Environmental Chemical Exposure Research and Characteristics of Study Subjects Recruited from Midwifery vs. Hospital Based Clinics

Rapport d'exposition chimique environnementale et caractéristiques des sujets participants recrutés par une pratique sage-femme versus les cliniques établies à l'hôpital

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ABSTRACT

Exposure to environmental contaminants during pregnancy is thought to play a role in the reported increase in developmental abnormalities of the male reproductive tract and rise in the rates in testicular cancer among young men as well as increasing prevalence of allergy, asthma, obesity, and diabetes in the general population. Traditional epidemiological studies have recruited pregnant women from hospital clinics, delivery wards or physician offices. Recruitment of expectant mothers from midwifery clinics is being employed in ongoing studies and comparison of study subject characteristics suggests that there are no important differences in the socio-economic indicators. Hence we suggest that midwives have an important role to play in future epidemiological studies designed to determine the health consequences of exposure to environmental contaminants.

KEYWORDS

development, pregnancy, toxicology, exposure, and contaminants

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RÉSUMÉ

On pense que l'exposition aux contaminants environnementaux durant la grossesse jouent un rôle face à l'augmentation observée des anomalies dans le développement du système reproductif masculin, la hausse du nombre de cancer du testicule chez les jeunes hommes et la prévalence des cas d'allergies, d'asthme, d'obésité et de diabète dans la population en général. Les études épidémiologiques traditionnelles ont fait appel aux femmes enceintes provenant des cliniques d'hôpitaux, des salles d'accouchement ou des bureaux de médecins. Dans le cadre des études en cours, le recrutement des femmes enceintes suivies dans des cliniques de sage-femme et la comparaison des caractéristiques des sujets étudiés suggère qu'il n'existe aucune différence importante au niveau des indicateurs socio-économiques. À la lumière des faits, nous pensons que les sages-femmes ont un rôle important à jouer dans les futures études épidémiologiques conçues afin de déterminer les conséquences de l'exposition aux contaminants environnementaux sur la santé.

MOTS CLÉS
Développement, grossesse, toxicologie, exposition et contaminants.

Cet article a été évalué par des pairs.

INTRODUCTION

Through media reports we frequently are alerted that yet another chemical present in our food, air, water or products we use has been measured in human tissues or fluids. The rates of developmental abnormalities of the male reproductive tract[1-3] and testicular cancer[4] prevalence have increased in recent years raising concern that exposure to environmental contaminants are potential causative factors. In addition the rates of allergy, asthma, obesity and diabetes[5] are also all increasing. Although the epidemiological evidence is unclear,[6] potential health effects of developmental exposure to environmental contaminants are suggested from animal experiments,[7-11] while other studies have yielded conflicting results[12-15] and the clinical importance of these studies remains unclear. Thus, it is not surprising then, that in the absence of evidence, patient guidelines around prenatal exposure to environmental pollutants cannot be developed. Consequently, there is a need for epidemiological studies designed to determine the relationship between exposure to environmental contaminants and adverse pregnancy outcomes. While exposure studies have typically involved adult populations or pregnant women attending hospital clinics, we propose that midwives and the women they serve have an important role to play in future studies.

The Barker Hypothesis[16-19] has alerted the biomedical community to the importance of the intra-uterine environment to post natal health. The potential health impact of exposure to environmental contaminants is thought to be especially important for the developing fetus[20]. Accordingly increasing attention has been paid to documenting exposure to environmental contaminants during pregnancy. However, the consequences of these exposures in the expectant mother and fetus include, but are not limited to: pre-eclampsia, eclampsia, gestational diabetes, hypertension, premature labor, pre-term premature rupture of membranes, and placental abnormalities as well as intra-uterine growth retardation and low birth weight. Moreover, the consequences of in utero exposure to environmental contaminants on neonatal and childhood health have also not been thoroughly investigated. Even with plentiful literature, results are ambiguous and thus it is difficult to determine the relevance of the findings for human health. For example, maternal exposure to the metal lead has in some cases been linked with spontaneous abortion[21-23] whereas other investigators have been unable to find an association.[24,25] The literature is equally as equivocal for other groups of chemicals such as pesticides.[26-29]

The consequences for health of the developing fetus and newborn resulting from exposure to environmental chemicals such as Bisphenol A (a weak estrogenic chemical used in the manufacture of polycarbonate plastics), phthalates (anti-adrogenic chemicals used in making plastics pliable) are largely unknown despite evidence of widespread human exposure.[30,31] Furthermore, the effects of developmental exposure to environmental contaminants in children such as allergy, asthma, obesity, and hypertension are largely unknown. While it is widely accepted that with exposure to toxic levels of any chemical, there are likely to be serious consequences to maternal-fetal health, the consequences of exposure to environmental contaminants at the concentrations measured in contemporary studies are unknown and poorly understood. In order to develop the evidence necessary for regulatory decisions designed to protect the health of pregnant women and their fetuses, both in the short and long-term, there is a need for well designed epidemiological studies that examine the association between exposure to chemical contaminants and obstetrical outcomes and development of the offspring.

Emerging Research and Comparison of Study Subject Characteristics

Several studies designed to quantify maternal exposure to environmental contaminants and determine the relationship between exposure and adverse health outcomes in pregnant women and their babies are currently in progress. The Maternal Infant Exposure to Environmental Chemicals (MIREC) is a national study that aims to recruit 2,000 expectant mothers from across Canada to determine the relationship between developmental exposure to environmental contaminants and pregnancy complications, fetal development and development of the offspring. While the bulk of the study subjects are being recruited from hospital based programs, midwifery clinics in Hamilton, Ontario are playing an active role in recruiting study participants for this study. This study has been extended to a second project titled the "Maternal Infant Exposure to Environmental Chemicals-Infant Development Study (MIREC-ID)" which aims to follow offspring to explore any adverse effects of developmental exposure to environmental chemicals and infant development. While premature to discuss study results we can compare the characteristics of the study subjects recruited in Hamilton with participants in similar studies (Table 1). Specifically, in another investigation also conducted in Hamilton, the FAMILY (Family Atherosclerosis Monitoring In earLY life) Study, a longitudinal cohort study designed to identify prenatal and early life determinants of obesity, allergy, dyslipidemia, diabetes, and cardiovascular disease risk indicators in the offspring,[32] expectant mothers were recruited during their first ultrasound visit. Comparing the characteristics of the study participants in these studies with subjects recruited to the MIREC study from local midwifery clinics (Table 1) no differences in age, socioeconomic markers or smoking behavior are readily apparent. More women were likely to be self-employed if recruited from the hospital site whereas more women self-identified as stay at home mothers if they were recruited from a local midwifery clinic. However, income level and education was generally equivalent between these two populations. In this study, exposure to important hormonally active chemicals such as the Perfluorinated compounds used as fabric stain guards[33] and brominated flame retardants (chemicals applied to electronics equipment and fabrics) were quantified.[34] The latter two studies have demonstrated that although there is widespread exposure to these chemicals the concentrations measured in the plasma of expectant mothers and the cord blood of their babies are very low and in most cases are lower compared to women from other countries. Furthermore, the exposures were not associated with any adverse obstetrical outcomes or negative effects on birth weight.

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In addition to maternal age other key determinants of maternal health and healthy life-style choices in pregnancy are education and cigarette smoking. The percentage of study subjects recruited from both the midwifery clinics and the tertiary care hospital in Hamilton who completed college or university programs were similar (82 and 84.5%, respectively) which is higher than the 2005 national average of 69.6 % (95% CI = 68.1-71.2), the last year for which data are available.[35] The percentage of expectant mothers who reported smoking during pregnancy recruited from the midwifery clinics and the hospital in Hamilton (9.3 and 7.2%, respectively) were similar but lower than the national average of 13.4 % (95% CI = 12.4-14.4) for 2005. Taken together these data suggest that the study subjects recruited from local midwifery clinics and a tertiary care hospital in Hamilton are potentially more health conscious than women from across Canada. Thus differences in socioeconomic status and the generally healthier attitudes of our study subjects during pregnancy may limit generalization of results from these studies to the Canadian population overall. Although these key determinants of maternal health and healthy

choices during pregnancy were somewhat better in our study subjects compared to national statistics, higher maternal age compared to the national averages is a concern. The proportion of women recruited from the midwifery clinics and the tertiary care hospital in Hamilton who were older than 35 years of age were similar (22.7 and 32%, respectively) but greater than the proportion of women in Canada (15.4%) who gave birth to live offspring in 2004.[35] Older maternal age is associated with increased risk for serious maternal and neonatal morbidity.[36,37] Hence, our data suggest that study subjects in Hamilton may be at increased risk for adverse pregnancy outcomes compared to the national average. While these data suggest that Hamilton study subjects, whether recruited from a midwifery clinic or a tertiary care hospital, may not be representative of other sites in Canada, we suggest that comparison with study subjects from other major Canadian cities may yield comparable results and is an issue that will require further investigation. Furthermore, the similarity of the study subject characteristics from midwifery clinics and the tertiary care hospital suggest that midwifery clients are a suitable population to study. The slightly younger age of expectant mothers recruited from the midwifery clinics and higher percentage of smokers may indicate that recruitment from this population could provide greater access to a difficult to recruit population of women and thus greater involvement of midwifery clinics in obstetrical research is encouraged.

Table 1: *Comparison of study subject characteristics recruited from midwifery clinics vs. a tertiary care hospital ultrasound clinic.*

	Midwifery Clinics	Tertiary Care Hospital
Variable	**N (%)**	**N (%)**
Age		
< 20	2 (1.3)	1 (1.0)
20 34	114 (76.0)	63 (65.0)
35 - 40	30 (20.0)	27 (27.8)
> 40	4 (2.7)	6 (6.2)
Education		
High School	27 (18)	13 (13.4)
College / University	96 (64)	43 (44.3)
Post- graduate	27 (18)	39 (40.2)
Household Income		
< 30, 000	11 (7.3)	4 (4.3)
30,001 50,000	14 (9.3)	14 (14.9)
50,001 70,000	20 (13.3)	18 (19.1)
70,001 100,000	50 (33.3)	28 (29.8)
> 100,000	46 (30.7)	30 (31.9)
Unknown	9 (6)	-
Occupation		
Homemaker	26 (17.3)	3 (3.2)
Secretarial / Office	17 (17.3)	15 (15.8)
Skilled Labour	5 (3.4)	2 (2.1)
Business	10 (6.6)	10 (10.5)
Professional	64 (42.7)	38 (40)
Self-employed	5 (3.4)	12 (12.6)
Other	23 (3.4)	15 (15.8)
Smoking		
Yes	14 (9.3)	7 (7.2)
No	136 (90.7)	90 (92.8)

SUMMARY AND CONCLUSIONS

Although there are few studies that have explored the relationship between exposure to environmental contaminants and obstetrical outcomes as well as effects in the offspring, ongoing studies designed to address this weakness in the literature have begun to recruit study participants from midwifery clinics. Indeed, while traditionally expectant mothers have been recruited from the community, delivery wards, ultrasound clinics, and family physician or obstetrician offices, the characteristics of study participants recruited from midwifery

clinics do not differ in any important way from women recruited through traditional approaches. Therefore, we anticipate that midwives will have an increasingly important role to play in future epidemiological studies in this area. In addition to playing an important role in recruiting study subjects, midwives will also have important roles in experimental study design, the communication of results back to study participants, and advising their clients about the risks associated with exposures to environmental chemicals. Finally, taken together, we conclude that exposure to environmental contaminants in our community are most often at background levels. However, we acknowledge that further research in this area will be essential especially for hormonally active chemicals such as Bisphenol A and phthalates.

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