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Breastfeeding and later maternal risk of hypertension and cardiovascular disease – The role of overall and abdominal obesity

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ABSTRACT

In this study, we examined how any, full, and partial breastfeeding durations were associated with maternal risk of hypertension and cardiovascular disease (CVD), and how prepregnancy body mass index (BMI) and waist circumference 7 years postpartum influenced these associations. A total of 63,260 women with live-born singleton infants in the Danish National Birth Cohort (1996–2002) were included. Interviews during pregnancy and 6 and 18 months postpartum provided information on prepregnancy weight, height, and the duration of full and partial breastfeeding. Waist circumference was self-reported 7 years postpartum. Cox regression models were used to estimate hazard ratios of incident hypertension and CVD, registered in the National Patient Register from either 18 months or 7 years postpartum through 15 years postpartum. Any breastfeeding ≥4 months was associated with 20–30% lower risks of hypertension and CVD compared to < 4 months in both normal/underweight and overweight/obese women. At follow-up starting 7 years postpartum, similar risk reductions were observed after accounting for waist circumference adjusted for BMI. Partial breastfeeding > 2 months compared to ≤2 months, following up to 6 months of full breastfeeding, was associated with 10–25% lower risk of hypertension and CVD. Compared with short breastfeeding duration, additional partial breastfeeding was as important as additional full breastfeeding in reducing risk of hypertension and CVD. Altogether, longer duration of breastfeeding was associated with lower maternal risk of hypertension and CVD irrespective of prepregnancy BMI and abdominal adiposity 7 years after delivery. Both full and partial breastfeeding contributed to an improved cardiovascular health in mothers.

1. Introduction

Cardiovascular disease (CVD) is a leading cause of death in women (Mathers et al., 2008). Multiple factors, including hypertension, are particularly important contributors to CVD (Wei et al., 2017). During pregnancy, metabolic changes such as hyperinsulinemia, insulin resistance, hyperlipidemia, and accumulation of fat mass can occur (Nelson et al., 2010). Breastfeeding may help reverse these changes faster and more completely after delivery than no breastfeeding (Stuebe & Rich-Edwards, 2009). Breastfeeding has been associated with less maternal cardiovascular risk factors (Natland et al., 2012; McClure et al., 2012a; Lee et al., 2005), and lower risk of hypertension (Natland et al., 2012; Stuebe et al., 2011; Chetwynd et al., 2017; Stuebe et al., 2009) and myocardial infarction through midlife (Gunderson et al., 2015). However, these associations may be influenced by maternal overall and abdominal obesity.

In obese women, the metabolic changes during pregnancy are exaggerated (Nelson et al., 2010). Therefore, maternal BMI may be a

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potential modifier of the protective association observed between breastfeeding and maternal cardiovascular health in previous studies (McClure et al., 2012a; Chetwynd et al., 2017; Gunderson et al., 2015; Stuebe, 2015a). Furthermore, abdominal adiposity, independently of BMI, may confound the association between breastfeeding and risk of hypertension and CVD (Emerging Risk Factors Collaboration, 2011). Abdominal adiposity and its accompanying metabolic dysfunctions are strong risk factors for hypertension and CVD, independently of BMI (Tchernof & Despres, 2013; Kirkegaard et al., 2015). In addition, when present before pregnancy, they have been associated with lack of breastfeeding initiation and delayed onset of lactogenesis, which may lead to shorter duration of breastfeeding (Nommsen-Rivers et al., 2012; Matias et al., 2014; Schwarz et al., 2010). Hence, less abdominal adiposity before pregnancy may be a potential confounder and explain some of the improvement in cardiovascular health following breastfeeding.

Previous studies on breastfeeding and cardiovascular health mainly address any breastfeeding duration versus never breastfeeding (Stuebe et al., 2011; Gunderson et al., 2015; Schwarz et al., 2009; Olsen et al., 2001). However, any breastfeeding consists of highly varying lengths of full and partial breastfeeding. Moreover, many women cease full breastfeeding earlier than recommended for various reasons, including return to work, but continue partial breastfeeding. Therefore, it is clinically important to address the influence of both partial and full breastfeeding. One study reports any and full breastfeeding in relation to risk of hypertension (Chetwynd et al., 2017), but neither this nor the other studies cited address whether partial breastfeeding subsequent to full breastfeeding affects cardiovascular health.

The aim of the present study was to examine how duration of any breastfeeding as well as it component parts, namely durations of full and partial breastfeeding, are associated with maternal risk of developing hypertension and CVD through midlife while examining the influence of prepregnancy BMI and waist circumference 7 years after delivery.

2. Methods

2.1. Danish National Birth Cohort

The Danish National Birth Cohort (DNBC) enrolled 91,386 pregnant women (1996–2002) (Bigaard et al., 2003). Recruitment took place all over Denmark at the first antenatal visit to the general practitioner. Four telephone interviews were conducted; Interview 1 and 2 at week 16 (median 16; 5th, 95th percentile (Gunderson et al., 2015; Greenland, 1995)) and week 30 (31; (White & Royston, 2009; Butte & King, 2005)) of gestation, Interviews 3 and 4 at 6 (6; (McClure et al., 2012a; Stuebe et al., 2011)) and 18 (19; (Schwarz et al., 2010; Bigaard et al., 2003)) months postpartum. A food frequency questionnaire was conducted at week 25 (26; [24; 31]) of gestation, which covered intake during the past month. When the child turned 7 years, a questionnaire-based follow-up was conducted (7; (Lee et al., 2005)) with a participation rate of 59%.

2.2. Anthropometry and breastfeeding

Breastfeeding duration was obtained from Interviews 3 and 4 (Specific questions are presented in supplemental material). Duration of any breastfeeding was based on the age of the child, in months and/or weeks, when the mother stopped breastfeeding, and divided into < 4, 4–10 and > 10 months, corresponding to the 25th and 75th percentiles. We divided the duration of any breastfeeding into duration of full and partial breastfeeding. The term “full breastfeeding” was used instead of “exclusive breastfeeding” as we could not distinguish “exclusive” breastfeeding (no other liquids and no solid foods given to the infant) from “predominant” breastfeeding (other liquids, including water, given infrequently). Thus, “full breastfeeding,” includes both exclusive and predominant breastfeeding practices as water was allowed for the reported duration of full breastfeeding. Full breastfeeding duration was reported in months, weeks and/or days and divided by the median into < 4 and 4–6 months. Partial breastfeeding started when food items other than water, vitamins and minerals were given to the infant including formula or solid food. Duration of partial breastfeeding was calculated as duration of any breastfeeding minus duration of full breastfeeding, and divided into < 2, 2–4, > 4 months.

Self-reported information on prepregnancy weight and height was obtained in Interview 1. Prepregnancy BMI was calculated as weight (kg)/height $(m)^2$ and presented as two strata, < 25 and ≥25 kg/m^2. The 7-year follow-up provided information on weight and waist circumference at that point in time (measured by the women using a mailed tape measure at the narrowest point around their belly). Waist circumference was transformed to the deviation in cm from the predicted value derived from the regression of waist circumference on BMI measured at the same time (WC_{BMI}) to adjust for BMI (Schmidt et al., 2015).

2.3. Outcomes

The unique Danish identification number assigned at birth or first recorded immigration to all citizens was used to obtain information from the National Patient Register (NPR), which includes all hospital admissions since 1977 and outpatient contacts since 1995 (Nohr et al., 2005). We assessed incident diagnoses of hypertension (International Classification of Diseases [ICD]-10: I10-I11) using the first diagnosis in the register. We also assessed ischemic heart disease (ICD-10: I20, I21, I24, I25), stroke (ICD-10: I60-I64), and other cardiovascular diseases (ICD-10: I42, I48, I50, I65-I70), either separately or combined as a composite endpoint (named CVD) (Supplemental Table 1 presents a description of all ICD-8 and ICD-10 codes used).

2.4. Covariates

Interview 1 included information on socio-occupational status (low, middle, or high) (Knudsen et al., 2008), leisure-time exercise during pregnancy (no exercise, 1–180 min/week, or > 180 min/week), and alcohol intake before pregnancy (none, 1–7, > 7 units per week). Interview 1 and 3 provided information on smoking status during pregnancy and the first 6 months postpartum and three categories were defined for this period (non-smoking, smoking cessation at any time point during the period, and smoking). The food frequency questionnaire information was used to characterize Western, intermediate, or health-conscious dietary patterns (Greenland, 1995). Information on the women's age at conception, and occurrence of preterm birth, diabetes (gestational diabetes, insulin-dependent diabetes, or no diabetes) and preeclampsia (yes or no) during the index pregnancy was derived from the NPR. The Danish Medical Birth Registry provided information on parity before and after the index pregnancy.

2.5. Study populations

We defined two study populations. Study population 1 was based on the 86,215 women with at least one live-born singleton within the DNBC. Study population 2 was based on the same women but restricted to 50,934 women who participated in the 7-year follow-up (**Fig. 1**).

Study population 1 started follow-up at the time of Interview 4 after the first live-born singleton within the DNBC. It encompassed 63,260 women after the following exclusions: 27 who died and 582 who emigrated before start of follow-up (information obtained from the Central Person Registry), 793 with a history of hypertension, ischemic heart disease, stroke or other cardiovascular disease diagnoses before start of follow-up, 3271 who gave birth again before start of follow-up, 14,620 missing any information on breastfeeding duration, and 3662 missing prepregnancy BMI.