# Prevalence of Pre-Pregnancy Diabetes, Obesity, and Hypertension in Canada

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## Abstract

**Objective:** Pre-existing diabetes mellitus (D), obesity (O), and chronic hypertension (H) can each alter the natural course of pregnancy, especially when they cluster together. Because the prevalence of various combinations of D, O, and H is unknown, the current study was undertaken.

**Methods:** This population-based cross-sectional study included 506 483 singleton and twin live birth and stillbirth deliveries in Ontario, occurring at ≥20 weeks gestation. All hospital births from 2012 to 2016 were identified in the Better Outcomes Registry and Network information system. The prevalence per 1000 births (95% confidence interval [CI]) of D, O, and H and their combinations were calculated. Prevalence estimates were stratified by twin and singleton gestations, maternal age, parity, and ethnicity (Canadian Task Force Classification II-2).

**Results:** During the study period, 5493 women (10.8 per 1000 births; CI 10.6–11.1) had D, 90,177 (178.2; 95% CI 177.0–179.3) had O, and 5667 (11.2; 95% CI 10.9–11.5) had H. The prevalence per 1000 of DO was 4.8, DH 1.0, and OH 5.5, whereas 359 women (0.71 per 1000) had all three combined. D and H each linearly increased with rising maternal age, along with their combinations, and to some degree with higher parity. The combination of O and H was highest among women of Black ancestry (14.5 per 1000) and lowest among those of Asian ancestry (3.0 per 1000).

**Conclusion:** D, O, and H are common conditions in pregnancy, both alone and in various combinations. These data can be used to assess the impact of each state on perinatal health.

**Key Words:** Diabetes mellitus, chronic hypertension, obesity, pre-pregnancy, pregnancy, prevalence, risk

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## Résumé

**Objectif :** Lorsqu'ils sont présents avant la grossesse, le diabète (D), l'obésité (O) et l'hypertension chronique (H) peuvent en modifier la progression naturelle, surtout s'ils sont présents simultanément. La présente étude a été entreprise pour déterminer la prévalence des diverses combinaisons de D, O et H, actuellement inconnue.

**Méthodologie :** Cette étude transversale fondée sur la population portait sur 506 483 accouchements s'étant soldés par une naissance vivante ou une mortinaissance d'un seul bébé ou de jumeaux en Ontario, survenus après au moins 20 semaines de gestation. Des données sur toutes les naissances survenues en hôpital de 2012 à 2016 ont été extraites du Registre et réseau des bons résultats dès la naissance. Les prévalences pour 1 000 accouchements (intervalle de confiance [IC] à 95 %) de D, O et H et de leurs combinaisons ont été calculées. Les estimations de la prévalence ont été stratifiées selon le type de grossesse (monofœtale ou gémellaire), l'âge de la mère, la parité et l'origine ethnique (classification II-2 du Groupe d'étude canadien).

**Résultats :** Durant la période à l'étude, nous avons recensé 5 493 femmes enceintes atteintes de diabète (10,8 pour 1 000

accouchements; IC à 95 % : 10,6–11,1), 90 177, d'obésité (178,2; IC à 95 % : 177,0–179,3), et 5 667, d'hypertension chronique (11,2; IC à 95 % : 10,9–11,5). La prévalence pour 1 000 accouchements était de 4,8 pour la combinaison DO, de 1,0 pour DH et de 5,5 pour OH; 359 femmes présentaient les trois affections simultanément (0,71 pour 1 000 accouchements). La prévalence du diabète et de l'hypertension chronique, seuls ou en combinaison, augmentait de façon linéaire avec l'âge maternel, ainsi qu'avec la parité (dans une certaine mesure). La prévalence de la combinaison OH était à son maximum chez les femmes d'ascendance noire (14,5 pour 1000) et à son minimum chez celles d'ascendance asiatique (3,0 pour 1000).

**Conclusion :** Le diabète, l'obésité et l'hypertension chronique sont des affections communément observées chez les femmes enceintes, seules ou en combinaison. Les données recueillies ici pourront servir à déterminer l'incidence de chacune sur la santé périnatale.



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## INTRODUCTION

Pre-pregnancy diabetes mellitus (D), obesity (O), and hypertension (H) have a negative effect on maternal and perinatal health globally. D, O, or H can alter the natural course of pregnancy because each of these conditions has been shown to causally heighten the risk of preeclampsia, Caesarean delivery, preterm birth, perinatal mortality, and congenital malformations.[1–6] In high-income countries, pre-existing D occurs in seven to 15 per 1000 pregnancies, with respective rates of 180 to 320 per 1000 for O and 13 to 15 per 1000 for H.[3,7–12] However, recent changes in characteristics of pregnant women, including advancing maternal age, a high proportion of births among immigrants, and the rising epidemic of D and O, suggest that the impact of D, O, and H, and their combinations has yet to be realized.

Prior investigators explored the prevalence of D, O, and H in pregnant populations, but with limitations on their generalizability. First, most studies examined these factors alone, not in combination. Second, prior population samples differed from the Canadian population with respect to ethnic composition, socioeconomic status, and access to universal health care. Although D, O, and H are considered to be "modifiable" non-communicable risk factors in pregnancy, the impact of interventions on each is inconsistent.[13] An intervention aimed at women with a combination of D, O, or H might be expected to lower their risk of adverse maternal and perinatal outcomes most efficiently; however, a firm grasp of the prevalence of these conditions is a necessary starting point.

The current study reports the population prevalence of D, O, and H – exclusively and in their varying combinations – including prevalence by maternal age, parity, ethnicity, and twin pregnancies.

## METHODS

### Study Design, Setting, and Population Sample

This cross-sectional study was completed across Ontario, Canada's most populous province, comprising approximately 14 million people.[14] All permanent residents receive universal health coverage under the Ontario Health Insurance Plan (OHIP).

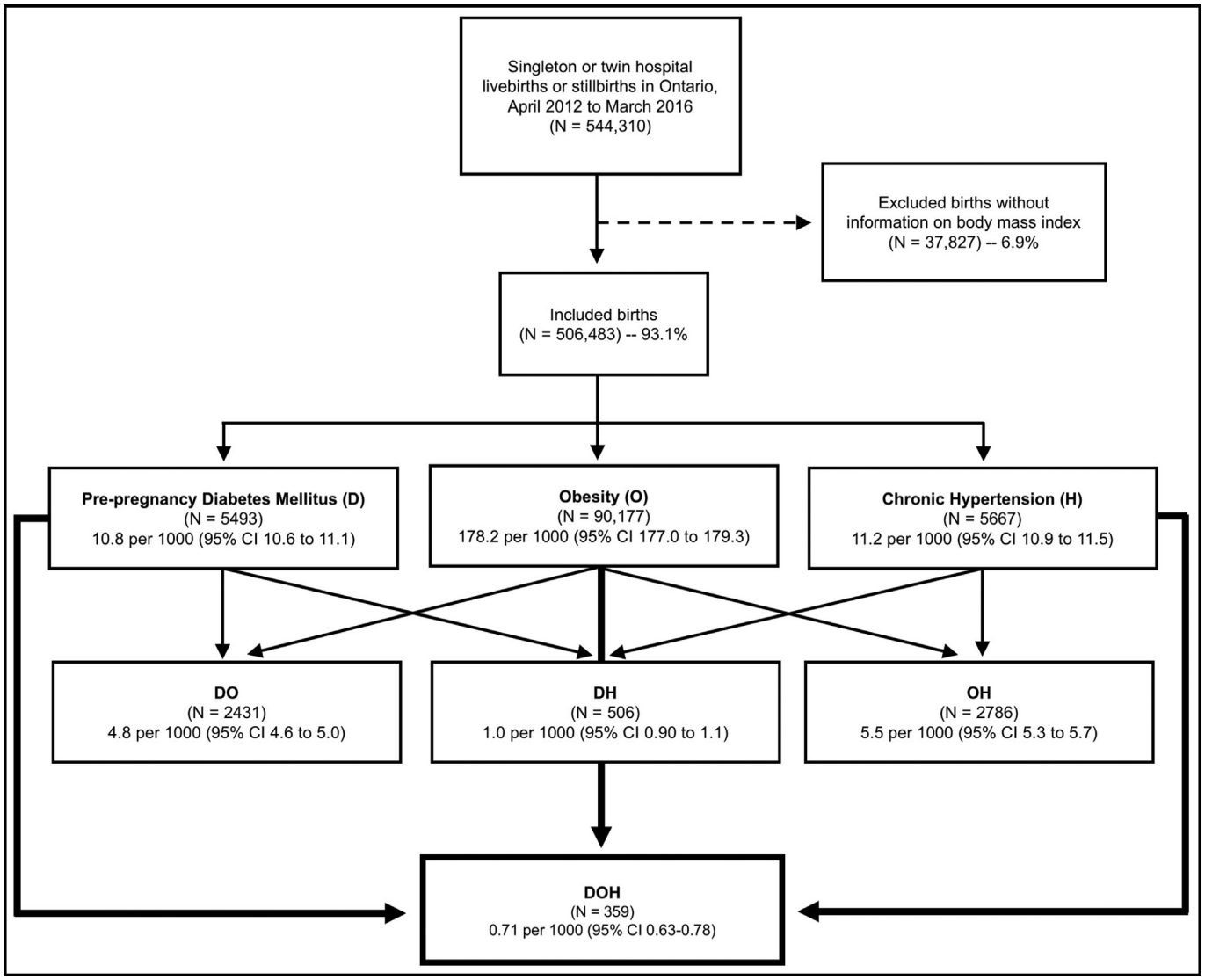
Included were women with a singleton or twin hospital live birth or stillbirth between April 1, 2012, and March 31, 2016. Since 2012, every birth has been captured by the province-wide Better Outcomes Registry & Network information system (BIS) (see https://www.bornontario.ca/en/about-born/ ). The BIS contains comprehensive information about "maternal demographics, health behaviors, reproductive history, and clinical information related to pregnancy, labour and birth, and neonatal outcomes."[15] Pregnancies ending in miscarriage, induced abortion, or at less than 20 weeks gestation are not routinely collected in the BIS.

### Definitions

To maximize the probability of identifying any women with D or H, diagnostic fields within the BIS (April 1, 2012, to March 31, 2016) were linked to the hospitalization Discharge Abstract Database (DAD) of the Canadian Institute for Health Information (April 1, 2012, to March 31, 2015). This BIS-DAD linkage contains a set of validated diagnostic codes from the International Statistical Classification of Diseases and Related Health Problems, 10th revision, Canadian version (ICD-10-CA). D was defined as the presence of a diagnosis of pre-pregnancy diabetes mellitus in the BIS or a relevant BIS-DAD ICD-10-CA code of E10, E11, E13, E14, or O24.5-O24.7. H was defined as the presence of a diagnosis of chronic hypertension in the BIS or a relevant BIS-DAD ICD-10-CA code of I10, I15, O10, or O11. Of note, the BIS-DAD linkage was not available for the final year of the study (2015-2016).

A diagnosis of O was solely identified in the BIS, defined as a self-reported pre-pregnancy body mass index (BMI) $\geq$30 kg/m$^2$. The level of missingness for BMI in the BIS for pre-pregnancy BMI is 19%; however, to overcome this limitation, two steps were taken. First, we identified pregnancies that could be linked to the Prenatal Screening

**Figure 1. Selection of study group.**

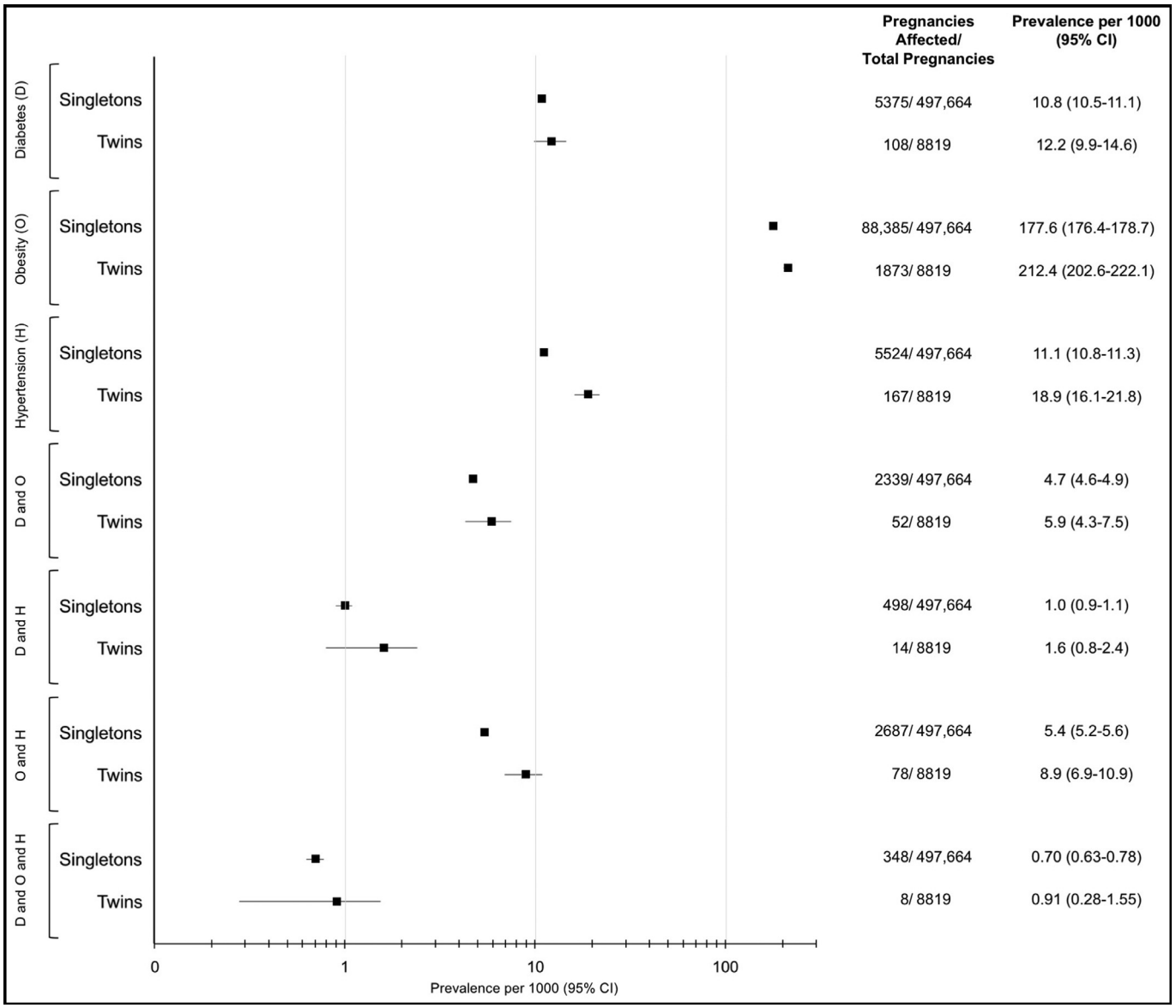



D: diabetes mellitus; H: chronic hypertension; O: obesity.

Ontario (PSO) database to ascertain first trimester weight. The PSO database contains data for approximately 70% of pregnancies in Ontario.[16] Only women with maternal height and missing pre-pregnancy weight were linked to the PSO database. Of those women who were successfully linked and had first trimester weight available, 2 kg was subtracted from first trimester weight, which is equivalent to that expected up to that point, to estimate pre-pregnancy weight, and subsequently BMI was calculated.[17] This approach reduced the level of missingness on BMI to 15%. Multiple imputation was performed as the second step, after the missing at random assumption was plausibly met, by analyzing the frequency, pattern, and reason for missing pre-pregnancy BMI. Multiple imputation was done using a chained equation approach, using a subset of women with available pre-pregnancy weight. Pre-pregnancy BMI was imputed by including only pre-pregnancy weight in the imputation model. We created 15 imputed data sets, which were then combined across all data sets by using Rubin's rule to obtain final prevalence estimates.[18] Following imputation, the level of missing was reduced to 7%, resulting in a final denominator of 506 483 pregnancies (Figure 1).

Maternal ethnicity was identified using the PSO database (Caucasian, Asian, Black, Other, Unknown) and has a high level of missingness (34%). No method of imputation was applied for this variable. As per privacy and reporting regulations, data on Indigenous persons were reported under "Other," which also included women of Hispanic and

**Figure 2. Prevalence of pre-pregnancy diabetes mellitus, obesity, and chronic hypertension in singletons and twins.**




CI: confidence interval; D: diabetes mellitus; H: chronic hypertension; O: obesity.

other ancestry. Data on parity, maternal age, and multiple gestation were obtained from the BIS.

## Data Analysis

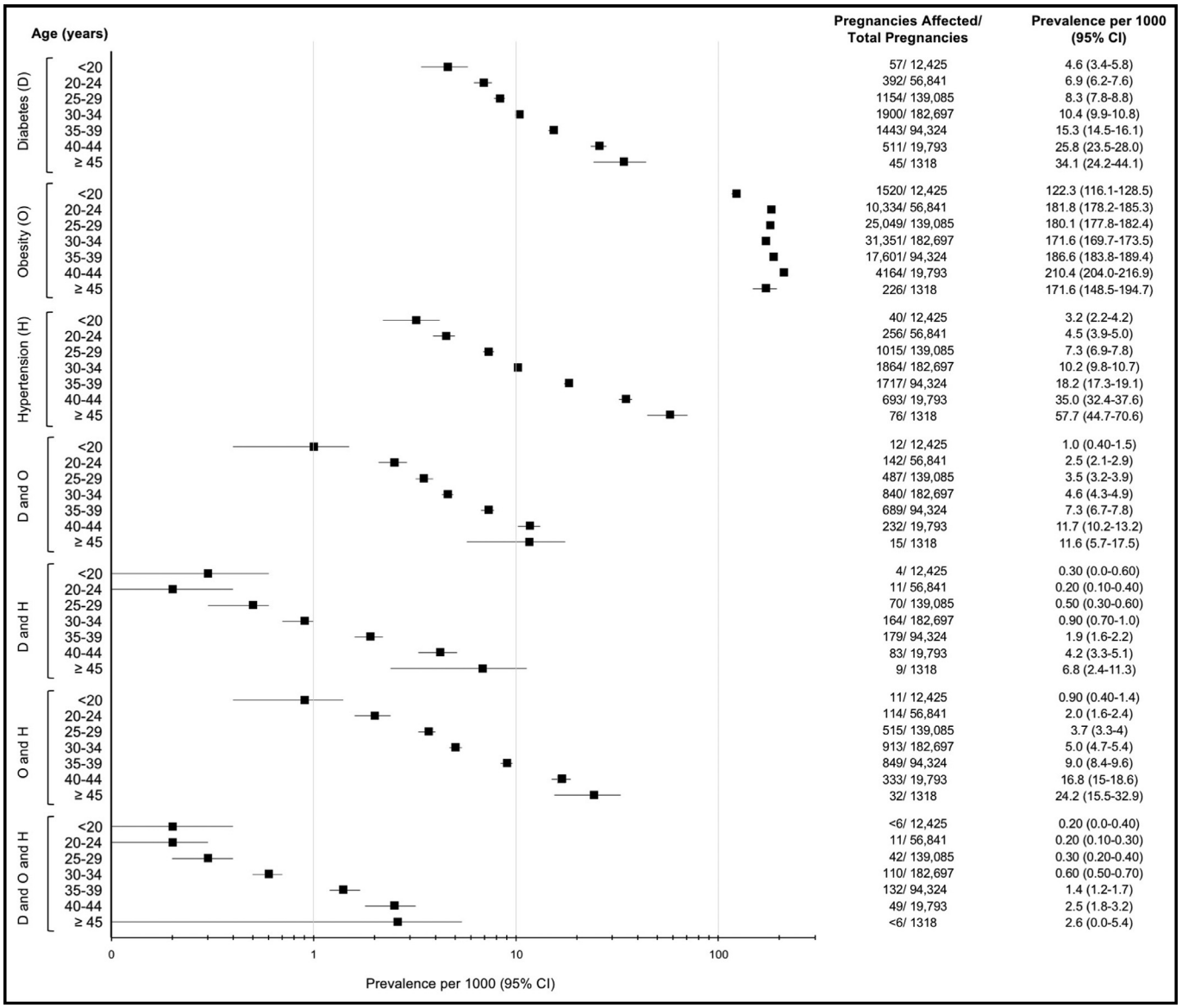
The non-exclusive prevalence of D, O, and H, and their combinations (DO alone, DH alone, OH alone, and DOH) was reported per 1000 pregnancies, along with exact 95% confidence intervals (CIs).[19]

Prevalence estimates for D, O, and H, and their combinations, were stratified by singleton versus twin pregnancies, maternal age (<20, 20 to 24, 25 to 29, 30 to 34, 35 to 39, 40 to 44, and ≥45 years), parity (0, 1, ≥2), and ethnicity (Caucasian, Asian, Black, Other, Unknown). When indicated, prevalence was compared between subgroups using a chi-square test.

Among Asians, it is argued that pathological O, as a percentage of body fat, is better set at a BMI ≥27.5 kg/m$^2$.[20] Accordingly, in an additional analysis stratifying by ethnicity, the prevalence of O and its combinations with D and H was re-calculated using this BMI cut point for Asians.

All analyses were conducted using Statistical Analysis Software (SAS) software version 9.4 (SAS Institute, Cary, NC). Forest plots were created in Microsoft Excel version 15 (Microsoft Corp., Redmond, WA) and plotted on a $\log_{10}$

**Figure 3. Prevalence of pre-pregnancy diabetes mellitus, obesity, and chronic hypertension by age group.**




CI: confidence interval; D: diabetes mellitus; H: chronic hypertension; O: obesity.

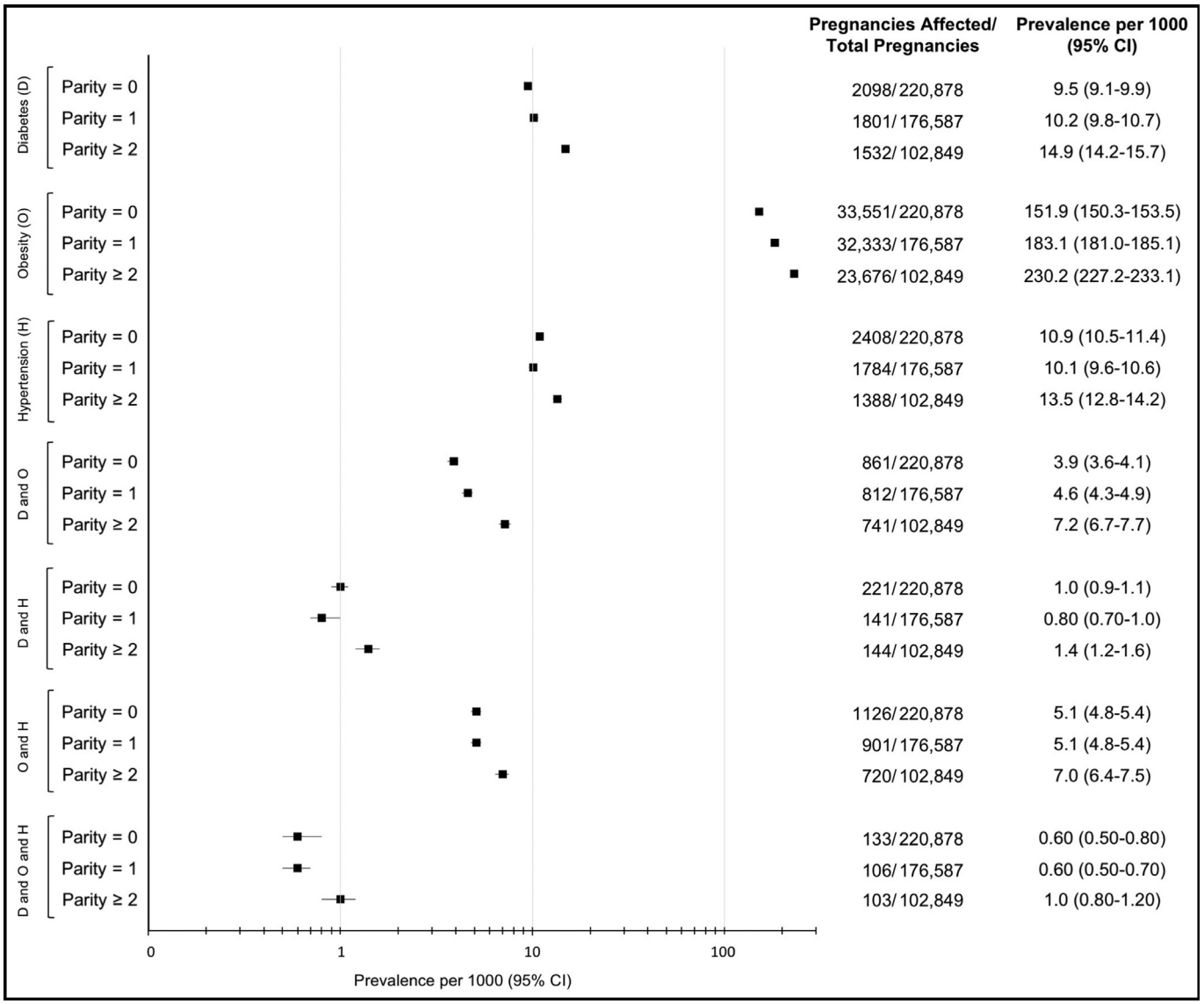
scale. Statistical significance, when indicated, was set at a *P* value <0.05. Permission to complete the study was granted by the Research Ethics Board of St. Michael's Hospital in Toronto (REB #16-345).

## RESULTS

Of 544 310 births in an Ontario hospital, 506 483 births met the inclusion criteria (Figure 1). During the study period 5493 women (10.8 per 1000 births; 95% CI 10.6−11.1) had D, 90 177 (178.2 per 1000 births; 95% CI 177.0−179.3) had O, and 5667 (11.2 per 1000 births; 95% CI 10.9−11.5) had H (Figure 1). The prevalence of DO was 4.8 per 1000 births (95% CI 4.6−5.0), the prevalence of DH was 1.0 per 1000 births (95% CI 0.90−1.1), and that of OH was 5.5 per 1000 births (95% CI 5.3−5.7), whereas 359 women (0.71 per 1000 births; 95% CI 0.63−0.73) had all three conditions combined. The characteristics of study participants, by D, O, and H, and their combinations, are shown in Online supplementary Table 1.

Generally, O (212.4 vs. 177.6 per 1000) and H (18.9 vs. 11.1 per 1000) were significantly more prevalent among twin than singleton pregnancies (Figure 2). The respective

**Figure 4. Prevalence of pre-pregnancy diabetes mellitus, obesity, and chronic hypertension by parity.**



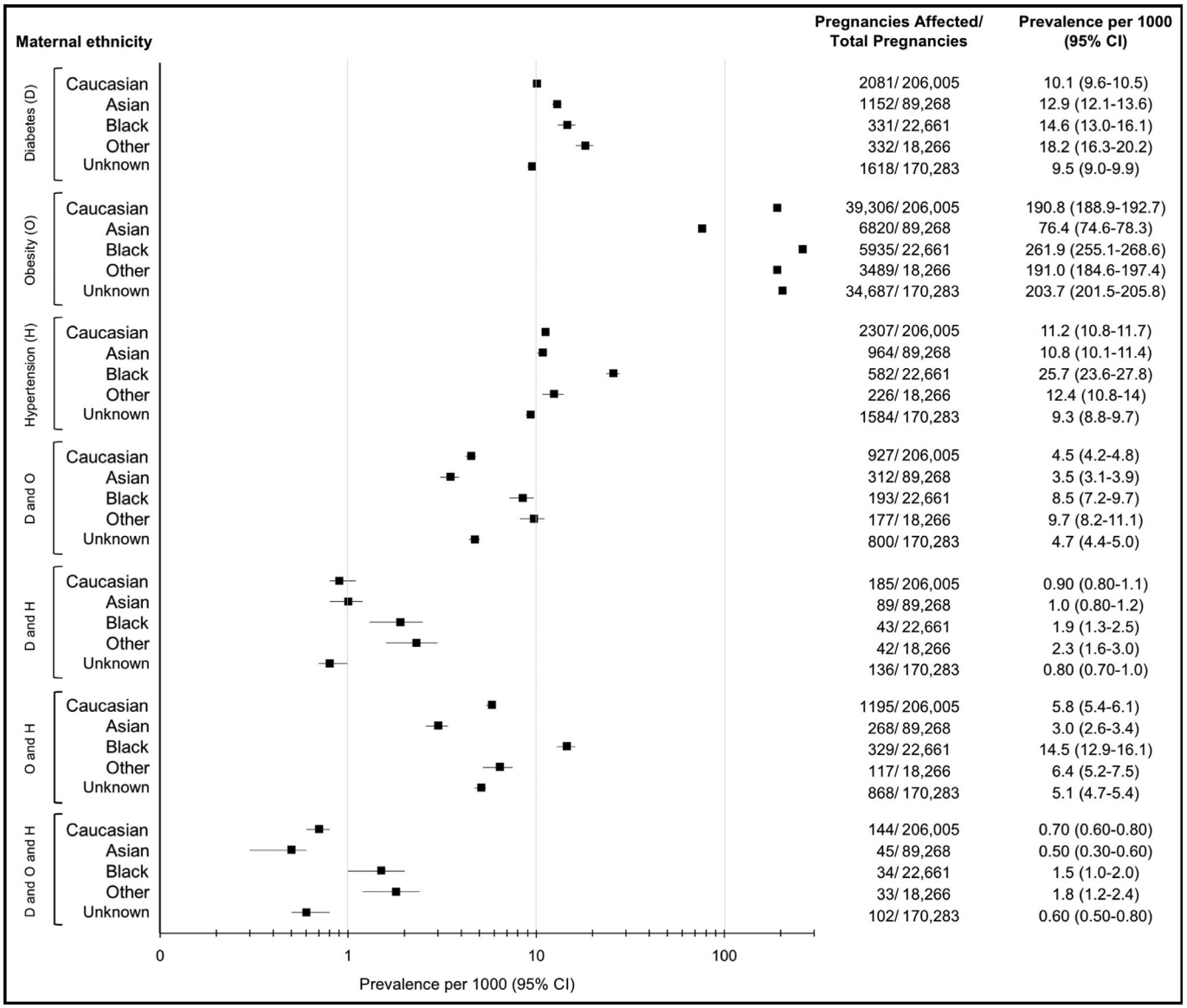

CI: confidence interval; D: diabetes mellitus; H: chronic hypertension; O: obesity.

rates for OH were also significantly higher among twin than singleton pregnancies (8.9 vs. 5.4 per 1000).

As maternal age increased, the prevalence of D, O, and H and their combinations significantly increased (Figure 3). The one exception was for O, which was generally the same for all age groups ≥20 years and peaked at the age category of 40 to 44 years (210.4 per 1000) (Figure 3). Women with a parity of two or greater had a significantly higher prevalence of D, O, and H and their combinations compared with women with a parity under two (Figure 4).

Ethnicity was unknown for about 34% of the study sample. Nonetheless, the prevalence of D, O, and H varied across the broad ethnic categories (Figure 5). Women of Black ethnicity had significantly higher rates of O (261.9 per 1000) and H (25.7 per 1000); their prevalence of OH (14.5 per 1000; 95% CI 12.9−16.1) was nearly five times higher than that among Asians (3.0 per 1000; 95% CI 2.6 −3.4) (Figure 5). Although Asian women had the lowest prevalence of O, they had a significantly higher prevalence of D (12.9 per 1000) (Figure 5). In the additional analysis, after lowering the BMI cut point from ≥30 to ≥ 27.5 kg/ $m^2$, the prevalence of O among Asians changed from 76.4 to 149.6 per 1000 (Online Table 2). Even so, this modified prevalence of O remained significantly lower than that among Black or White women (Figure 1, Online Table 2).

**Figure 5. Prevalence of pre-pregnancy diabetes mellitus, obesity, and chronic hypertension by ethnicity.**




CI: confidence interval; D: diabetes mellitus; H: chronic hypertension; O: obesity.

## DISCUSSION

Within a contemporary multiethnic population, with complete ascertainment of all hospital births, more than one in six pregnancies were affected by O, and one in 100 pregnancies was affected by pre-pregnancy D or H. With rising maternal age and parity, D, O, and H increased, both individually and combined. O and H together were most prevalent in women of Black ancestry, affecting one in 70 pregnancies.

This is the first study to describe the prevalence of D, O, and H and their various combinations in pregnancy, thus providing a breakdown of the scope of the DOH "epidemic" in a high-income country such as Canada. Study strengths also include the use of a population-based provincial registry, with prospectively collected provincial data. Because over one third of all births in Canada occur in Ontario, these data on DOH can likely be extrapolated to other regions of Canada.[14] Although the data sets used in this cohort comprised patient-level clinical data, which are routinely checked for quality control and validated, inaccuracies in data entry and missingness persist. This was especially evident for measures of maternal BMI and ethnicity.

One limitation of this study was that the method to impute BMI, although validated, may have produced erroneous

estimates.[18] An additional limitation was that although the BIS-DAD linkage maximizes the probability of identifying any women with D and H, full capture of D and H may still be limited. Moreover, the BIS-DAD linkage was available only from April 1, 2012, to March 31, 2015; thus, the BIS was the sole source of diagnoses of D and H for the period between April 1, 2015, and March 31, 2016. Maternal ethnicity was not known for 34% of the study sample, and categorization was broad. For example, the "Asian" category could comprise Southeast Asians (e.g., Chinese) and South Asians (e.g., Indians), and this certainly does not appreciate their many differences, nor was there any differentiation between immigrants and non-immigrants. Finally, in this study design, women could contribute more than one pregnancy during the time period, thus potentially overestimating some of the DOH components. However, but women with repeat pregnancies constituted only a small fraction of the cohort (Online Table 1).

This study was designed to provide health care providers and policymakers a "bird's-eye" view of the magnitude of the problem of DOH in pregnancy, rather than exploring potential confounding. Maternal age, parity, and ethnicity can each influence the likelihood of a woman's exhibiting D, O, and/or H. Instead of adjusting for these factors, we stratified by them, thereby producing precise estimates of DOH across each category.

The O epidemic in women has been well described by others. For example, U.S. data for the years 2013 to 2014 revealed that 370 per 1000 women of reproductive age have O, with a higher prevalence among non-Hispanic Blacks (570 per 1000) and a lower rate in Asians (100 per 1000).[21] These findings are in contrast to the respective prevalence figures seen in our study, 178, 272 and 76 per 1000. In fact, the overall prevalence of O in our study (178 per 1000) is consistent with that reported for Canadian women in 2011 (171 per 1000).[22] Furthermore, O rates were steady across maternal age categories of 20 to 39 and rose only thereafter. Although somewhat surprising, this change may reflect the complex relationship among age, parity, and lifestyle and the risk of O in women.[23] Other North American studies broadly grouped women from ages 20 to 39.[24]

The age-adjusted prevalence of D in pregnancy was previously reported to be seven per 1000 in 1996 and 15 per 1000 in 2010,[12] compared with a prevalence of 11 per 1000 in this study. In the United States, in 2004, the prevalence of D was 7.5 per 1000, which may have been underestimated as a result of the investigators' sole reliance on administrative data codes at hospital discharge.[25] In low- and middle-income countries, the burden and distribution of D in pregnancy are insufficiently captured.[26] Given the high rate of immigration to Canada from these regions, the data herein could be further expanded and serve as a proxy for the rates of D in immigrants' native countries. The prevalence of H seen in the present study (11.2 per 1000) is comparable to that previously reported in a U.S. study of 56 494 634 deliveries between 1995 (10.1 per 1000) and 2007 (17.6 per 1000).[11]

D and H, and to a lesser degree O, showed a strong trend with increasing maternal age and parity, as seen elsewhere.[27,28] Although parity and maternal age are known to be strongly correlated, an independent effect is also plausible. Delayed child-bearing is increasingly more common in Canada and other high-income nations, a factor that could contribute disproportionately to the rate of DOH in pregnancy in primiparous women of advanced maternal age.[29] Although not directly assessed in this study, high rates of use of assisted reproductive technology in older mothers may also explain the higher observed prevalence of O and H in twin pregnancies.[30] In 2015, 61.2% of mothers in Ontario who underwent in vitro fertilization were over age 35.[31]

Ethnicity was another factor shown to be associated with DOH. Black women had the highest prevalence of O, H, and O and H together, and Asian women had the lowest. Such differences might explain the higher rate of morbidity observed in women and newborns of African and Caribbean ancestry.[32] Despite their lower rate of O, even upon re-defining O at a pre-pregnancy BMI $\geq$27.5 kg/m$^2$, Asian women had a higher prevalence of D. This latter finding is in keeping with recent evidence suggesting that these women have a higher percentage of body fat for the same BMI as non-Asians and a higher prevalence of type 2 diabetes and insulin resistance at relatively lower BMI cut points.[33,34]

## CONCLUSION

D, O, H, and their various combinations can be readily determined in a woman before conception and in early pregnancy. The prevalence of each has been outlined herein, by maternal age, parity and ethnicity, and in singleton and twin pregnancies. These data can inform health care planning and risk reduction strategies aimed at reducing maternal and perinatal morbidity and mortality,[1–6] thus potentially leading to improved quality of life and lower health care expenditures. Future research can quantify both the short-term and long-term outcomes in pregnancies with D, O, and H, especially when these conditions are co-present.

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## SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jogc.2019.01.020.

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## SUPPLEMENTARY FILES

Supplementary Table 1

Supplementary Table 2

**Supplementary Table 1.** Characteristics of pregnancies with a live birth or stillbirth in Ontario, April 1, 2012 to March 31, 2016. **All data are presented as a number () unless otherwise indicated. Data are suppressed in instances where a cell count is less than 6.**

| | Measurement | | | | | | |
|---|---|---|---|---|---|---|---|
| Characteristic | Diabetes (D) (N = 5,493) | Obesity (O) (N = 90,177) | Hypertension (H) (N = 5,667) | D and O (N = 2,409) | D and H (N = 513) | O and H (N = 2,768) | D and O and H (N = 359) |
| **Maternal age** (years) | | | | | | | |
| Mean ± SD | 32.5 ± 5.5 | 30.7 ± 5.4 | 33.5 ± 5.4 | 32.8 ± 5.3 | 34.6 ± 5.4 | 33.5 ± 5.3 | 34.3 ± 5.1 |
| ≤ 19 | 57 (1.0) | 1,513 (1.7) | 40 (0.71) | 12 (0.50) | <6 (suppressed) | 11 (0.40) | <6 (suppressed) |
| 20-24 | 392 (7.1) | 10,349 (11.5) | 253 (4.5) | 141 (5.9) | 14 (2.7) | 115 (4.2) | 9 (2.5) |
| 25-29 | 1,153 (21.0) | 24,996 (27.7) | 1,021 (18.0) | 491 (20.4) | 64 (12.5) | 513 (18.5) | 48 (13.4) |
| 30-34 | 1,893 (34.5) | 31,337 (34.8) | 1,868 (33.0) | 837 (34.7) | 159 (31.0) | 920 (33.2) | 113 (31.5) |
| 35-39 | 1,443 (26.3) | 17,588 (19.5) | 1,717 (30.3) | 684 (28.4) | 180 (35.1) | 845 (30.5) | 134 (37.3) |
| ≥ 40 | 555 (10.1) | 4,394 (4.9) | 768 (13.6) | 244 (10.1) | 92 (17.9) | 364 (13.2) | 53 (14.8) |
| **Maternal Ethnicity** | | | | | | | |
| Caucasian | 2,071 (37.7) | 39,276 (43.6) | 2,315 (40.9) | 927 (38.5) | 194 (37.8) | 1,185 (42.8) | 140 (39.0) |
| Asian | 1,148 (20.9) | 6,835 (7.6) | 961 (17.0) | 313 (13.0) | 92 (17.9) | 271 (9.8) | 43 (12.0) |
| Black | 330 (6.0) | 5,940 (6.6) | 583 (10.3) | 188 (7.8) | 43 (8.4) | 330 (11.9) | 34 (9.5) |
| Other | 333 (6.1) | 3,489 (3.9) | 226 (4.0) | 175 (7.3) | 42 (8.2) | 118 (4.3) | 33 (9.2) |
| Missing | 1,611 (29.3) | 34,637 (38.4) | 1,582 (27.9) | 806 (33.5) | 142 (27.7) | 864 (31.2) | 109 (30.4) |
| **Parity** | | | | | | | |
| Nulliparous | 2,100 (38.2) | 33,540 (37.2) | 2,415 (42.6) | 852 (35.4) | 217 (42.3) | 1,121 (40.5) | 145 (40.4) |
| Parous | 3,344 (60.9) | 55,945 (62.0) | 3,176 (56.0) | 1,541 (64.0) | 288 (56.1) | 1,619 (58.5) | 207 (57.7) |
| Unknown | 49 (0.90) | 692 (0.77) | 76 (1.3) | 16 (0.66) | 8 (1.6) | 28 (1.0) | 7 (1.9) |
| **Maternal body mass index, kg/m2** (mean ± SD) | 30.0 ± 7.9 | 35.6 ± 5.7 | 30.9 ± 8.0 | 37.1 ± 6.2 | 34.5 ± 7.8 | 37.3 ± 6.1 | 38.3 ± 6.0 |
| **Gestational age at delivery** (weeks) | | | | | | | |
| ≤ 22 | 18 (0.33) | 265 (0.28) | 20 (0.35) | 10 (0.42) | <6 (suppressed) | 13 (0.47) | <6 (suppressed) |
| 23-31 | 123 (2.2) | 1,198 (1.3) | 292 (5.2) | 53 (2.2) | 30 (5.8) | 120 (4.3) | 19 (5.3) |
| 32-36 | 1,092 (19.9) | 6,270 (7.0) | 1,025 (18.1) | 468 (19.4) | 156 (30.4) | 470 (17.0) | 106 (29.5) |
| 37-42 | 4,252 (77.4) | 82,372 (91.3) | 4,326 (76.3) | 1,875 (77.8) | 325 (63.4) | 2,163 (78.1) | 233 (64.9) |
| ≥ 43 | 8 (0.15) | 63 (0.070) | <6 (suppressed) | <6 (suppressed) | 0 (0.00) | <6 (suppressed) | 0 (0.00) |
| Missing | 0 (0.00) | 9 (0.010) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) |
| **Number of pregnancies per woman** | | | | | | | |
| 1 | 4,877 (88.8) | 76,909 (85.3) | 5,144 (90.8) | 2,130 (88.4) | 462 (90.1) | 2,491 (90) | 323 (90) |
| 2 | 600 (10.9) | 12,811 (14.2) | 511 (9) | 272 (11.3) | 49 (9.6) | 271 (9.8) | 35 (9.7) |
| ≥3 | 16 (0.3) | 457 (0.5) | 12 (0.2) | 7 (0.3) | <6 (S) | 6 (0.2) | <6 (S) |

**Supplementary Table 2. Additional analysis of the prevalence of pre-existing diabetes mellitus (D), obesity (O) and chronic hypertension (H), and their various combinations, upon re-defining obesity among Asians as a pre-pregnancy body mass index ≥ 27.5 kg/m$^2$.**

| | Prevalence per 1,000 (95% confidence interval) by ethnic group | | | | | |
|---|---|---|---|---|---|---|
| Measurement | Caucasian (N = 206,005) | Asian (N = 89,268) | Black (N = 22,661) | Other/Mixed/Unknown (N = 18,266) | Missing[a] (N = 170,283) | *P*-value |
| Diabetes (D) | 10.1 (9.6-10.5) | 12.9 (12.1-13.6) | 14.6 (13.0-16.1) | 18.2 (16.3-20.2) | 9.5 (9.0-9.9) | < 0.001[b] |
| Obesity (O) | 190.8 (188.9-192.7) | 149.6 (147.0-152.2) | 261.9 (255.1-268.6) | 191.0 (184.6-197.4) | 203.7 (201.5-205.8) | < 0.001[b] |
| Hypertension (H) | 11.2 (10.8-11.7) | 10.8 (10.1-11.4) | 25.7 (23.6-27.8) | 12.4 (10.8-14) | 9.3 (8.8-9.7) | < 0.001[b] |
| D and O | 4.5 (4.2-4.8) | 5.1 (4.6-5.6) | 8.5 (7.2-9.7) | 9.7 (8.2-11.1) | 4.7 (4.4-5.0) | < 0.001[b] |
| D and H | 0.9 (0.80-1.1) | 1.0 (0.80-1.2) | 1.9 (1.3-2.5) | 2.3 (1.6-3.0) | 0.8 (0.7-1.0) | < 0.001[b] |
| O and H | 5.8 (5.4-6.1) | 4.5 (4.0-4.9) | 14.5 (12.9-16.1) | 6.4 (5.2-7.5) | 5.1 (4.7-5.4) | < 0.001[b] |
| D and O and H | 0.7 (0.60-0.80) | 0.6 (0.50-0.80) | 1.5 (1.0-2.0) | 1.8 (1.2-2.4) | 0.60 (0.50-0.80) | < 0.001[b] |

Data Sources: BORN Ontario (2012-2016), CIHI Discharge Abstract Database (2012-2015)

[a] Ethnicity was missing for 33.6% of the study sample, and should be interpreted with caution.

[b] Refers to *p*-value <0.05, which indicates at least one significant difference exists between ethnic groups for a particular measurement, and based on the chi-squared test