

Biostatistical investigation of correlation between breastfeeding and obesity

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Abstract. Breastfeeding is a classic aspect of health, which has benefits for both children and mothers in the long and short terms. In Europe, the obesity epidemic for children becomes an urgent problem needed to be solved. Recent research indicates that prolonging breastfeeding time would reduce the proportion of obesity and overweight. Breastfeeding has been seen as a protective factor. In this article, we make a secondary analysis of the data from several European countries in the WHO European Childhood Obesity Surveillance Initiative (COSI) to study the correlation between breastfeeding and obesity. This survey is the fourth round. The result shows that there is a positive correlation between breastfeeding and obesity.

1 Introduction

Obesity is an unhealthy state of life. Excessive accumulation of fat could affect health adversely. Research shows that being overweight is related to heart disease, high blood pressure, diabetes, asthma, and other diseases [1]. Reasons which caused obesity are complicated. Excessive diet, improper lifestyle, and family heredity could be predisposing causes of obesity [2]. The survey shows that the obesity rate has increased significantly in developed and developing countries [3]. The World Health Organization recognized obesity as a global epidemic in 1997. In the United States, 39.6% of adults are affected by obesity [4]. Meanwhile, the proportion of obese children in the United States increased to 16% in 2008 [5].

The most recent National Health and Nutrition Examination Surveys (NHANES) suggest that around 2/3 of the adult population are obese, 32.2% by men and 35.5% by women [6]. The Global Burden of Metabolic Risk Factors of Chronic Diseases Collaborating Group (GBMR Group) collected from 200 countries also indicated that between 1980 and 2008, the mean BMI increased 0.4 per decade globally [6]. The latest information from Canadian Community Health Survey (CCHS) states that 89% of Canadians started breastfeeding directly after childbirth during 2011-2012 compared with 85% in 2003 [7]. However, the biggest reason why 26% of mothers halted breastfeeding exclusively was insufficient breast milk, while 18% of them were already ready for solid food [7].

The composition between breast milk and formula milk is different quantitatively and qualitatively [8]. Breast milk is a better diet for the newborn. It contains more lactose proportionally to fuel the central nervous system and specific fats and cholesterol for building central nervous system tissue [9]. Breast milk contains naturally more balanced omega three and omega six content,

decreasing the risk of infant inflammation compared with that in formula milk [9]. Research showed that omega three and omega six ratio in formula milk generates more inflammation in infants' bodies and the development of obesity-related diseases [9]. Furthermore, breast milk also contains bioactive factors to influence adipocyte [8] and regulate enzymes, hormones, chemokines, growth factors, therefore inhibiting a better role in one's growth. At the same time, it is still a new field among studies [9]. It has to be noted that prolonged exclusive breastfeeding to infants shows higher weight and length growth at three months old followed by slower growth until they reach 12 months old compared with weaned infants [10]. Therefore, the longer the duration of breastfeeding continues, the lower the risk of offspring overweight across all levels of maternal body sizes is [10]. Harder et al. found a strong correlation between these two variables: the longer the duration of breastfeeding exclusively, the 4% lesser reduction in risk of overweight per month of breastfeeding [10].

Studies showed that breastfeeding could prevent 820,000 deaths among children under the age of five [11]. For children, breastfeeding plays a positive role in reducing the risk of diarrheal, food allergy, asthma, type 1 diabetes, and obesity [11]. For mothers, breastfeeding can reduce the risk of postpartum depression [11]. Breastfeeding rates vary widely in different regions. The early breastfeeding rate of Hispanic women was 80.6%, while the early breastfeeding rate of white women in America was 77.7% [12]. For African American women, the early breastfeeding rate reaches 58.1% only [12]. However, only 38% of infants are exclusively breastfed after birth [11]. In this paper, a secondary analysis was made using COSI data to explore the statistical correlation between breastfeeding and obesity.

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2 Method and material

2.1. Data collection

Based on the Childhood Obesity Surveillance Initiative (COSI), regional samples were chosen [13]. There is no unified standard for measuring obesity in the international scope, which makes it challenging to integrate the data. At the WHO European Ministerial Conference on Counteracting Obesity in 2006 in Istanbul, the importance of standardization of obesity measurement was recognized [13]. It is necessary to establish a standardized and unified system to detect obesity. Therefore, the WHO European Office established Childhood Obesity Surveillance Initiative (COSI) in the region [13]. As an independent system, COSI measures the trends of overweight and obesity in children aged 6-9.9 years [13]. It is used to collect, analyze, interpret and disseminate descriptive information to detect overweight [13]. Over the years, more than half of European countries have established COSI systems [13]. Babies born from 22 countries were recruited with parental consent [13, 14]. Infants were weighed at birth. Mothers were interviewed at birth and six months to determine whether they breastfed their child and ascertain the exclusive duration [13, 14]. The countries collect data according to an agreed-upon agreement. The semi-longitudinal design is applied to COSI, which means that in each round of data collection, cross-sectional samples of children in the same age group are selected and repeated at specified time intervals [13, 14]. Three data collection forms are compiled: a mandatory child's record form, a mandatory school record form, and a voluntary family record form [13, 14]. COSI conducted the first round of data collection in 2007-2008, the second round in 2009-2010, and the third round in 2012-2013. The fourth collection was conducted in 2015-2016, with 35 participating countries [13]. Thirteen countries cannot provide voluntary family record forms. Therefore 22 countries participated in this study: Albania (ALB), Bulgaria (BUL), Croatia (CRO), Czechia (CZH), Denmark (DEN), France (FRA), Georgia (GEO), Ireland (IRE), Italy (ITA), Kazakhstan (KAZ), Latvia (LVA), Lithuania (LTU), Malta (MAT), Montenegro (MNE), Poland (POL), Portugal (POR), Romania (ROM), Moscow city (RUS), San Marino (SMR), Spain (SPA), Tajikistan (TJK) and Turkmenistan (TKM) [14].

It should be noted that Russia only conducts data collection in Moscow city [14]. Bulgaria, Czechia, Denmark, Georgia, Ireland, Latvia, Lithuania, Malta, Montenegro, Portugal, the Russian Federation, Tajikistan, and Turkmenistan are only collected from 7-year-old children. Albania, Croatia, Poland, and Romania only collected data from 8-year-old children. Kazakhstan only collected data from 9-year-old children. France collects data for two age groups: 7 and 8 years old, Italy and San Marino collect data on eight and 9-year-old children, Spain collects data on children of all age groups [13, 14]. The mother filled out the data in the family record form and provided complete information on breastfeeding and birth weight [13].

2.2. Research variable

The following variables should be considered to assess the relationship between breastfeeding and childhood obesity.

- Child weight: After obtaining the child's consent, COSI's staff will measure the child's weight according to WHO's standardized technology. The body mass index (BMI) would determine whether the children have obesity and overweight. If the z-score of BMI was between +1 and +2, the sample would be defined as overweight and obese.
- Breastfeeding duration in general: The data was collected by asking the mother questions about breastfeeding time. The duration was divided into two groups: one is never breastfeeding, and less than six months, one is larger than six months.
- Chosen countries: In our research, eight countries, including Ireland, France, Italy, Spain, Moscow City, Kazakhstan, Albania, and Turkmenistan, would be chosen to analyze the differences and similarities specifically.

2.3 Statistical Analysis

The software we use in this study is the JASP (version 0.14.1) and Microsoft Excel 2016. We employ Pearson's χ^2 test, t-test, analysis of variance as statistical measures to exhibit and interpret results. The model we adopted to examine the association between breastfeeding and childhood obesity is the logistic regression model. The logistic regression models were implemented to give a satisfactory record and explanation. Adjusted odds ratios (adjORs) for never breastfed and having been breastfed for longer than 6 months versus less than 6 months were calculated in the duration of general breastfeeding.

3 Result and Discussion

The collected data on the duration of exclusive breastfeeding is incomplete. Thus, we will analyze the duration of any breastfeeding only in this paper. Ireland (IRE), France (FRA), Italy (ITA), and Spain (SPA) could be regarded as developed countries, Kazakhstan (KAZ), Albania (ALB), and Turkmenistan (TKM) were developing countries. At the same time, samples were taken only in Moscow city in Russia (RUS).

Table 1. Birth rate and duration of breastfeeding of the study population, by country, COSI round 4 (2015/2017)

Country	Birth rate %	Duration of any breastfeeding, %	
		never and <6 months	≥6 months
IRE	92.4	77.4	22.6
FRA	86.2	73.6	26.4
ITA	85.4	57.7	42.6
SPA	83.9	56.7	43.3
RUS	93.6	39.8	60.2
KAZ	95.9	11.5	88.5
ALB	96.2	20.3	79.7
TKM	97.7	6.3	93.7
Average	91.4	42.9	57.1

According to Table 1, the average birth rate in 8 countries was 91.4%. Developed countries show a relatively low birth rate than developing countries, such as SPA with 83.9% only. Some countries show an extremely low percentage in terms of duration of any breastfeeding larger than six months, such as IRE (22.6%) and FRA (26.4%). By contrast, TKM, KAZ, and ALB have a particularly high proportion of duration of breastfeeding larger than six months, which were 93.7%, 88.5%, and 79.7%, respectively. Overall, in developed countries, the duration of breastfeeding is relatively short, accompanied by low fertility. The average percent of the duration of breastfeeding less than six months (42.9%) was lower than the duration larger than six months experience. Besides, the function of interaction with customers should be upgraded, and the user's voice chats interaction experience is poor. Last but not least, personalization functions such as tone, response time, and humour adjustment need to be improved.

The risk ratio (RR) is the ratio of the risk of an event in the exposed group compared to the risk of the event in the nonexposed group [15]. The odds ratio (OR) is the ratio of odds of an event in the exposed group compared to the odds of the event in the nonexposed group [15]. By being invariant to the labeling of the outcome measure, the odds ratio could avoid Ambiguity [15]. The RR was used in the cohort study, while OR could be used in the case-control study [15].

The adjusted ORs of being obese were provided in Table 2. The ORs very obviously between different countries. Put children breastfed for larger than six months as a baseline. The children's odds of being obese were high if children were breastfed less than six months (adjOR: 1.02) or never breastfed (adjOR: 1.21). Compared to children who have been breastfeeding longer than 6 months, ALB (adjOR: 2.10) and KAZ (adjOR: 1.78) indicated that children who have never been breastfeeding were related to high odds of obesity. The general duration of breastfeeding longer than six months would be a protective factor compared with a breastfeeding duration shorter than six months in ITA (adjOR: 1.24) and ALB (adjOR: 1.39). Specifically, in ALB, children not breastfed and those breastfed for the shorter time were 2.10 and 1.39 times more possibly to be overweight and obese.

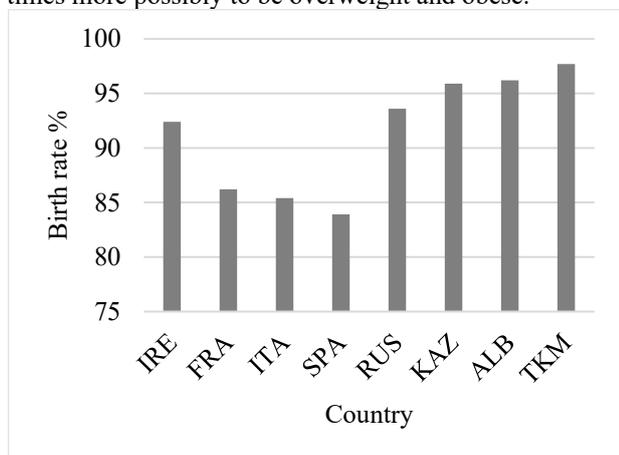


Figure 1. Graph of birth rate for the study population, by country, COSI round 5 (2015/2017)

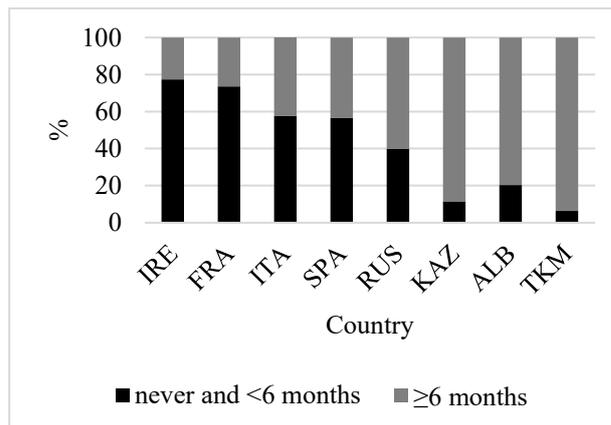


Figure 2. Graph of the duration of breastfeeding for the study population, by country, COSI round 5 (2015/2017)

Table 2. Adjusted ORs (adjORs) of being obese related to breastfeeding duration, by country, COSI round 4 (2015/2017)

Adjusted ORs of being obese			
Country	never breastfed	< 6 months of breastfeeding	average OR
IRE	0.38	0.72	0.55
FRA	0.88	0.99	0.94
ITA	1.02	1.24	1.13
SPA	1.25	1.00	1.13
RUS	-	-	-
KAZ	1.78	0.97	1.38
ALB	2.10	1.39	1.75
TKM	1.07	0.82	0.95
Average	1.21	1.02	1.12

4 Conclusion

The statistical analysis in this work authenticates the salubrious outcome of breastfeeding with respect to the likelihood of growing overweight. If the duration of breastfeeding for a child is less than six months, the probability of being obese for this child increases significantly.

For the limitation, COSI did not take GDP and parental education into consideration. Social and economic differences are important risk factors for obesity and giving up breastfeeding. Children with low socioeconomic status (SES) are more likely to be obese than children with high SES, and their obesity rate is increasing at a faster rate. Women's depression during pregnancy will also affect their feeding behaviour after childbirth. The mother's depression is affected by food insecurity. In Brazil, a study discussed the relationship between environmental, socioeconomic, and nutritional factors and children's overweight and obesity. It has been observed that the possibility of childhood obesity increases with the increase of family income.

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