. Depression as a response to reproductive failure. *J Soc Biol Struct* 1985;8:279–87.
- [17] Hagen EH. The functions of postpartum depression. *Evol Hum Behav* 1999;20:325–59.
- [18] Dennis C, McQueen K. The relationship between infant-feeding outcomes and postpartum depression: a quantitative systematic review. *Pediatrics* 2009;123:736–51.
- [19] Hannah P, Adams D, Lee A, Glover V, Sandler M. Links between early postpartum mood and post-natal depression. *Brit J Psychiat* 1992;160:777–80.
- [20] Hatton DC, Harrison-Hohner J, Coste S, Dorato V, Curet LB, McCarron DA. Symptoms of postpartum depression and breastfeeding. *J Hum Lact* 2005;21:444–54.
- [21] Yonkers KA, Ramin SM, Rush AJ, Navarrete CA, Carmody T, March D, et al. Onset and persistence of postpartum depression in an inner-city maternal health clinic system. *Am J Psychiat* 2001;158:1856–63.
- [22] Sherman C. Breast-feeding may halve the risk of postpartum depression. *OB/GYN News* July 15; 2002.
- [23] Sharma V, Corpse CS. Case study revisiting the association between breastfeeding and postpartum depression. *J Hum Lact* 2008;24:77–9.

- [24] Susman VL, Katz JL. Weaning and depression: another postpartum complication. *Am J Psychiat* 1988;145:498–501.
- [25] Pipitone RN, Leadholm K, Carrone KJ, Gallup Jr GG. Postpartum depression: bottle feeding simulates child loss. Paper presented at the annual meeting of the Northeastern Evolutionary Psychology Society. Oswego, New York; 2009.
- [26] Kaplan J. Responses of mother squirrel monkeys to dead infants. *Primates* 1973;14:89–91.
- [27] Warren Y, Williamson EA. Transport of dead infant mountain gorillas by mothers and unrelated females. *Zoo Biol* 2004;23:375–8.