# Ethnic variation in causes of stillbirth in high income countries: A systematic review and meta-analysis

Saiuj Bhat[1], Nadya Birdus[2], and Sangeeta Bhat[3]

[1]Royal Perth Hospital
[2]Fiona Stanley Hospital
[3]Armadale Health Service

April 05, 2024

## Abstract

Background: Inequities in stillbirth rate according to ethnicity persist in high income nations. Objectives: To investigate whether causes of stillbirth differ by ethnicity in high-income nations. Search strategy: Medline, Embase, Scopus, CINAHL, Cochrane Library, and Global Health databases since their inception to 1 February 2021. Selection criteria: Cohort, cross-sectional, and retrospective studies investigating the causes of stillbirth in various ethnic groups. Data collection and analysis: Systems of classification and causes of stillbirth were aligned to the International Classification of Disease 10 for Perinatal Mortality (ICD10-PM) and pooled estimates were derived by meta-analysis. Main results: Fifteen reports from 3 countries (72,555 stillbirths) were included. Seven ethnic groups – "Caucasian" (n = 11 studies, n = 37,578 stillbirths), "African" (n = 11 studies, n = 17,883 stillbirths), "Hispanic" (n = 7 studies, n = 12,810 stillbirths), "Indigenous Australian" (n = 4 studies, n = 1,117 stillbirths), "Asian" (n = 2 studies, n = 15 stillbirths), "South Asian" (n = 2 studies, n = 55 stillbirths), and "American Indian" (n = 1 study, n = 27 stillbirths) – were identified. There was an overall paucity of recent, high-quality data for many ethnicities. For those with the greatest amount of data – Caucasian, African, and Hispanic – no major differences in the causes of stillbirth were identified. Conclusion: There is a paucity of high-quality information on causes of stillbirth for many ethnicities. Improving investigation and standardising classification of stillbirths is needed to assess whether causes of stillbirth differ across more diverse ethnic groups.

**Title:** Ethnic variation in causes of stillbirth in high income countries: A systematic review and meta-analysis

**Authors:** Saiuj Bhat[1], Nadya Birdus[2], Sangeeta Malla Bhat[3]

**Affiliations:**

[1]Royal Perth Hospital, Perth, Western Australia, Australia

[2]Fiona Stanley Hospital, Murdoch, Western Australia, Australia

[3]Armadale Hospital, Mount Nasura, Western Australia, Australia

**Corresponding author:**

Mr Saiuj Bhat

10 Henrietta Avenue, Mount Nasura, Western Australia, 6112

+61 431 552 431

saiujbhat59@hotmail.com

**Abbreviated title:** Ethnic variation in causes of stillbirth

**ABSTRACT**

**Background:** Inequities in stillbirth rate according to ethnicity persist in high income nations.

**Objectives:** To investigate whether causes of stillbirth differ by ethnicity in high-income nations.

**Search strategy:** Medline, Embase, Scopus, CINAHL, Cochrane Library, and Global Health databases since their inception to 1 February 2021.

**Selection criteria:** Cohort, cross-sectional, and retrospective studies investigating the causes of stillbirth in various ethnic groups.

**Data collection and analysis:** Systems of classification and causes of stillbirth were aligned to the International Classification of Disease 10 for Perinatal Mortality (ICD10-PM) and pooled estimates were derived by meta-analysis.

**Main results:** Fifteen reports from 3 countries (72,555 stillbirths) were included. Seven ethnic groups – "Caucasian" ($n = 11$ studies, $n = 37,578$ stillbirths), "African" ($n = 11$ studies, $n = 17,883$ stillbirths), "Hispanic" ($n = 7$ studies, $n = 12,810$ stillbirths), "Indigenous Australian" ($n = 4$ studies, $n = 1,117$ stillbirths), "Asian" ($n = 2$ studies, $n = 15$ stillbirths), "South Asian" ($n = 2$ studies, $n = 55$ stillbirths), and "American Indian" ($n = 1$ study, $n = 27$ stillbirths) – were identified. There was an overall paucity of recent, high-quality data for many ethnicities. For those with the greatest amount of data – Caucasian, African, and Hispanic – no major differences in the causes of stillbirth were identified.

**Conclusion:** There is a paucity of high-quality information on causes of stillbirth for many ethnicities. Improving investigation and standardising classification of stillbirths is needed to assess whether causes of stillbirth differ across more diverse ethnic groups.

**Funding:** Nil

**Key words:** stillbirth, causes, ethnicity, inequity, public health, obstetrics, pregnancy, foetal

**Tweetable abstract:** Data investigating ethnic variation in causes of stillbirth is limited but our review does not suggest any differences between ethnicities.

**INTRODUCTION**

Stillbirth is a devastating pregnancy outcome that not only has emotional, psychological and financial consequences for affected women and families,[1] but also impacts individual healthcare workers, health care networks and the wider society.[2] The global stillbirth rate is estimated to be 18.4 per 1,000 births, equating to approximately 2.6 million stillbirths every year.[3] The World Health Organisation's (WHO) *Every Newborn: An Action Plan to End Preventable Deaths* aims to reduce the stillbirth rate to ≤12 per 1,000 births by 2030 worldwide.[4] For countries already meeting this target, mostly high-income nations, the *Every Newborn* initiative aims to reduce equity gaps within the population.[4, 5]

Despite similar access to healthcare services,[6] inequities in stillbirth rates continue to persist in high income nations, especially in certain minority ethnic groups. For example, women of ethnic minorities who birth in Australia or Europe have stillbirth rates 2-3 times higher than Caucasian women.[7-9] A similar trend is observed in women of African ancestry compared to their Caucasian counterparts in the United States.[10, 11] A higher incidence of modifiable risk factors associated with stillbirth are observed in some minority ethnic groups[12] and may contribute, at least partly, to the higher rates of stillbirth observed. Given increasing international migration to high-income countries,[13] it is pertinent to understand the ethnic variation in causes of stillbirth in order to address the persistent equity gaps.

A recent systematic review by Reinebrant and colleagues[14] evaluated the causes of stillbirth according to geographical region and economic development around the world. Others have evaluated risk factors associated with stillbirth in various ethnic groups.[12] However, whether differences in the *actual* causes of

2

stillbirth between ethnicities exist is unknown. The aim of this study, therefore, was to perform a systematic review of the literature to investigate the causes of stillbirths in various ethnic groups in high income countries. This will assist in deepening the understanding of possible ethnic differences in causes of stillbirth and work towards the WHO's goal to reduce equity gaps in stillbirth.

## METHODS

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Appendix S1) and MOOSE guidelines (Appendix S2) and was registered on PROSPERO [CRD42021224100]. A protocol was not prepared for this review. Two authors (SB and NB) independently conducted the literature search, screened studies for eligibility, extracted data, and performed the quality assessment.

### Search strategy and information sources

A systematic literature search up to 1 February 2021 was conducted in Medline, Embase, Scopus, Cumulative Index of Nursing and Allied Health (CINAHL), Cochrane Library, and Global Health databases since their inception without language restrictions using the search terms outlined in Appendix S3. Reference lists of eligible studies were manually scanned to identify additional relevant publications.

### Eligibility criteria

Cohort, cross-sectional, and retrospective studies investigating the causes of stillbirths in singleton pregnancies in various ethnic groups in high income countries were eligible for inclusion. Studies that only reported risk factors associated with stillbirth in various ethnic groups but did not investigate the actual cause of foetal death were excluded. Reports were also excluded if they did not provide data on causes in an extractable format. Given the considerable heterogeneity in the definition of stillbirth between studies, we did not specify a pre-determined definition to use as an eligibility criterion.

### Data extraction

The following data were extracted into pre-piloted forms where available: period of data collection, country, setting (population/national, multicentre hospital, or single centre hospital), study design, mean maternal age, mean gestational age, total number of births, total number of stillbirths, stillbirth rate, stillbirth definition, stillbirth classification system used, proportion of stillbirths classified, data source, examination rate (autopsy, placental histology), and cause of stillbirth. Discrepancies were resolved by consensus or by involvement of a third independent reviewer (SMB). Missing data were reported as such and any corresponding authors were contacted for unclear information.

### Quality assessment

Quality of the included studies was evaluated using the modified Joanna Briggs Institute Critical Appraisal Checklist for Studies Reporting Prevalence Data tool as described previously.[14] An overall quality rating was derived for each report as low, medium, or high quality.

### Data analysis

Each reported cause of stillbirth was mapped to the relevant International Classification of Disease of perinatal mortality (ICD-10-PM) category. The ICD-PM includes five major maternal conditions categories (M1-5) and thirteen foetal categories, six with antepartum timing (A1-6), seven with intrapartum timing (I1-7), and others with unknown timing. For the Unknown (U) timing category, we included those categories described previously for consistency. Categories of stillbirth causes were represented as proportions of the total number of stillbirths for various ethnicities. Results for each ethnicity from different studies were statistically pooled using random effects meta-analysis using the *metaprop* command in STATA (version 16, Stata Corp, TX, USA) for binomial data. Pooled estimates were calculated after Freeman-Tukey double arcsine transformation of data to stabilise the variances and enable studies with estimated proportions of 0 or 1 to be retained.[15] $I^2$ values were not reported as measures of heterogeneity as such statistics may be

less informative in meta-analyses of cohort/observational studies where sample sizes are relatively large and the within-study variation correspondingly small.[16] Data were tabulated as pooled estimate of proportion (95% confidence interval).

## RESULTS

### Study characteristics

Of 791 studies identified in our search, 15 met inclusion and exclusion criteria and were included for analysis (**Figure 1** ).[17-32] Five studies were excluded as they either did not provide data in an extractable format or used language spoken at home or country of birth as a surrogate for ethnicity.[33-37] Characteristics of the included studies are presented in **Table S1** . These fifteen studies encompassed 72,555 stillbirths, equating to a stillbirth rate ranging from 0.35% to 6.8% of all births. Seven were conducted in the United States of America, five in Australia, and three in the United Kingdom. Most ($n = 10$) were conducted more than 10 years ago and of these, six had data collected more than 20 years ago. Three studies were limited to a single institution, seven were multicentred, and five were conducted at a population or national level. Only eight of the included studies provided an indication of the autopsy rate. In these studies, the autopsy rate ranged from 37.6% to 100%. While the definition of stillbirth varied slightly between studies, a majority of studies defined stillbirth as death of foetus of at least 20 weeks' gestation. The classification system used to describe the cause of stillbirth varied widely, with four studies using the ICD system, three studies using INCODE, two studies using PSANZ, and six using a classification system unique to the study. Most studies were either retrospective cohort studies ($n = 7$) or cross-sectional in nature ($n = 4$), three were case-control, and one was prospective. Only one study was deemed to be of high quality; the rest were deemed to be either medium ($n = 7$) or low ($n = 7$) quality (**Table S2** ).

### Causes of stillbirth

Mapping of the causes of stillbirth to the ICD10-PM classification system revealed a total of 23 unique causes of stillbirths. Overall, maternal categories of causes of stillbirth (M1-M5) had higher frequencies compared to foetal causes and were thus used to present data. This may be explained by the fact that there are only five maternal categories of causes of stillbirth and thirteen foetal categories in the ICD-10-PM classification system. Of these, "complications of placenta, cord and membrane with no foetal cause (M1)", "maternal medical and surgical conditions with no foetal cause (M4)", and "other foetal cause with no maternal condition identified (M5U6)" were the most common causes of stillbirth in our pooled analyses.

### Ethnic variation in causes of stillbirth

Data for six ethnic groups were available from the included studies. These included African ($n = 11$ studies), Caucasian ($n = 11$ studies), Hispanic ($n = 7$ studies), Asian ($n = 2$ studies), South Asian ($n = 2$ studies), and American Indian ($n = 1$ study) populations. Within the Australian context, data were also available for the Indigenous population ($n = 4$ studies). The pooled proportion of cases based on ethnicity for each mapped cause of stillbirth is shown in **Table S3.** Pooled causes of stillbirth for each ethnicity according to the maternal categories of ICD-10-PM are presented as pooled estimates (95% confidence intervals) in**Figure 2** with detailed results shown in **Table 1** and**Table S4.** Pooled causes of stillbirth for Indigenous Australians and non-Indigenous Australians are presented in**Table S5** . Caucasian and Hispanic ethnicities showed similar proportions attributable to various maternal causes in the ICD-PM classification system (Figure 2). By comparison, African women had a higher proportion of stillbirths caused by other complications of labour and delivery (M3) and fewer due to complications of placenta, cord and membranes (M1) compared to Caucasian and Hispanic women. Similarly, compared to non-Indigenous Australians, Indigenous Australians had a higher proportion of stillbirths caused by other complications of labour and delivery (M3). Women of Asian and South Asian ethnicities had a different profile of causes of stillbirth, with the majority of stillbirths caused by complications of placenta, cord and membranes (M1).

## DISCUSSION

### Main findings

4

This systematic review and meta-analysis identified 15 studies investigating the causes of stillbirth in various ethnic groups in high income nations. Despite over 70 thousand stillbirths included in this review, there was an overall paucity of recent, high quality studies investigating the causes of stillbirth in many ethnic groups. While proportions of stillbirth attributable to various ICD-10-PM causes appeared largely comparable between ethnic groups for which data were available, a significant proportion of stillbirths were either unexplained or fell into the *other* category, highlighting one of the key challenges in achieving the WHO's *Every Newborn* stillbirth target. Our results support the need for additional appropriately designed autopsy studies that utilise a consistent stillbirth classification system to further investigate the causes of stillbirth in ethnic groups poorly represented in our study.

### Strengths and limitations

To the best of our knowledge, this is the first systematic review that synthesised data on the ethnic variation of the causes of stillbirth in high income nations and to standardise reporting of outcomes using the ICD-10-PM classification. To increase the accuracy of identified causes, we included only those studies that reported foetal autopsy and/or placental pathology data to determine the *actual* cause of stillbirth[38] rather than associated risk factors, and excluded studies that used surrogate markers of ethnic identity such as mother tongue or language spoken at home. Mapping disparate causation data from individual studies to the ICD-10-PM and subsequently pooling results by meta-analysis allowed improved interpretation of findings and easier comparison between ethnic groups.

Results from this study should be interpreted in the context of some limitations. First, exclusion of studies reporting only associations between various risk factors and stillbirth may have resulted in loss of information and limited our ability to assess the full value of the ICD-PM. Second, use of crude categories to define ethnicity may be limited by being only proximal guides to experiences, practices, and beliefs of individuals and may not capture the associated complex and interrelated socioeconomic determinants such as education and employment that may be driving disparities in stillbirth rates.[27, 39-44] Inequalities in stillbirth between various ethnic groups have been shown to reduce after acculturation and adoption of host nationality,[45] highlighting the limitation in interpreting stillbirth data segregated by ethnicity. Third, differences in causes of stillbirth between studies may be a consequence of differences in classification rather than any important differences in pathological processes per se. This is especially pertinent in the context of the myriad classification tools available and used in various studies, making regional and global comparisons difficult. The ICD-PM itself faces challenges including insufficient differentiation of causes from associated conditions and insufficient detail on maternal conditions. Fourth, most data used in our analyses were collected more than 10 years ago and may not reflect recent migration patterns and demographic changes, and current socioeconomic and health care environments. Finally, despite including studies investigating the *causes* of stillbirths, we found considerable variation in autopsy rate between studies with some studies reporting rates as low as 38%. Previous studies have shown that ethnic minority groups have lower rates of being asked for consent for a post-mortem study, and also lower rates of consent when asked.[46, 47] This may be due to assumptions and/or actual differences in religious or cultural observances and may reflect an inherent limitation in studies involving minority ethnic groups and causes of stillbirth. Due to this limitation it is also worth considering alternatives to post-mortem examination which may be accessible in high income counties, such as MRI,[48] to assist in assigning cause of death when post-mortem examination is declined.

### Interpretation

Reinebrant and colleagues' seminal work[14] provided a comprehensive overview of the causes of stillbirth around the globe. In our review, we built upon this foundation by investigating ethnic variation of causes of stillbirth in high-income countries. While perinatal outcomes in some ethnic minority groups appear to have improved over time, disparities in stillbirth rates based on ethnicity continue to persist in the majority of reported cases.[7-9, 34, 36, 39, 40, 49-59] Ethnicities with the largest sample sizes (Caucasian, African and Hispanic) overall showed similar proportions in the causes of stillbirth. Compared to non-Indigenous Australians, Indigenous Australian women showed higher frequencies of stillbirth attributed to other complications of labour and delivery. This category includes stillbirth that has been attributed to malpresentation, forceps delivery,

vacuum delivery, caesarean delivery or induction of labour. This is in agreement with a population-based study from the Northern Territory, Australia which demonstrated higher rates of emergency caesarean and malpresentation in Indigenous mothers compared to non-Indigenous,[60] but contrary to the study by Kildea and colleagues who found Indigenous Australian to have lower rates of instrumental delivery and induction of labour.[61] In our review, Asian and South Asian ethnicities showed a larger proportion of stillbirths attributed to complications of placenta, cord and membranes, in line with previous work showing higher rates of placental insufficiency[62] and placenta praevia[63] in women of Asian heritage. However, the utility of the interpretation of differences observed in Indigenous Australian, Asian and South Asian women is limited due to their small sample sizes.

Our findings imply that the higher incidence of stillbirths observed in minority ethnic groups in previous studies are likely to be a consequence of factors other than intrinsic differences such as culturally inappropriate antenatal care[64] and higher incidence of modifiable risk factors such as obesity, maternal smoking, hypertension, and diabetes.[12] The effect of the migration experience and the associated socioeconomic disadvantage migrants may face is difficult to dissect from intrinsic differences between various ethnic groups, if any, with regards to stillbirth outcomes.[24, 65-67] Gibson-Helm and colleagues[68] found that after adjusting for confounding factors such as age, parity, BMI and relative socio-economic disadvantage, the difference in stillbirth rates between migrants and women from host countries disappeared. These results, together with findings from our study, suggest that socio-cultural-economic factors may be more important in explaining the disparities in stillbirth rates between ethnic groups rather than intrinsic differences.

## Conclusion

It has long been postulated whether there were underlying differences in causes of stillbirths in different ethnic groups, as disparities in stillbirth rates and perinatal outcomes continue to persist in many high-income nations. Understanding the ethnic variation in stillbirth rate and causes is crucial to bringing us a step closer to achieving the WHO's *Every Newborn* initiative. Results from this review suggest that while no obvious differences are apparent in causes of stillbirths in those ethnicities with sufficient data, important gaps in our knowledge persist. Future studies in high-income countries should aim to investigate causes of stillbirth in minority ethnic groups poorly represented in this review by using high quality placental histology and foetal autopsy data. To enable global comparisons, monitor trends, and clearly ascertain underlying causes, a widely accepted tool such as the ICD-PM that can capture more detailed information in data-rich settings should be used. Comprehensive testing across diverse settings and in as many ethnic groups as possible will enable focussed used of healthcare resources and corresponding policy changes.

References

1. Heazell AEP, Siassakos D, Blencowe H, Burden C, Bhutta ZA, Cacciatore J, et al. Stillbirths: economic and psychosocial consequences. Lancet. 2016;387(10018):604-16.
2. Campbell HE, Kurinczuk JJ, Heazell A, Leal J, Rivero-Arias O. Healthcare and wider societal implications of stillbirth: a population-based cost-of-illness study. BJOG. 2018 Jan;125(2):108-17.
3. Lawn JE, Blencowe H, Waiswa P, Amouzou A, Mathers C, Hogan D, et al. Stillbirths: rates, risk factors, and acceleration towards 2030. Lancet. 2016 Feb 6;387(10018):587-603.
4. World Health Organisation. *Every Newborn: An Action Plan to End Preventable Deaths.* Geneva, Switzerland: 2014.
5. Blencowe H, Cousens S, Jassir FB, Say L, Chou D, Mathers C, et al. National, regional, and worldwide estimates of stillbirth rates in 2015, with trends from 2000: A systematic analysis. Lancet Glob Health. 2016 Feb;4(2):e98-e108.
6. Flenady V, Wojcieszek AM, Middleton P, Ellwood D, Erwich JJ, Coory M, et al. Stillbirths: recall to action in high-income countries. Lancet. 2016 Feb 13;387(10019):691-702.
7. Khalil A, Rezende J, Akolekar R, Syngelaki A, Nicolaides KH. Maternal racial origin and adverse pregnancy outcome: a cohort study. Ultrasound Obstet Gynaecol. 2013;41(3):278-85.
8. Ravelli ACJ, Tromp M, Eskes M, Droog JC, van der Post JAM, Jager KJ, et al. Ethnic differences in stillbirth and early neonatal mortality in The Netherlands. J Epidemiol Community Health. 2011;65(8):696-701.
9. Drysdale H, Ranasinha S, Kendall A, Knight M, Wallace EM. Ethnicity and the risk of late-pregnancy stillbirth. Med J Aust. 2012;197(5):278-81.
10. Willinger M, Ko C-W, Reddy UM. Racial disparities in stillbirth risk across gestation in the United States. Am J Obstet Gynecol. 2009;201(5):469.e1-8.
11. Rowland Hogue CJ, Silver RM. Racial and ethnic disparities in United States: stillbirth rates: trends, risk factors, and research needs. Semin Perinatol. 2011;35(4):221-33.
12. Flenady V, Koopmans L, Middleton P, Frøen JF, Smith GC, Gibbons K, et al. Major risk factors for stillbirth in high-income countries: a systematic review and meta-analysis. Lancet. 2011 Apr 16;377(9774):1331-40.
13. International Organisation for Migration. World Migration Report 2020. Geneva, Switzerland; 2020.
14. Reinebrant HE, Leisher SH, Coory M, Henry S, Wojcieszek AM, Gardener G, et al. Making stillbirths visible: a systematic review of globally reported causes of stillbirth. BJOG. 2018 Jan;125(2):212-24.
15. Nyaga VN, Arbyn M, Aerts M. Metaprop: a Stata command to perform meta-analysis of binomial data. Arch Public Health. 2014;72(1):39.
16. Higgins JP. Commentary: Heterogeneity in meta-analysis should be expected and appropriately quantified. International journal of epidemiology. 2008 Oct;37(5):1158-60.
17. Buck GM, Shelton JA, Mahoney MC, Michalek AM, Powell EJ. Racial variation in spontaneous fetal deaths at 20 weeks or older in upstate New York, 1980-86. Public Health Rep. 1995;110(5):587-92.
18. Terry PB, Condie RG. Ethnic differences in the distribution of normally formed singleton stillbirths. Postgrad Med J. 1983;59(696):659-60.
19. Alessandri LM, Stanley FJ, Waddell VP, Newnham J. Stillbirths in Western Australia 1980-1983: influence of race, residence and place of birth. Aust N Z J Obstet Gynaecol. 1988;28(4):284-92.
20. Stillbirth Collaborative Research Network Writing G. Causes of death among stillbirths. JAMA. 2011;306(22):2459-68.
21. Gibbins KJ, Pinar H, Reddy UM, Saade GR, Goldenberg RL, Dudley DJ, et al. Findings in stillbirths associated with placental disease. Am J Perinatol. 2020;37(7):708-15.
22. Hoyert DL, Gregory ECW. Cause of death data from the fetal death file, 2015-2017. National vital statistics reports : from the Centers for Disease Control and Prevention, National Center for Health Statistics, National Vital Statistics System. 2020;69(4):1-20.
23. Hoyert DL, Gregory ECW. Cause of fetal death: data from the fetal death report, 2014. National vital statistics reports : from the Centers for Disease Control and Prevention, National Center for Health Statistics, National Vital Statistics System. 2016;65(7):1-25.
24. Mozooni M, Preen DB, Pennell CE. Stillbirth in Western Australia, 2005-2013: the influence of maternal

migration and ethnic origin. Med J Aust. 2018;209(9):394-400.

25. Chek K, Kerr GR. Factors associated with fetal mortality in the triethnic population in texas, 1993 through 1995. Texas Med. 1999;95(12):78-83.

26. Alessandri LM, Chambers HM, Blair EM, Read AW. Perinatal and postneonatal mortality among Indigenous and non-Indigenous infants born in Western Australia, 1980-1998. Med J Aust. 2001;175(4):185-9.

27. Ibiebele I, Coory M, Boyle FM, Humphrey M, Vlack S, Flenady V. Stillbirth rates among Indigenous and non-Indigenous women in Queensland, Australia: is the gap closing? BJOG. 2015;122(11):1476-83.

28. Yerlikaya G, Akolekar R, McPherson K, Syngelaki A, Nicolaides KH. Prediction of stillbirth from maternal demographic and pregnancy characteristics. Ultrasound Obstet Gynaecol. 2016;48(5):607-12.

29. Rammah A, Whitworth KW, Han I, Chan W, Hess JW, Symanski E. Temperature, placental abruption and stillbirth. Environ Int. 2019 Oct;131:105067.

30. Lyon AJ, Clarkson P, Jeffrey I, West GA. Effect of ethnic origin of mother on fetal outcome. Arch Dis Child Fetal Neonatal Ed. 1994;70(1):F40-3.

31. Page JM, Bardsley T, Thorsten V, Allshouse AA, Varner MW, Debbink MP, et al. Stillbirth Associated With Infection in a Diverse U.S. Cohort. Obstet Gynaecol. 2019;134(6):1187-96.

32. Monk A, Harris K, Donnolley N, Hilder L, Humphrey M, Gordon A, et al. Perinatal deaths in Australia 1993-2012. Perinatal Deaths Series No 1. 2016:ix-pp.

33. Getahun D, Ananth CV, Kinzler WL. Risk factors for antepartum and intrapartum stillbirth: a population-based study. Am J Obstet Gynecol. 2007 Jun;196(6):499-507.

34. Brehm Christensen M, Fredsted Villadsen S, Weber T, Wilken-Jensen C, Nybo Andersen AM. Higher rate of serious perinatal events in non-Western women in Denmark. Dan Med J. 2016 Mar;63(3).

35. Auger N, Racape J, Raynault M-F, Bilodeau-Bertrand M, Lee GE, Janevic T. Stillbirth among Arab women in Canada, 1981-2015. Public Health Rep. 2020;135(2):245-52.

36. Pruitt SM, Hoyert DL, Anderson KN, Martin J, Waddell L, Duke C, et al. Racial and ethnic disparities in fetal deaths - United States, 2015-2017. Morb Mortal Wkyl Report. 2020;69(37):1277-82.

37. Auger N, Costopoulos A, Naimi AI, Bellingeri F, Vecchiato L, Fraser WD. Comparison of stillbirth rates by cause among Haitians and non-Haitians in Canada. Int J Gynaecol Obstet. 2016;134(3):315-9.

38. Page JM, Christiansen-Lindquist L, Thorsten V, Parker CB, Reddy UM, Dudley DJ, et al. Diagnostic tests for evaluation of stillbirth: results from the Stillbirth Collaborative Research Network. Obstet Gynaecol. 2017;129(4):699-706.

39. de Graaff EC, Wijs LA, Leemaqz S, Dekker GA. Risk factors for stillbirth in a socio-economically disadvantaged urban Australian population. J Matern Fetal Neonatal Med. 2017;30(1):17-22.

40. Gardosi J, Madurasinghe V, Williams M, Malik A, Francis A. Maternal and fetal risk factors for stillbirth: population based study. BMJ. 2013;346:f108.

41. Racape J, Schoenborn C, Sow M, Alexander S, Spiegelaere Md. Are all immigrant mothers really at risk of low birth weight and perinatal mortality? The crucial role of socio-economic status. BMC Pregnancy Childbirth. 2016;16(75).

42. Stacey T, Thompson JMD, Mitchell EA, Ekeroma AJ, Zuccollo JM, McCowan LME. Relationship between obesity, ethnicity and risk of late stillbirth: a case control study. BMC Pregnancy Childbirth. 2011;11:3.

43. Luque-Fernandez MA, Franco M, Gelaye B, Schomaker M, Garitano IG, D'Este C, et al. Unemployment and stillbirth risk among foreign-born and Spanish pregnant women in Spain, 2007-2010: a multilevel analysis study. Eur J Epidemiol. 2013;28(12):991-9.

44. Luque-Fernandez MA, Lone NI, Gutierrez-Garitano I, Bueno-Cavanillas A. Stillbirth risk by maternal socio-economic status and country of origin: a population-based observational study in Spain, 2007-08. Eur J Public Health. 2012;22(4):524-9.

45. Racape J, Spiegelaere Md, Dramaix M, Haelterman E, Alexander S. Effect of adopting host-country nationality on perinatal mortality rates and causes among immigrants in Brussels. Eur J Obstet Gynaecol and Reprod Biol. 2013;168(2):145-50.

46. Henderson J, Redshaw M. Parents' experience of perinatal post-mortem following stillbirth: A mixed

methods study. PLOS One. 2017;12(6):e0178475.

47. Cronin RS, Li M, Wise M, Bradford B, Culling V, Zuccollo J, et al. Late stillbirth post mortem examination in New Zealand: Maternal decision-making. Aust N Z J Obstet Gynaecol. 2018 Dec;58(6):667-73.

48. McPherson E, Nestoridi E, Heinke D, Roberts DJ, Fretts R, Yazdy MM, et al. Alternatives to autopsy for fetal and early neonatal (perinatal) deaths: Insights from the Wisconsin Stillbirth Service Program. Birth Defects Research. 2017 2017;109(18):1430-41.

49. Ravelli ACJ, Eskes M, van der Post JAM, Abu-Hanna A, de Groot CJM. Decreasing trend in preterm birth and perinatal mortality, do disparities also decline? BMC Public Health. 2020;20(1):783.

50. Kingdon C, Roberts D, Turner MA, Storey C, Crossland N, Finlayson KW, et al. Inequalities and stillbirth in the UK: a meta-narrative review. BMJ Open. 2019;9(9).

51. Belihu FB, Davey MA, Small R. Perinatal health outcomes of East African immigrant populations in Victoria, Australia: a population based study. BMC Pregnancy Childbirth. 2016;16(86).

52. Wingate MS, Barfield WD, Smith RA, Petrini J. Perinatal disparities between American Indians and Alaska natives and other US populations: Comparative changes in fetal and first day mortality, 1995-2008. Mat Child Health J. 2015;19(8):1802-12.

53. Calderon-Margalit R, Sherman D, Manor O, Kurzweil Y. Adverse perinatal outcomes among immigrant women from Ethiopia in Israel. Birth. 2015;42(2):125-31.

54. Sorbye IK, Stoltenberg C, Sundby J, Daltveit AK, Vangen S. Stillbirth and infant death among generations of Pakistani immigrant descent: a population-based study. Acta Obstetricia et Gynecologica Scandinavica. 2014;93(2):168-74.

55. Penn N, Oteng-Ntim E, Oakley LL, Doyle P. Ethnic variation in stillbirth risk and the role of maternal obesity: analysis of routine data from a London maternity unit. BMC Pregnancy Childbirth. 2014;14:404.

56. Faiz AS, Demissie K, Rich DQ, Kruse L, Rhoads GG. Trends and risk factors of stillbirth in New Jersey 1997-2005. J Matern Fetal Neonatal Med. 2012;25(6):699-705.

57. Stillbirth Collaborative Research Network Writing G. Association between stillbirth and risk factors known at pregnancy confirmation. JAMA. 2011;306(22):2469-79.

58. Stacey T, Thompson JMD, Mitchell EA, Ekeroma AJ, Zuccollo JM, McCowan LME. The Auckland Stillbirth study, a case-control study exploring modifiable risk factors for third trimester stillbirth: methods and rationale. Aus N Z J Obstet Gynaecol. 2011;51(1):3-8.

59. Reeske A, Kutschmann M, Razum O, Spallek J. Stillbirth differences according to regions of origin: an analysis of the German perinatal database, 2004-2007. BMC Pregnancy Childbirth. 2011;11:63.

60. Coffey P, Condon J, Dempsey K, Guthridge S, Thompson F. A retrospective population-based study of induction of labour trends and associated factors among aboriginal and non-aboriginal mothers in the northern territory between 2001 and 2012. BMC Pregnancy Childbirth. 2016;16(1):126-.

61. Kildea S, Stapleton H, Murphy R, Kosiak M, Gibbons K. The maternal and neonatal outcomes for an urban Indigenous population compared with their non-Indigenous counterparts and a trend analysis over four triennia. BMC Pregnancy Childbirth. 2013 2013/08/30;13(1):167.

62. Audette MC, Levytska K, Lye SJ, Melamed N, Kingdom JC. Parental ethnicity and placental maternal vascular malperfusion pathology in healthy nulliparous women. Placenta. 2018 Jun;66:40-6.

63. Kim LH, Caughey AB, Laguardia JC, Escobar GJ. Racial and ethnic differences in the prevalence of placenta previa. J Perinatol. 2012 Apr;32(4):260-4.

64. Cross-Sudworth F, Williams M, Gardosi J. Perinatal deaths of migrant mothers: Adverse outcomes from unrecognised risks and substandard care factors. Br J Midwifery. 2015;23(10):734-40.

65. Col Madendag I, Eraslan Sahin M, Madendag Y, Sahin E, Demir MB, Ozdemir F, et al. The effect of immigration on adverse perinatal outcomes: analysis of experiences at a Turkish tertiary hospital. BioMed Res Int. 2019;2019:2326797.

66. Choi SKY, Henry A, Hilder L, Gordon A, Jorm L, Chambers GM. Adverse perinatal outcomes in immigrants: A ten-year population-based observational study and assessment of growth charts. Paediatr Perinat Epidemiol. 2019;33(6):421-32.

67. Nybo Andersen A-M, Gundlund A, Villadsen SF. Stillbirth and congenital anomalies in migrants in

9

Europe. Best Pract Res Clin Obstet Gynaecol. 2016;32:50-9.

68. Gibson-Helm ME, Teede HJ, Cheng IH, Block AA, Knight M, East CE, et al. Maternal health and pregnancy outcomes comparing migrant women born in humanitarian and nonhumanitarian source countries: a retrospective, observational study. Birth. 2015 Jun;42(2):116-24.

**Table 1: Pooled estimate of causes of stillbirth based on the ICD 10-PM classification in various ethnic groups.** CI, confidence interval; ICD, International Classification of Diseases; M1, complications of placenta, cord, and membranes; M2, maternal complications of pregnancy; M3, other complications of labour and delivery; M4, maternal medical and surgical conditions; M5, no maternal condition identified; PE, pooled estimate.

| Ethnicity | ICD-10-PM Code | References | Studies (n) | Stillbirths (n) | Total births ( |
|---|---|---|---|---|---|
| Caucasian | M1 | 17, 18, 20-23, 25, 28-30 | 10 | 10,917 | 38,079 |
| | M2 | 17, 22, 23, 25 | 4 | 4,775 | 37, 271 |
| | M3 | 20 | 1 | 41 | 183 |
| | M4 | 17, 18, 20, 22, 23, 25, 30 | 7 | 2,555 | 37,551 |
| | M5 | 17, 18, 20, 22, 23, 25, 30, 31 | 9 | 19,186 | 37,970 |
| African | M1 | 17, 18, 20-23, 25, 28-30 | 10 | 4,787 | 18,221 |
| | M2 | 17, 22, 23, 25 | 4 | 3,016 | 17,584 |
| | M3 | 20 | 1 | 50 | 115 |
| | M4 | 17, 18, 20, 22, 23, 25, 30 | 7 | 2,030 | 17,743 |
| | M5 | 17, 18, 20, 22, 23, 25, 30, 31 | 9 | 8,000 | 17,992 |
| Hispanic | M1 | 20-23, 25 | 6 | 6,276 | 13,593 |
| | M2 | 22, 23, 25 | 3 | 1,875 | 12,915 |
| | M3 | 20 | 1 | 44 | 176 |
| | M4 | 20, 22, 23, 25 | 4 | 1,003 | 13,091 |
| | M5 | 20, 22, 23, 25, 31 | 5 | 6,276 | 13,267 |
| Indigenous Australians | M1 | 19, 27, 32 | 3 | 92 | 768 |
| | M2 | 19 | 1 | 2 | 47 |
| | M3 | 27 | 1 | 110 | 527 |
| | M4 | 19, 27, 32 | 3 | 103 | 768 |
| | M5 | 19, 26, 27, 32 | 4 | 472 | 1,121 |
| Asian | M1 | 18, 30 | 2 | 6 | 17 |
| | M2 | - | - | - | - |
| | M3 | - | - | - | - |
| | M4 | 30 | 1 | 1 | 10 |
| | M5 | 18, 30 | 2 | 8 | 17 |
| South Asian | M1 | 18, 28 | 2 | 21 | 55 |
| | M2 | - | - | - | - |
| | M3 | - | - | - | - |
| | M4 | 18 | 1 | 6 | 39 |
| | M5 | 18, 28 | 2 | 21 | 55 |
| American Indian | M1 | 17 | 1 | 7 | 27 |
| | M2 | 17 | 1 | 4 | 27 |
| | M3 | - | - | - | - |
| | M4 | 17 | 1 | 3 | 27 |
| | M5 | 17 | 1 | 13 | 27 |

**Hosted file**

`Figure_1.pptx` available at https://authorea.com/users/734821/articles/711566-ethnic-

variation-in-causes-of-stillbirth-in-high-income-countries-a-systematic-review-and-
meta-analysis

**Hosted file**

`Figure_2.pptx`     available     at     https://authorea.com/users/734821/articles/711566-ethnic-
variation-in-causes-of-stillbirth-in-high-income-countries-a-systematic-review-and-
meta-analysis