Is being childless associated with a woman's risk of overweight and obesity during young adulthood? Results from a national longitudinal study

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Abstract

Aim: To examine the association between motherhood status (mothers, voluntarily childless, involuntarily childless) and overweight and obesity over 22 years.

Methods: A total of 4,092 women aged 18-23 years were followed from 1996 to 2018. Motherhood status was defined by women's reports on their fertility, attempts to conceive, use of in vitro fertilisation and fertility hormones, and number of biological children. Associations between motherhood status and overweight and obesity were examined using generalized estimating equations models, adjusting for socio-demographic characteristics, lifestyle factors, depressive symptoms, early life factors, and polycystic ovary syndrome (PCOS).

Results: At age 40-45 years, 12% of women were voluntarily childless and 5% were involuntarily childless. The prevalence of overweight and obesity increased with age and women who were voluntarily or involuntarily childless had higher prevalence of obesity than mothers in all surveys. After adjusting for covariates, compared with mothers, women who were voluntarily childless had higher odds of being overweight (odds ratio [OR], 95% confidence interval [CI]: 1.29, 1.09-1.52) and obese (OR, 95% CI: 1.67, 1.30-2.13). Involuntary childlessness was not associated with overweight, and its association with obesity was attenuated after adjusting for PCOS in the final model (OR, 95% CI: 1.39, 0.98-1.96).

Conclusions: Around one in nine Australian women remained voluntarily childless by their late reproductive years. On average, they had higher odds of being overweight and obese than mothers, suggesting that overweight and obesity prevention programs should consider tailoring their advice by motherhood status.

Introduction

Globally, 40% of adult women are overweight or obese[1]. Weight gain in adulthood mainly occurs in early to middle adulthood[2]. In Australia, the prevalence of overweight or obesity is 60% in adult women and rises rapidly from 40% in early adulthood (18–24 years) to 65% in middle adulthood (45–54 years)[3]. Overweight and obesity have been associated with higher risks of diabetes, cardiovascular diseases, breast cancer, endometrial cancer, and mortality in women[4–6].

Motherhood has been seen as a game changer in weight gain trajectories of women of childbearing age[7]. Due to biological, psychosocial, and behavioural changes accompanying motherhood, most mothers retain some weight after childbearing – 1 to 2 kg on average at 1 year postpartum, and even decades later[8]. However, regardless of motherhood status (i.e., being a mother or childless), women gain around 0.3 to 1.2 kg annually in early to middle adulthood [9–11]. When putting the effects of childbearing and ageing together, it remains unclear whether mothers have higher risks of overweight and obesity than women without children in the long run. While some longitudinal studies have found that motherhood was positively associated with long-term weight gain or incident obesity[12–14], others have found that the association varies depending on race, baseline body mass index (BMI), parity (primiparas versus multiparas), marital status (partnered versus non-partnered), or income [9, 15–17], or that there was no association[18, 19].

One of the limitations of previous studies was not differentiating between voluntary childlessness (i.e., the choice to not have children) and involuntary childlessness (i.e., the inability to have children)[20]. The differences between women who are voluntarily childless and women who are involuntarily childless in demographic

characteristics (e.g., race, marital status, education, employment status) and health conditions (e.g., the prevalence of polycystic ovary syndrome [PCOS]) might result in distinct weight trajectories[21–24]. As most countries with a low-fertility rate (e.g., Eastern Asia and Europe) have seen an increase in the prevalence of childlessness during the last several decades[25], it is important to first distinguish between women who are voluntarily childless and women who are involuntarily childless and then to explore whether they are at higher risks of overweight and obesity than mothers. Understanding these associations could inform the development of overweight and obesity prevention programs. Thus, our study aims to examine the associations between motherhood status (mothers, voluntarily childless, or involuntarily childless) and overweight and obesity over a 22-year period.

Methods

Data source and study population

The Australian Longitudinal Study on Women's Health (ALSWH) is an ongoing population-based cohort study that aims to investigate the health and well-being of Australian women born in 1921-26, 1946-51, 1973-78 and 1989-95. Women in the 1921-26, 1946-51, and 1973-78 cohorts were chosen at random from the national health and insurance database (now called Medicare) in 1996. Women in the 1989-95 cohort were recruited in 2013. Details of the study design, recruitment methods, and study population characteristics can be found elsewhere[26, 27]. The study was approved by the Human Research Ethics Committees of the Universities of Queensland and Newcastle. All women signed informed consent.

Our sample was drawn from the 1973-78 cohort. A total of 14,247 women aged 18–23 years responded to the first survey in 1996. Self-administered questionnaires have been sent to the women approximately every 3 years. Our analysis included 4,092 women who completed all surveys, provided relevant information on motherhood status and at least one BMI measurement, and could be classified as mothers, voluntarily childless, or involuntarily childless at Survey 8 (Fig. 1).

Exposure – motherhood status

Women were classified into four categories regarding their motherhood status at Survey 8 when they were 40–45 years old: mothers, voluntarily childless, involuntarily childless, and childless for other reasons. Women who reported that they had children were classified as mothers; women who reported that they had no children, were not currently pregnant, were able to have children, had never tried to conceive (naturally or through in vitro fertilisation), and were not using hormones to treat infertility were classified as voluntarily childless; women who reported that they had no children, were not currently pregnant, and met one of the following criteria were classified as involuntarily childless: unable to have children, having infertility, using in vitro fertilisation, or using hormones to treat infertility. The category of being childless for other reasons included women who were childless, had tried or were trying to get pregnant, but did not report problems with infertility; women who were currently pregnant but had never given birth; and women who were childless and had inconsistent responses. This category was excluded from analysis.

Outcome – overweight and obesity

Self-reported body weight and height were collected in all surveys. BMI was calculated as weight in kilograms divided by height in meters squared and classified as underweight (< 18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25-29.9kg/m^2), or obesity (≥ 30 kg/m^2) [28].

Covariates

Socio-demographic characteristics included age (continuous), area of residence (major cities, inner regional, outer regional/remote)[29], marital status (married/de facto, separated/divorced/widowed, single), education (university degree or higher, trade/certificate/diploma, ≤ 12 years of schooling), and ability to manage on income (easy/not too bad, sometimes difficult, impossible/difficult always). Lifestyle factors included physical activity (measured as MET-mins per week: nil/sedentary 0–39, low 40–599, moderate 600–1199, high ≥ 1200)[30], sitting time (average number of hours spent sitting every day, continuous), smoking status (never, ex-smoker, current smoker), and alcohol consumption (non-drinker, rarely drinker, low-risk drinker, and risky drinker)[31]. Depressive symptoms were assessed by the 10-item Center for Epidemiologic Studies Depression Scale[32], and a total score ≥ 10 denoted depressive symptoms. Early life factors included highest parental education (university degree or higher, trade/certificate/diploma, ≤ 12 years of schooling), childhood abuse experiences (ever experienced psychological/physical/sexual abuse or family dysfunction [exposure to substance abuse, mental illness within the home, criminal behavior, or household intimate partner violence] when aged < 18 years), childhood health status (self-reported: fair/poor, good, very good/excellent), and childhood body weight (self-reported weight when aged 10 years: underweight, average, overweight). We also included the diagnosis/treatment of PCOS, which was associated with both fertility and weight gain[24].

Statistical analyses

Descriptive statistics (mean ± standard deviation or number and percentage) were used to summarize women's characteristics at Survey 8 by motherhood status. Differences among motherhood status groups were examined by analysis of variance or chi-squared tests. Generalized estimating equations (GEE) models with nominal responses (0 = underweight/normal weight, 1 = overweight, 2 = obesity), performed by R package "*multgee*", were used to examine the associations between motherhood status and overweight and obesity. Mothers were chosen as the reference group. The regression analyses were adjusted for socio-economic characteristics (age, area of residence, education, marital status, ability to manage on income), lifestyle factors (physical activity, alcohol consumption, smoking status, and sitting time), depressive symptoms, early life factors (highest parental education, childhood adverse experiences, childhood health status and body weight), and PCOS. GEE analyses were performed in R studio and all other statistical analyses were performed using SAS (Version 9.4). All statistical tests were two-sided, and a *P* value < 0.05 was taken as statistically significant.

Results

Characteristics of the study population at Survey 8

Table 1 presents the distribution of women's characteristics by motherhood status at Survey 8. Women's mean age was 42.4 ± 1.5 years, and the majority of them lived in major cities (57.0%). There were 83%, 12%, and 5% of women who were mothers, voluntarily childless, and involuntarily childless, respectively. More women who were voluntarily childless were single and had higher education compared with women who were involuntarily childless and mothers. Compared with mothers, more women who were voluntarily or involuntarily childless reported it was

easy or not too bad for them to manage on their income. Women who were voluntarily or involuntarily childless had higher BMI, higher physical activity levels, longer sitting time, were more likely to be risky drinkers, and had higher prevalence of depressive symptoms compared with mothers. Compared with women who were voluntarily childless and mothers, women who were involuntarily childless were more likely to be current smokers. Regarding early life factors, women who were voluntarily or involuntarily childless were more likely to have childhood abuse experiences and poorer childhood health status, and to be overweight in childhood. Women who were involuntarily childless had a higher prevalence of PCOS than mothers and women who were voluntarily childless.

Table 1
Characteristics of women who were mothers, voluntarily childless, and involuntarily childless at Survey 8

	All women (N = 4092), N (%)	Mothers (N = 3392), N (%)	Women who were voluntarily childless (N = 488), N (%)	Women who were involuntarily childless (N = 212), N (%)	*P*-value
Age	42.4 ± 1.5	42.5 ± 1.5	42.3 ± 1.5	42.4 ± 1.6	0.140
Area of residence					0.025
Major cities	2279 (57.0)	1859 (56.0)	304 (64.0)	116 (57.1)	
Inner regional	1103 (27.6)	934 (28.1)	112 (23.6)	57 (28.1)	
Outer regional/remote	617 (15.4)	528 (15.9)	59 (12.4)	30 (14.8)	
Marital status					< 0.001
Married/de facto	3210 (80.3)	2883 (87.4)	186 (38.2)	141 (67.1)	
Separated/divorced/widowed	378 (9.5)	330 (10.0)	27 (5.5)	21 (10.0)	
Single	409 (10.2)	87 (2.6)	274 (56.3)	48 (22.9)	
Education					0.042
University degree or higher	2441 (61.1)	1988 (60.3)	328 (67.5)	125 (59.5)	
Trade/certificate/diploma	1049 (26.3)	883 (26.8)	106 (21.8)	60 (28.6)	
≤12 years of schooling	504 (12.6)	427 (13.0)	52 (10.7)	25 (11.9)	
Ability to manage on income					< 0.001
Easy/not too bad	2511 (62.9)	2022 (61.4)	347 (71.4)	142 (67.6)	
Sometimes difficult	982 (24.6)	844 (25.6)	94 (19.3)	44 (21.0)	
Impossible/difficult always	497 (12.5)	428 (13.0)	45 (9.3)	24 (11.4)	
Body mass index (kg/m^2)	27.4 ± 6.5	27.2 ± 6.2	28.7 ± 7.5	28.4 ± 7.7	< 0.001

	All women (N = 4092), N (%)	Mothers (N = 3392), N (%)	Women who were voluntarily childless (N = 488), N (%)	Women who were involuntarily childless (N = 212), N (%)	*P*-value
Physical activity (MET-min/week)					< 0.001
Nil/sedentary (0–39)	460 (12.3)	394 (12.8)	42 (9.2)	24 (11.9)	
Low (40–599)	1170 (31.2)	986 (32.0)	123 (26.9)	61 (30.2)	
Moderate (600–1199)	827 (22.1)	699 (22.7)	88 (19.2)	40 (19.8)	
High (≥ 1200)	1289 (34.4)	1007 (32.6)	205 (44.8)	77 (38.1)	
Sitting time (mean ± SD, h/day)	6.2 ± 2.8	5.9 ± 2.6	7.8 ± 2.9	7.6 ± 3.1	< 0.001
Smoking status					0.002
Never	2668 (66.2)	2191 (65.8)	347 (71.1)	130 (61.6)	
Ex-smoker	1036 (25.7)	884 (26.5)	99 (20.3)	53 (25.1)	
Current smoker	327 (8.1)	257 (7.7)	42 (8.6)	28 (13.3)	
Alcohol consumption					0.033
Non-drinker	404 (10.0)	315 (9.5)	60 (12.3)	29 (13.7)	
Rarely drinker	931 (23.1)	762 (22.9)	123 (25.2)	46 (21.8)	
Low-risk drinker	2451 (60.8)	2062 (61.8)	269 (55.1)	120 (56.9)	
Risky drinker	248 (6.2)	196 (5.9)	36 (7.4)	16 (7.6)	
Depressive symptoms	926 (23.1)	721 (21.8)	141 (29.0)	64 (30.2)	< 0.001
Highest parental education					0.066
University degree or higher	1113 (29.6)	893 (28.7)	156 (34.4)	64 (34.0)	
Trade/certificate/diploma	1230 (32.7)	1041 (33.4)	135 (29.8)	54 (28.7)	

	All women (N = 4092), N (%)	Mothers (N = 3392), N (%)	Women who were voluntarily childless (N = 488), N (%)	Women who were involuntarily childless (N = 212), N (%)	*P*-value
≤12 years of schooling	1415 (37.7)	1183 (38.0)	162 (35.8)	70 (37.2)	
Childhood abuse experiences	1551 (41.1)	1251 (40.2)	206 (44.5)	94 (47.7)	0.033
Childhood health status					< 0.001
Fair/poor	176 (4.4)	118 (3.6)	42 (8.6)	16 (7.6)	
Good	489 (12.2)	370 (11.2)	80 (16.4)	39 (18.5)	
Very good/excellent	3337 (83.4)	2816 (85.2)	365 (75.0)	156 (73.9)	
Childhood body weight					0.011
Underweight	1013 (25.0)	867 (25.8)	98 (20.3)	48 (23.0)	
Average	2141 (52.8)	1778 (52.9)	257 (53.1)	106 (50.7)	
Overweight	899 (22.2)	715 (21.3)	129 (26.7)	55 (26.3)	
Ever been diagnosed with Polycystic ovary syndrome	395 (9.7)	309 (9.1)	40 (8.2)	46 (21.7)	< 0.001

Table 2

The associations between motherhood status and overweight and obesity over 22 years*

	Model 1	Model 2	Model 3	Model 4
Overweight				
Mothers	Ref	Ref	Ref	Ref
Women who were voluntarily childless	1.27 (1.08, 1.49)	1.35 (1.14, 1.58)	1.27 (1.01, 1.50)	1.29 (1.09, 1.52)
Women who were involuntarily childless	1.14 (0.89, 1.45)	1.17 (0.92, 1.49)	1.12 (0.88, 1.43)	1.06 (0.84, 1.36)
Obesity				
Mothers	Ref	Ref	Ref	Ref
Women who were voluntarily childless	1.56 (1.23, 1.96)	1.78 (1.41, 2.24)	1.62 (1.27, 2.07)	1.67 (1.30, 2.13)
Women who were involuntarily childless	1.68 (1.18, 2.38)	1.72 (1.21, 2.45)	1.57 (1.11, 2.23)	1.39 (0.98, 1.96)

* Generalized estimating equations models with nominal responses (0 = underweight/normal weight, 1 = overweight, 2 = obesity).

Model 1 was adjusted for survey and age.

Model 2 was further adjusted for area of residence, education, marital status, ability to manage on income, physical activity, alcohol consumption, smoking status, sitting time, and depressive symptoms.

Model 3 was further adjusted for highest parental education, childhood adverse experiences, childhood health status, and childhood body weight.

Model 4 was further adjusted for polycystic ovary syndrome.

Prevalence of overweight and obesity by motherhood status from Survey 1 (1996) to Survey 8 (2018)

Figure 2 presents the prevalence of overweight and obesity by motherhood status over 22 years. From Survey 1 to Survey 8, the prevalence of overweight changed from 14.8–29.6% among mothers, from 16.7–27.0% among women who were voluntarily childless, and from 14.8–31.4% among women who were involuntarily childless. The prevalence of obesity changed from 4.8–26.5% among mothers, from 8.7–34.8% among women who were voluntarily childless, and from 11.1–30.5% among women who were involuntarily childless. Compared with mothers, women who were voluntarily and involuntarily childless had similar prevalence of overweight across surveys, while they had higher prevalence of obesity in all surveys.

The association between motherhood status and overweight and obesity

After adjusting for socio-demographic factors, lifestyle factors, depressive symptoms and early life factors, compared with mothers, women who were voluntarily childless had higher odds of being overweight (odds ratio [OR], 95% confidence interval [CI]: 1.27, 1.01–1.50) and obese (OR, 95% CI: 1.62, 1.27–2.07), and women who were

involuntarily childless had higher odds of being obese (OR, 95% CI: 1.57, 1.11–2.23). The association between voluntary childlessness and overweight and obesity remained similar after further adjusting for PCOS (OR for overweight, 95% CI: 1.29, 1.09–1.52; OR for obesity, 95% CI: 1.67, 1.30–2.13), while the association between involuntary childlessness and obesity was attenuated (OR, 95% CI: 1.39, 0.98–1.96).

Discussion

To the best of our knowledge, this study was the first to examine the associations between motherhood status and overweight and obesity, while differentiating between voluntary and involuntary childlessness. Using data from a large longitudinal study, we found that the prevalence of voluntary childlessness and involuntary childlessness was 12% and 5% in women in their late reproductive years (40–45 years), respectively. After adjusting for socio-demographic factors, lifestyle factors, depressive symptoms, early life factors, and PCOS, compared with mothers, women who were voluntarily childless had higher odds of being overweight and obese. Involuntary childlessness was not associated with overweight, and its association with obesity was attenuated after adjusting for PCOS in the final model.

While some studies have found motherhood status was not associated with overweight and obesity[18, 19], others have found that mothers gained more weight compared to non-mothers[9, 12–15]. Defining parenthood as a binary variable of whether having biological or non-biological children, researchers from the Americans' Changing Lives Survey found parents gained on average two units of BMI more than non-parents through adulthood[12], and researchers from the Coronary Artery Risk Development in Young Adults study (CARDIA) found the average difference in BMI-change in mothers and non-mothers is 0.65 kg/m^2 among Blacks and 1.12 kg/m^2 among Whites over a 7-year period[13]. Results from studies examining the association between parity (i.e., number of biological children) and weight gain were inconsistent. Gunderson et al. [15] using CARDIA data found that women who had one child over a 10-year period gained 1–6 kg more than nulliparous women who had no pregnancies, but the effect diminished for higher parity. Brown et al.[9] and Rosenberg et al.[14] also found that the effect of having the first child on weight gain was stronger than higher parity. Brown and colleagues[16] using a nationally representative sample of Americans found the OR for overweight/obesity associated with each additional child was 1.15 (95% CI: 1.01, 1.31), while number of children was not associated with BMI gain. The inconsistency between previous studies and our results has several explanations. First, none of these studies separated voluntary childlessness from involuntary childlessness. In our study, we found that the body weight trajectories of women who were voluntarily childless and women who were involuntarily childless were not identical, suggesting that combining these two groups might dilute the results. Second, some studies defined motherhood as having either biological children or non-biological children [12, 13]. Since having biological children or adopted children might have distinct health, social, and economic impacts on parents[33, 34], the inclusion of adopted children might contribute to the inconsistency. Furthermore, the differences in women's characteristics (race, age), year of data collection, and duration of follow-up may all play a role. When differentiating between voluntary childlessness and involuntary childlessness, our study provided a novel insight that women who were voluntarily childless were more likely to be overweight and obese than mothers in their reproductive years.

Our analysis could not determine why women who were voluntarily childless had higher odds of being overweight and obese than mothers, but previous literature and the descriptive results in our study could provide some possible explanations. First, in our study, women who were voluntarily childless spent on average two hours longer

in sitting every day than mothers. A large European study has shown an independent association between sitting time and BMI[35]; and studies using ALSWH data found that sitting time was associated with weight gain in both young and middle-aged women[36, 37]. Second, depressive symptoms, which has been linked to weight gain and obesity[38], were more commonly reported by women who were voluntarily childless than mothers (29.0% versus 21.8% at Survey 8). Third, women who were voluntarily childless were more likely to report experiences of childhood abuse, poorer health status and higher weight in childhood, which are risk factors for overweight and obesity in adulthood[39–41]. However, after adjusting for these factors in the models, women who were voluntarily childless still showed higher odds of being overweight and obese. Thus, more research is needed to interrogate the mechanisms linking voluntary childlessness with overweight and obesity.

Our results have implications for health promotion policies. While mothers are often the focus of overweight and obesity prevention programs – from preconception to pregnancy and postpartum[42, 43], women who are voluntarily childless are overlooked in many weight control strategies. For example, Australia's National Obesity Strategy 2022–2032[44] suggests that support for healthy eating, sleeping and physical activity should be embedded into standard maternal health service practice (i.e., before, during and after pregnancy). However, women who are voluntarily childless would not use maternal health services, suggesting that they might have fewer opportunities to access knowledge and resources regarding weight control. Given the considerable prevalence of voluntary childlessness – 12% among women in their late reproductive years in our study, women who are voluntarily childless should be informed of their higher risk of overweight and obesity when interacting with general practitioners. Furthermore, overweight and obesity prevention programs need to pay more attention to women who are voluntarily childless in their designs to help them maintain a healthy weight in young adulthood, which may lower their risks of developing chronic diseases in later life.

Several limitations of the current study merit consideration. First, heights and weights were self-reported, which might introduce potential bias. However, in a comparison of self-reported and measured heights and weights among 498 women who completed Survey 8 and clinical assessments, we found a substantial agreement between BMI categories derived from self-reported and measured data (percent agreement = 79%, weighted kappa = 0.76, data not shown). In addition, although women who were overweight or obese were more likely to underreport their weight, this bias applied similarly to women in different motherhood status. Second, we used behaviours (e.g., trying to get pregnant or not) instead of fertility intention to define motherhood status. Although a previous study found a strong link between fertility intention and behaviour[45], it is possible that women defined as voluntarily childless in their 40s may give birth in their late reproductive years. The chance of this happening was very low given that only 3% of nulligravid women fall pregnant in a monthly cycle after the age 40 [46], hence it is unlikely that our results would be subject to misclassification bias. Third, we could not determine if being voluntarily childless causes overweight and obesity, or women who are overweight or obese tend to choose not to have children, or this association could be explained by unmeasured confounders.

In conclusion, our study found that the prevalence of voluntary childlessness was considerable – one in nine among women in their late reproductive years in Australia, and women who were voluntarily childless were more likely to be overweight and obese in their reproductive years than mothers, suggesting overweight and obesity prevention programs should pay more attention to women who were voluntarily childless.

Declarations

Competing Interest: The authors have no relevant financial or non-financial interests to disclose.

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Ethics approval: The study was approved by the Human Research Ethics Committees of the Universities of Queensland and Newcastle.

Consent to participate: Informed consent was obtained from all individual participants included in the study.

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Author contribution: CYJ and GDM contributed to all aspects of the study design. CYJ conducted the data analysis and drafted the manuscript with input from LRT and XLX. All authors were involved in interpreting the data and critically reviewing the manuscript drafts. All authors approved the final version of the manuscript.

Data availability statement: ALSWH survey data are owned by the Australian Government Department of Health and due to the personal nature of the data collected, release by ALSWH is subject to strict contractual and ethical restrictions. Ethical review of ALSWH is by the Human Research Ethics Committees at The University of Queensland and The University of Newcastle. De-identified data are available to collaborating researchers where a formal request to make use of the material has been approved by the ALSWH Data Access Committee. The committee is receptive of requests for datasets required to replicate results. Information on applying for ALSWH data is available from https://alswh.org.au/for-data-users/applying-for-data/.

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Figures

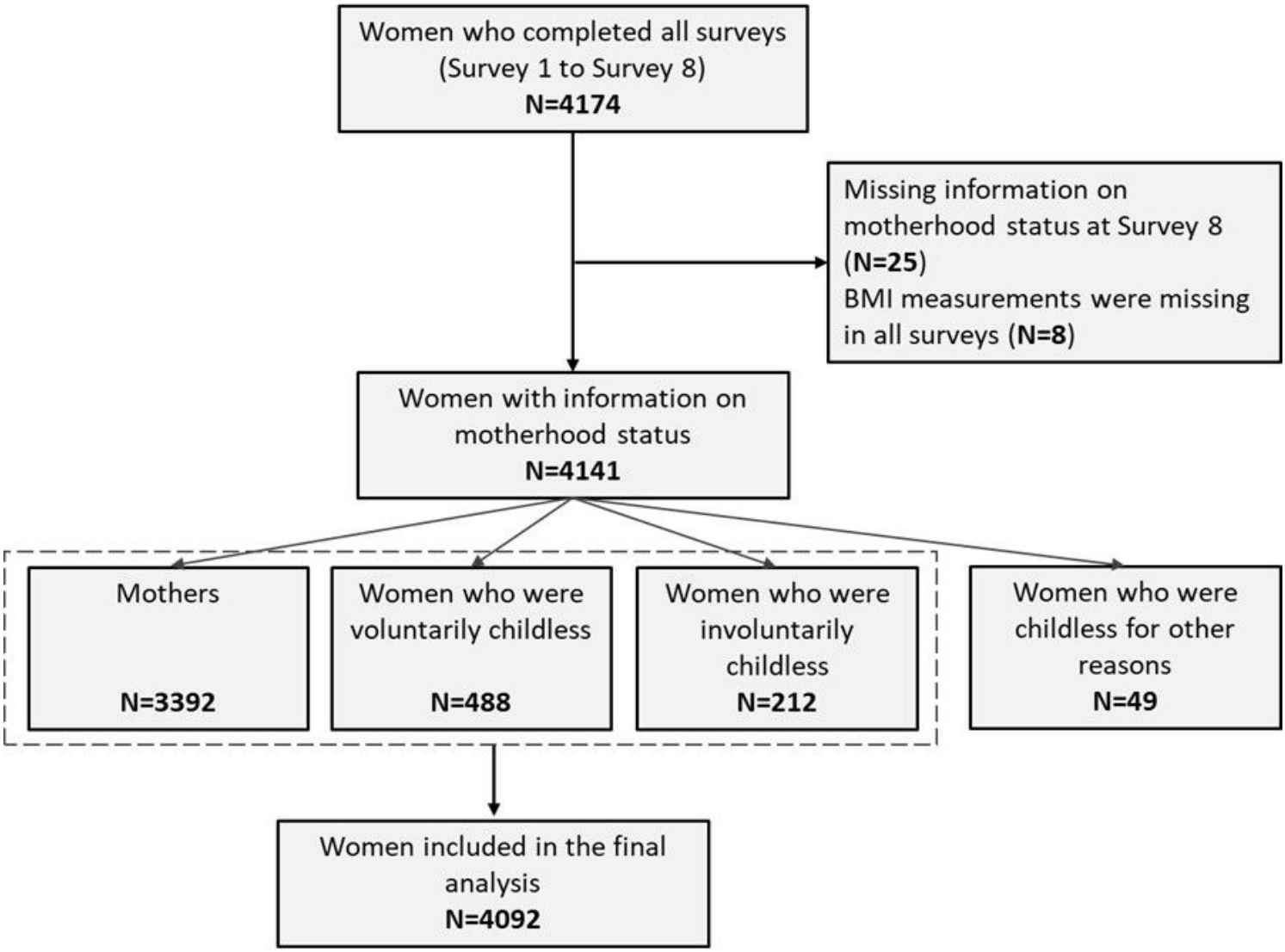

Figure 1

Flow chart of the selection of the study population

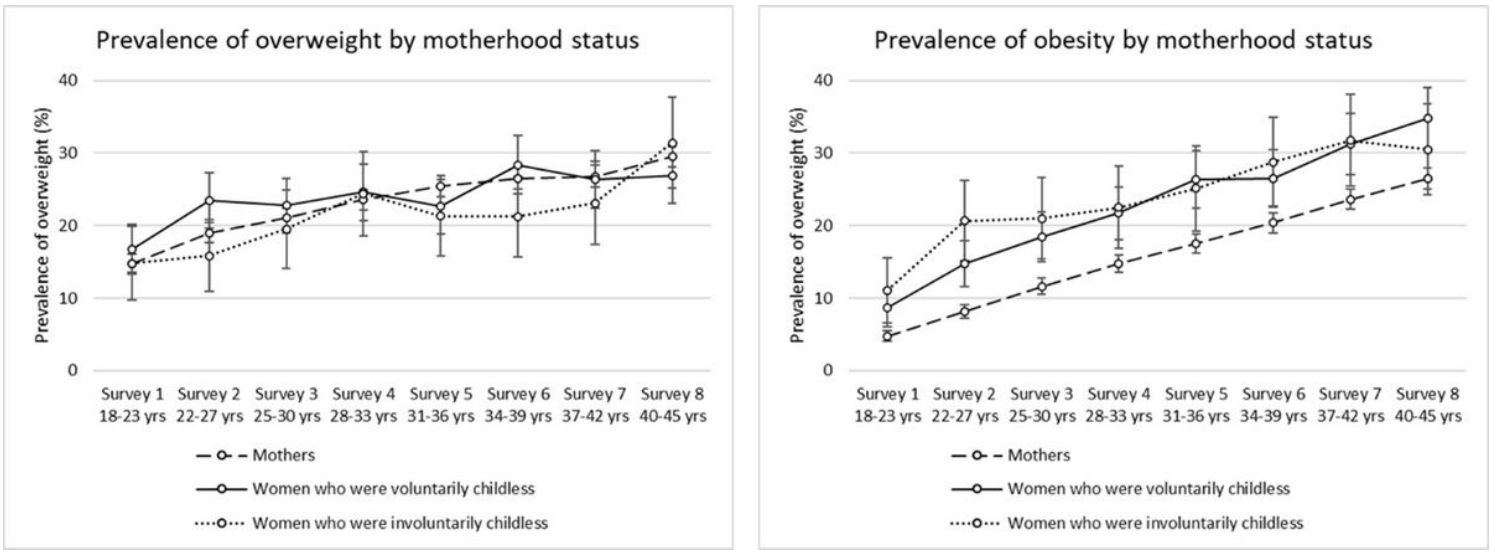

Figure 2

Prevalence of overweight and obesity by motherhood status from Survey 1 (1996) to Survey 8 (2018), N=4092