

ACHIEVING SAFE MOTHERHOOD: APPLYING A LIFE COURSE AND MULTIPLE DETERMINANTS PERINATAL HEALTH FRAMEWORK IN PUBLIC HEALTH

Dawn P. Misra, MHS, PhD^{a,c*} and Holly Grason, MA^{b,c}

^aDepartment of Health Behavior and Health Education, University of Michigan School of Public Health, Ann Arbor, Michigan

^bDepartment of Population and Family Health Sciences, Bloomberg School of Public Health, The Johns Hopkins University, Baltimore, Maryland

^cWomen's and Children's Health Policy Center, Bloomberg School of Public Health, The Johns Hopkins University, Baltimore Maryland

Received 5 July 2005; revised 3 November, 2005; accepted 9 February 2006

Safe motherhood has begun to be identified as a priority for the health of American women. We argue that safe motherhood can be achieved through application of a life course and multiple determinants framework. This framework, with its focus on the preconception period, poses a dilemma in that it links together periods of life and domains of activities that have traditionally not been linked with maternal health. The interests of women and children have often been juxtaposed in the making of policy. Further, the domains of women's health, maternal and child health, and family planning have often clashed over policy priorities and funds. This framework shows that the research literature now links them inextricably to better health outcomes, albeit indirectly; there are no intervention studies that have demonstrated the empirical efficacy of this approach. Thus, although this framework creates a strong rationale for the linkages described, it also demands attention to a set of implementation strategies that will overcome existing barriers. Through a focus on one maternal factor, obesity, we discuss how a range of strategies grounded in the framework can be undertaken to address maternal morbidity and mortality. We then examine selected strategies at each level of the multiple determinants life course framework and emphasize how public policies and public and private sector professional practice can be reexamined to improve outcomes for women in all time periods and aspects of reproductive potential, which in turn might enhance outcomes for their offspring, both at birth and beyond. Our intent is to influence how policy makers, public health professionals, clinicians, and researchers approach safe motherhood.

Introduction

Although maternal mortality in the United States has reached an historic low, the health of mothers is far from ensured. Although maternal mortality ratios in the United States underwent precipitous declines in the 20th century prior to plateauing in the

past 2 decades (Guyer, Freedman, Strobino, & Sondik, 2000), rates remain above those of several other developed nations including the United Kingdom, Canada, Spain, Italy, and Germany (AbouZahr & Wardlaw, 2003). Furthermore, there is a growing appreciation of the extent to which women experience significant and sometimes permanent morbidity as a result of pregnancy and childbirth (Bennett & Adams, 2002; Danel, Berg, Johnson, & Atrash, 2003; Wilcox, 2002). Although much of maternal morbidity is neither measured nor monitored (Bennett & Adams, 2002), recent studies in this area (Danel et al., 2003) provide considerable evidence that we are failing to safeguard the

Author Description.

* Correspondence to: Dawn P. Misra, Department of Health Behavior and Health Education, University of Michigan School of Public Health, 1420 Washington Heights, M5015, Ann Arbor, MI 48109.

E-mail: dmisra@umich.edu.

health of mothers in the United States (also see Geller et al. and Guendelman et al. in this issue of *Women's Health Issues*) Finally, US women experience persistent and sizable racial/ethnic and socioeconomic disparities for maternal morbidity (Bennett, Kotelchuck, Cox, Tucker, & Nadeau, 1998; Franks, Kendrick, Olson, & Atrash, 1992) and mortality (Atrash, Koonin, Lawson, Franks, & Smith, 1990; Berg, Atrash, Koonin, & Tucker, 1996; Centers for Disease Control and Prevention [CDC], 2001a).

Safe motherhood, once thought to be a concern only for developing countries, has begun to receive attention as a woman's health issue in the United States (Atrash, Alexander, & Berg, 1995; Bruce & The Safe Motherhood Working Group, 2002; Wilcox, 2002). Although the causes of maternal mortality and morbidity may differ across the globe, safe motherhood means "ensuring that all women receive the care they need to be safe and healthy throughout pregnancy and childbirth" (www.safemotherhood.org). Much of the focus in the developed as well as developing countries has been on maternal mortality. More recently, problems that arise during pregnancy and childbirth, whether they lead to lifelong sequelae or to severe short-term morbidity, are being identified as necessary to address if passage through motherhood is indeed to be "safe" for women (Bennett & Adams, 2002; Danel et al., 2003; Wilcox, 2002). Finally, although some may argue whether women have the "right" to safe motherhood, the increasing absolute and relative (to men) life expectancy of women suggests that protection of women's health pays long-term dividends to our society. With increasing numbers of women living into their 80s and 90s and insured by Medicare and Medicaid (Misra, 2001), the long-term cost-savings of safe motherhood could be substantial.

In this paper, we argue that approaches that simultaneously take account of the entire lifespan as well as multiple determinants may need to be adopted to improve maternal morbidity and mortality and thus provide safe motherhood for all women. We propose consideration of a framework that integrates these approaches and is supported by the research literature. Using scientific literature and reports of health and social programs and policies, we articulate how a life course and multiple determinants framework can be the basis for developing strategies that achieve safe motherhood. Through a focus on one maternal factor—obesity—we discuss how a range of strategies grounded in the framework can be undertaken to address maternal morbidity and mortality. Our intent is to influence how policy makers, public health professionals, clinicians, and researchers approach safe motherhood.

Background

Changing demographics of pregnancy

Trends in the demographic and health characteristics of the US childbearing population further compel us to develop a contemporary framework from which effective strategies to address safe motherhood may be devised. The age composition of the childbearing population has changed dramatically in the last few decades (Heck, Schoendorf, Ventura, & Kiely, 1997; Ventura, Curtis, & Mathews, 1999; Ventura, Mosher, Curtin, Abma, & Henshaw, 1999). For example, women are increasingly postponing childbearing until their 30s and 40s. The birth rates for women 30–44 years of age have been increasing since the 1970s with the rates in 2003 the highest since the advent of modern contraception. As a result, while women in their 20s still delivered the majority of live births in 2003, nearly 40% of births were to women ≥ 30 years (Martin, Kochanek, Strobino, Guyer, & MacDorman, 2005). This shift in age presents challenges to safe motherhood goals; there are both theoretical and empirical arguments that older mothers are at greater risk for maternal morbidity and mortality. First, the risk of most chronic diseases increases with age. Second, the longer a woman has had a chronic condition, the more likely it is that her health has been adversely affected so that she enters pregnancy in poorer health than a younger woman. Third, maternal mortality rates increase with maternal age (Chang et al., 2003) and the risk of maternal morbidity also appears to increase with maternal age (Cunningham & Leveno, 1995; Israel & Deutschberger, 1964; Morrison, 1975; Naeye, 1983; Peipert & Bracken, 1993; Stein, 1985; Ventura, 1989; Williams & Mittendorf, 1993). Furthermore, some studies suggest that even healthy older mothers experience increased rates of antenatal and intrapartum complications (Astolfi & Zonta, 2002; Cunningham & Leveno, 1995; Peipert & Bracken, 1993).

Changes in health insurance coverage for women

Health insurance coverage for women is another important demographic factor that is undergoing tremendous shifts. Although coverage for pregnant women has greatly expanded over the past 3 decades, rates of insurance coverage currently are trending downward across the board, and the scope of covered services is narrowing as payors face rising health care costs. In 2003, approximately 19% of women ages 18–64 were uninsured (Kaiser Family Foundation, 2004). Younger women of childbearing age are the least likely to be insured, with 29% of women 19–24 years lacking coverage (Kaiser Family Foundation, 2004). Women are more likely than men to be covered as dependents rather than to have job-based coverage in their own name (Kaiser Family Foundation, 2004).

This places women at greater risk for losing coverage both because employers are more apt to drop family coverage than employee coverage and women lose coverage if they divorce or are widowed. The gender disparity in loss of coverage was marked between 2002 and 2003, during which nearly 900,000 women lost health insurance coverage compared to 600,000 men (Holohan & Ghosh, 2004). This follows a 5-year trend in which the population of uninsured women has grown 3 times faster than the population of men without health insurance coverage (Lambrew, 2001). Although there are many factors producing health, the association between health and insurance coverage is well documented (Institute of Medicine Committee on the Consequences of Uninsurance, 2002). Although lack of coverage may not produce incident chronic diseases, health insurance coverage increases access to and utilization of health care and may minimize the adverse effects of chronic disease on one's health (Institute of Medicine Committee on the Consequences of Uninsurance, 2002). Furthermore, a lack of insurance and medical care following pregnancy may increase the likelihood that pregnancy-associated morbidity produces permanent health problems for a woman.

Although not a direct result of the changes in maternal age or health insurance coverage, other changes have also occurred that influence the health of the childbearing population in the United States and overlap with the trends in maternal age and insurance coverage in terms of implications for safe motherhood. We focus here on one condition that has changed the health of US women strikingly in the past 2 decades: obesity.

Childbearing and obesity

Overweight and obesity have both been increasing over the past 25 years. Based on the most current National Health and Nutrition Examination Survey (NHANES) data, the percentage of obese women 20–39 years old rose from 12.3% from 1976–1980 to 29.1% from 1999–2002 (Flegal, Carroll, Ogden, & Johnson, 2002; Hedley et al., 2004). Using the perinatal database of the University of Alabama, Lu et al. (2001) reported that the average body weight at the first prenatal visit increased 20% over the 20-year period (1980–1999), as did the percent of women weighing >200 pounds. A 10-fold increase was seen in the proportion of patients weighing \geq 300 pounds (Lu et al., 2001). Even more troubling are the increased rates of overweight and at risk for overweight being seen in children and adolescents, our future “mothers.” Among girls 6–19 years old in 1999–2002, 30.3% were at risk for overweight or were already overweight (Hedley et al., 2004). Obese women are at increased risk for antenatal and intrapartum complications of pregnancy, and experience higher rates of maternal

mortality and morbidity (Baeten, Bukusi, & Lambe, 2001; Ehrenberg, Durnwald, Catalano, & Mercer, 2004; Jensen et al., 2003; Rosenberg, Garbers, Chavkin, & Chiasson, 2003; Sebire et al., 2001; Weiss et al., 2004). Obesity also increases the likelihood that a woman will enter pregnancy with a chronic disease (Must et al., 1998), and therefore increases maternal morbidity and mortality as a result.

As a result of the increases in obesity in the child-bearing population, the role of chronic disease with regard to maternal morbidity and mortality again emerges as an important factor in ensuring safe motherhood for women. Pregnancy can certainly exacerbate chronic diseases (Landon & Samuels, 1991; Samuels, 1991b). Haas, Berman, Goldberg, Lee, and Cook, (1996) reported that women were 4 times more likely to be hospitalized antenatally if they had a history of chronic hypertension and 2 times more likely if they had a history of diabetes mellitus. The stage of pregnancy also may play a role with differing effects and differing levels of adherence to medical regimens at different points in the pregnancy (e.g., women may use less medication than prescribed because of fears of malformations).

Framework

We recently articulated a framework for perinatal health that integrates a lifespan approach with a multiple determinants model (Misra, Guyer, & Allston, 2003). The lifespan perspective focuses attention toward the preconceptional and interconceptional periods as targets for intervention in improving perinatal health. In this paper, we propose that safe motherhood can be achieved through application of this framework.

Briefly, we summarize the rationale for the life course aspect of the framework (see Misra et al., 2003, for further information) and emphasize the maternal health components of the model. First, some of the most powerful influences on pregnancy outcome are related to influences on women's health that occur long before pregnancy begins. Yet the focus of public health and clinical professionals has been on addressing factors in the antenatal period. In the latter sections of this paper, we focus on maternal obesity as one factor for which the lifespan perspective is particularly salient. Second, as discussed earlier in this paper, the demography of pregnancy has changed dramatically in the last 3 decades, with women delaying age at first birth (Martin et al., 2003; Ventura, Mosher, et al., 1999; Ventura, 1989). In response, our perinatal health framework therefore married a life course perspective with a multiple determinants model, incorporating forces that influence the health of women through successive stages of their lives and

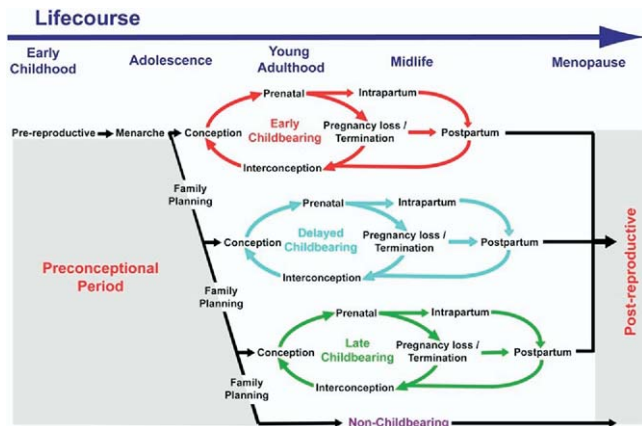


Figure 1. Women's reproductive cycles.

their reproductive cycles. Childhood and adolescence may represent critical periods for women for a range of behaviors and exposures (e.g., family planning, protection against sexually transmitted infections, nutrition). Integral to the framework are the potential reproductive periods and paths within a woman's life course (Figure 1). As noted, strategies to improve perinatal health have primarily focused on the prenatal, intrapartum, and immediate postpartum periods, and these strategies have failed to adequately address the impact of child, adolescent, and women's health on maternal and infant outcomes.

We adapted the perinatal health framework (Figure 2) from the Evans and Stoddart (1990) model of the determinants of health. Three of the 4 groups of outcomes from Evans and Stoddart are included here: (1) diseases and complications, (2) health and functioning, and (3) well-being. Table 1 describes the maternal outcomes in these 3 categories with diseases and complications subdivided as short term and long term. There are 2 levels of risk factors described in the framework. At the distal level, the framework brings focus to risk factors that place an individual or population at greater susceptibility to proximal risk factors. Although having the potential to directly influence individual health status, distal factors are more relevant in terms of increasing or decreasing an individual's predisposition toward developing compromising health conditions, engaging in high-risk behaviors, or being exposed to potential toxins. The primary categories of distal risk factors are genetic factors, the physical environment, and the social environment. At the proximal level of the framework, risk factors that have a direct impact on individual health status are represented by 2 categories—behavioral and biomedical responses.

Figure 2 also shows that health care can modify the relationships between the various components of the framework. Health care, in this context, is defined as the broad range of activities from primary preven-

tion—societal-level programs that could be targeted to preventing young adolescents from having unplanned pregnancy—to medical interventions that screen for or treat specific disease processes. Currently, data on utilization of prenatal care are routinely collected and monitored; the proportion of women receiving early and adequate care is nearly universally considered a sentinel indicator of the perinatal health system. However, data on even utilization of postpartum care, much less data on content and quality of the care, are neither routinely collected nor monitored in our current system. Our failure to monitor care in the immediate postpartum period, as well during the complete interconceptional period, also limits surveillance of maternal morbidity.

Proximal Factor: Obesity

In this paper, we focus on obesity as an example of how to address proximal-level factors as they relate to safe motherhood across the lifespan. This is intended to be representative of key issues for the wider range of proximal factors that can be more effectively addressed in the preconceptional and interconceptional periods. We first review the evidence base linking the factor of obesity to maternal morbidity and mortality. We follow this by discussing a set of broad strategies that could be used to advance some or all of the components of the perinatal health framework vis-à-vis safe motherhood. Finally, we outline strategies to address obesity across the life course stages. Our framework suggests that addressing factors across the life course rather than solely in the prenatal period is essential to ensuring safe motherhood. Throughout our discussion, we also examine the intersection of these proximal factors with racial/ethnic and socioeconomic disparities that are echoed by disparities in safe motherhood across the life course (maternal morbidity and mortality).

Review of obesity literature

As noted in the introduction, overweight and obesity have risen sharply among the entire United States population, including women currently of childbearing age as well as among children who represent the next generation of mothers. Obese women are at increased risk for complications of pregnancy (e.g., gestational diabetes [Baeten et al., 2001; Nucci et al., 2001; Sebire et al., 2001; Weiss et al., 2004], hypertensive disorders of pregnancy [Baeten et al., 2001; Cedergren, 2004; Nucci et al., 2001; Sebire et al., 2001; Weiss et al., 2004]) regardless of their health prior to pregnancy. Furthermore, obesity increases the risk of chronic disease, including diabetes, cardiovascular disease, osteoarthritis, and some forms of cancer (Ballard-Barbash & Swanson, 1996; Colditz et al., 1990;

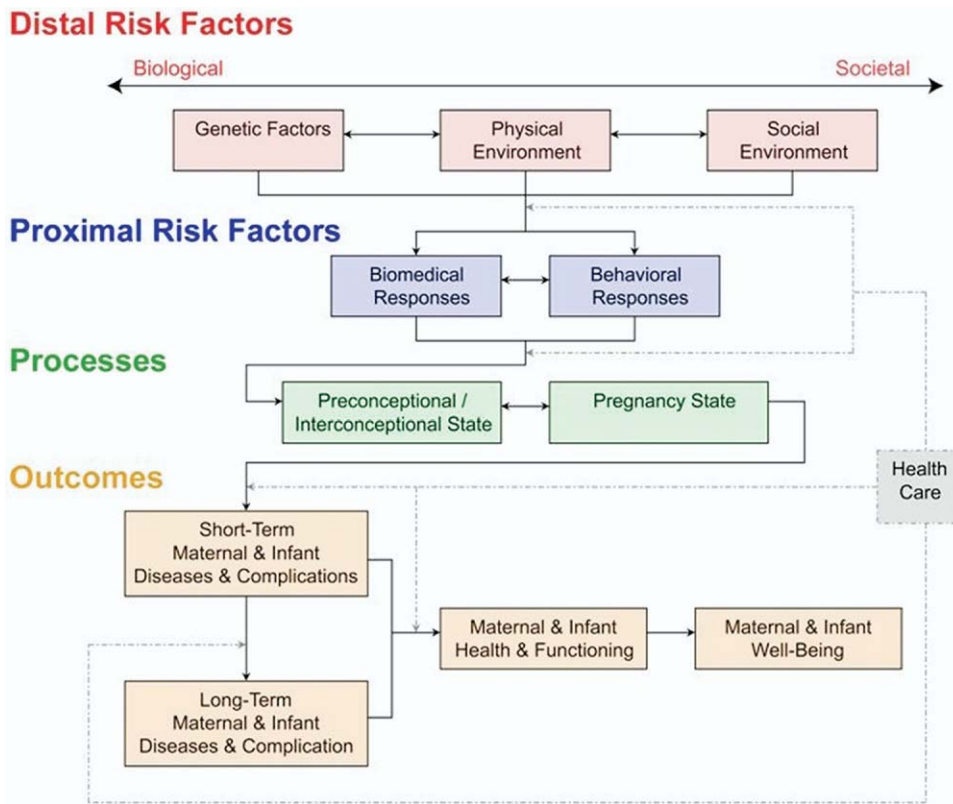


Figure 2. Perinatal health framework.

Felson, 1996; Kannel, D’Agostino, & Cobb, 1996; Manson et al., 1995; Must et al., 1998), which produces its own adverse effects on maternal morbidity and mortality. A recent study has raised the possibility that the effectiveness of oral contraceptives is reduced for overweight and obese women, increasing their risk of unintended pregnancy (Holt, Cushing-Haugen, & Daling, 2002).

Labor and delivery problems are also correlated with maternal body mass index (BMI) and risks for cesarean deliveries are elevated for obese women (Baeten et al., 2001; Dietz, Callaghan, Morrow, & Cogswell, 2005; Ehrenberg et al., 2004; Jensen et al., 2003; Rosenberg et al., 2003; Sebire et al., 2001; Weiss et al., 2004). This appears to be a function of a longer length of labor (Vahratian, Zhang, Troendle, Savitz, & Siega-Riz, 2004) as well as the increased frequency of macrosomia in the infant (Baeten et al., 2001; Nucci et al., 2001; Sebire et al., 2001; Weiss et al., 2004) and complications that require delivery to be expedited (e.g., preeclampsia). However, there is also growing evidence that obesity and excess pregnancy weight gain may also both increase a woman’s risk of intra-partum complications, regardless of her antenatal and preconceptional health (Ehrenberg et al., 2004; Jensen et al., 2003; Rosenberg et al., 2003). Recent studies suggest that overweight and obesity may even limit a

Table 1. Maternal outcomes

Short-term diseases and complications
Hemorrhage
Preeclampsia
Gestational diabetes
Cesarean section
Antenatal hospitalizations
Emergency department visits
Maternal mortality
Long-term diseases and complications
Postpartum depression
Pregnancy weight gain retention
Urinary incontinence
Risks during subsequent pregnancies
Cancer
Osteoporosis
Maternal health and functioning
Life expectancy
Limitations of daily living activities
Maternal well-being
Economic stability
Positive relationships
Autonomy
Personal growth
Self-acceptance
Purpose in life
Environmental mastery

woman's ability to successfully breastfeed (Baker, Michaelsen, Rasmussen, & Sorensen, 2004; Donanth & Amir, 2000; Hilson, Rasmussen, & Kjolhede, 1997; Kugyelka, Rasmussen, & Frongillo, 2004; Li, Jewell, & Grummer-Strawn, 2003). The mechanisms for lower rates of breastfeeding initiation and duration in obese women have not yet been definitively determined but physiologic, physical, and psychological factors all appear to play a role (Baker et al., 2004; Donanth & Amir, 2000; Hilson et al., 1997; Kugyelka et al., 2004; Li et al., 2003). Beyond morbidity, obesity is also related to the risk of maternal death. Although studies of maternal mortality have not focused on obesity as a determinant, Robinson, O'Connell, Joseph, and McLeod (2005) reported that prepregnancy obesity was an important risk factor for several clinical conditions that contribute to maternal death, chiefly pregnancy-induced hypertension, antepartum venous thromboembolism, labor induction, cesarean delivery, and wound infection.

The problems associated with obesity in women of childbearing age has also been considered with regard to costs. In a retrospective cohort study, Galtier-Dereure, Montpeyroux, Boulot, Bringer, and Jaffiol (1995) reported that the cost of prenatal care in overweight women was between 5- and 16-fold higher than in normal weight women and increased with level of obesity. In a later prospective study by the same group, the average cost of hospitalization antenatally was 5 times higher for women who began pregnancy overweight. Combining prenatal and postnatal hospitalization duration, obese women stayed approximately 4.5 days longer than normal weight women (Galtier-Dereure, Boegner, & Bringer, 2000).

There are no national statistics on what proportion of women gain more weight during pregnancy than is recommended for their prepregnancy weight. According to national birth certificate data, 33% of women gain >35 pounds, whereas the Institute of Medicine suggests a weight gain of 25–35 pounds is appropriate for average weight women (Martin et al., 2003). The extent to which pregnancy may contribute to obesity in women who were not obese prior to pregnancy is not fully understood, but may be an underappreciated long-term consequence of pregnancy for women. Gunderson and Abrams (1999), reviewing the literature in this area, estimated that between 14% and 20% of women weigh at least 5 kg more at 6–18 months postpartum. Early studies of prenatal weight gain and postpartum weight retention were criticized for limited length of follow-up and cross-sectional study designs (Rooney & Schauburger, 2002). However, more recent studies using longitudinal designs and following women for longer time periods strongly confirm the notion that pregnancy weight gain can lead to increases in women's weight and risk of obesity. The most important predictors of long-term

weight gain and higher BMIs at 10 (Rooney & Schauburger, 2002) and 15 years (Rooney, Schauburger, & Mathiason, 2005) after the study pregnancy were excess (over recommended amounts) pregnancy weight gain and the failure to lose pregnancy weight gain in the first 6 months postpartum. The potential risk that retained pregnancy weight gain may pose to the health of women, at present unmeasured and unexamined, needs to be monitored and addressed within the context of safe motherhood.

Disparities

The racial/ethnic and socioeconomic disparities seen for so many health conditions are also mirrored for obesity and overweight in adults as well as children. Based on 1999–2002 NHANES data, nearly half of non-Hispanic black women 20–39 years of age were classified as obese (46.6%) compared with one quarter of non-Hispanic whites (24.9%) and nearly one third (31.2%) of Mexican-American women in this age group (Hedley et al., 2004). In a study of all registered New York City births from 1998–1999, black women were disproportionately represented among those with prepregnant weights of 200–299 and over 300 pounds (Rosenberg et al., 2003). In that same time period, the proportion overweight was nearly double for non-Hispanic black girls (23.2) compared to non-Hispanic whites (12.9) with Mexican-American girls (18.5%) also much higher (Hedley et al., 2004). In a recent longitudinal study, Walker and colleagues (2004) studied the behavioral and psychosocial context of postpartum weight changes through the first postpartum year in a sample of low-income white, Hispanic, and African-American women. Although all the women experienced declines in their BMI in the first 6 weeks postpartum, only the white women experienced declines in BMI in the second 6 months; Hispanic and African-American women had small increases or no changes between measurements (Walker et al., 2004). This is consistent with an earlier study by Parker and Abrams (1993) demonstrating differences in postpartum weight retention between black and white women.

Rationale for addressing factors across life course

We have argued that obesity is an important risk factor that jeopardizes the health of our mothers. Many public health and medical professionals have called for increased attention to this condition. What has not been sufficiently emphasized is the critical need to address these factors across the life course and not exclusively in the prenatal period. We assert that there are 2 primary reasons why efforts have not shifted away from the prenatal period and toward a life course perspective. First, both public health and clinical professionals have become wedded to the notion that provision of prenatal care is fundamental

to continued improvements in maternal and infant health. But in our continuing efforts to ensure safe motherhood in the United States, we must critically evaluate whether more prenatal care is the only or best strategy (Misra & Guyer, 1998). There is tremendous support for prenatal care as an all-encompassing strategy to achieve better outcomes. Some assert that prenatal care ought to be one of the primary mechanisms to deliver yet to be developed interventions that will succeed in preventing maternal morbidity and mortality. To some extent, this presumes that causes and interventions will be biomedical. The successes of community based programs in women's health (Kushner & Ange, 2005; Poole & Kushner, 2005), which can reach women outside of clinical care settings, suggest that prenatal care may not be the "natural" and necessary locus for delivery of interventions. Even with improved utilization, there are clearly women who do not reach the medical system and these are the same women who are most in need of intervention. Furthermore, it is also unclear whether early and more intensive utilization of prenatal care reduces risk to the extent many have assumed it will, especially among those most at risk. As we argue in the conceptualization of the framework, the health of a woman prior to pregnancy strongly influences her risk of diseases and complications, her health and functioning, and her well-being. Increasing the utilization of prenatal care will not improve a woman's preconceptional health. Moreover, treating preexisting conditions when a woman presents for prenatal care can be more complex and more costly. Social factors also have strong influences, and it may be that changes in the woman's environment and resources are both more important and timely than medical services provided through prenatal care. Factors such as obesity are particularly difficult to address effectively during prenatal care, compared with a behavior such as cigarette smoking. Although prenatal care clearly has some benefits, the public health and clinical community may have oversold the idea of increasing prenatal care utilization as a way of protecting maternal health.

The importance of preconception care was duly noted in a number of reports published in the last 2 decades. However, although there has been past recognition that many health-related factors should be addressed outside of the pregnancy period, overall there have been difficulties with operationalizing this notion and approaching perinatal health from the lens of women's health. Although many of these frameworks have called attention to the preconceptional period, the factors and strategies identified have been limited in scope. For example, *Perinatal Health Strategies for the 21st Century* (1992) notes the need for attention to the preconceptional period. However, there is little in the strategic plan that addresses the

period prior to and between pregnancies. In the delineation of a "comprehensive perinatal health care benefits package," a yearly preconception care visit (risk assessment and health promotion) is included, but ongoing primary care for the woman is not explored. This emphasizes the clinical approach to preconceptional health, paralleling the prenatal care model. The strategic plan also addresses preconceptional health in its "education in perinatal health" component. Again, however, the emphasis is on changing factors in the perinatal period, not on ensuring that women are healthy throughout their lives and arrive at pregnancy in optimal health. The *Towards Improving the Outcomes of Pregnancy II* (TIOP II) recommendations (Committee on Perinatal Health, 1993) put forth by the March of Dimes, addressed the preconceptional period more comprehensively, calling attention to this period in 3 of the 10 key areas of recommendations: health promotion and health education; reproductive awareness; and preconception and interconception care. However, the bulk of the report focuses on regionalization of the perinatal care system with little substantive attention given to the preconceptional period issues. The TIOP II framework does not identify or discuss in detail the particular issues that should be included or emphasized in preconceptional (women's) health except for providing a reproductive health screening checklist to be used by the clinical provider.

The second reason we believe the medical and public health communities have become entrenched in the prenatal care model relates to financing of health care and funding of public health interventions. With the exception of some illegal immigrants, most women in this country do indeed now have financial access to prenatal care. Faced with evidence of prenatal care's value and cost effectiveness, legislative protections specific to prenatal care access have been enacted with respect to women publicly insured through Medicaid, and to commercially insured women, such as found in the Health Insurance Portability and Accountability Act (1996). These expansions have certainly increased the utilization of prenatal care (Kogan et al., 1998).

Health insurance coverage outside of pregnancy, however, is not nearly as universal. As discussed earlier in this paper, 1 in 5 adult women are uninsured and many women are underinsured and cannot afford the out-of-pocket medical expenses (Kaiser Family Foundation, 2004). Medicaid eligibility ends for women 60 days postpartum unless they are eligible for coverage on the basis of low-income status or reside in one of several states that have secured federal waiver authority to provide family planning and/or primary care services to non-pregnant low-income women. Financing of public health strategies is also closely tied a woman's pregnancy status, with funding politically more feasible when directly linked to programs ad-

dressing prenatal and intrapartum services such as prenatal care outreach and regionalization of perinatal care. Funding for programs to prevent future maternal morbidity and mortality by addressing the needs of nonpregnant women, adolescents, and children are not perceived to be as necessary or as urgent as those that provide for pregnant mothers.

In this context, we argue that obesity is an example of factors that are not only difficult to deal with in prenatal care, but is a condition for which prevention in childhood and adolescence is far more effective than are attempts at change in adulthood. No single strategy appears to be effective in the long term for weight loss in adulthood. There is also a tension between the needs of the fetus and the needs of the mother during the pregnancy with regard to weight gain. The ideal approach to obesity is prevention. The period in which prevention appears to be most effective occurs extremely distant from the prenatal period. Childhood and adolescence are critical periods in addressing these issues.

Strategies to Address Factors Across the Life Course

The issues of concern related to pregnancy and perinatal outcomes highlighted in this paper are linked with broader health concerns and health behaviors of women. A major challenge faced, however, is how to extend current thinking and programming related to perinatal health into that undertaken to address women's health. Reorientation of how we think about safe motherhood is important, not only to better address perinatal health concerns, but also because this approach allows health care policy makers and practice professionals to address the needs of women beyond any relation to motherhood.

This framework, with its focus on the preconception period, however, poses a particular dilemma in that it links together periods of life and domains of activities that have traditionally not been linked with maternal health. The interests of women and children have often been juxtaposed in the making of policy. Yet, this framework links girls, as children, to their future roles as adolescents and mothers. Further, the domains of women's health, maternal and child health, and family planning have often clashed over policy priorities and funds. This framework shows that the research literature now links them inextricably to better health outcomes, albeit indirectly as there are no intervention studies that have demonstrated the empirical efficacy of this approach. Thus, although this framework creates a strong rationale for the linkages described, it also demands attention to a set of implementation strategies that will overcome existing barriers.

Notwithstanding a social and political environment that might accommodate our propositions, policy makers and practitioners face a dilemma in incorporating new research into their programs. First, they are often presented with new research findings that are uncoordinated, confusing, and often conflicting. Second, they already have a set of operational frameworks, policies, and constituencies that constrain their ability to incorporate any new approaches into their work. Third, many are not themselves well trained or prepared to translate the research findings into a logical set of practices. Thus, one of the purposes of this perinatal health framework is to provide the organization of ideas and translation of research findings to make them accessible and usable by policy makers and public health practitioners. This section of the paper is intended to guide this process.

Below, we outline a set of such strategies that could be used to advance all or some of the components of the perinatal health framework. A range of public health and clinical care policy and practice strategies are available to stimulate progress. These generic approaches include (but are not limited to) communication/information strategies, regulatory strategies, data-driven strategies, administrative strategies, provider strategies, financing strategies, consumer awareness, promotion by nongovernmental organizations, and environmental changes. These strategies can be considered alongside the spectrum of determinants—from the most distal to the most proximal.

Figure 3 identifies examples of such broad thinking when applied to the specific health issue of obesity as it relates to women's and perinatal health. For our discussion, we focus on a few strategies that might be more feasibly implemented in the near term. Given the extensive and protracted timeframe needed in the United States to effect the profound social changes required to sufficiently change the environment (such as safe neighborhoods that allow for physical activity, and for children's freedom from pressures to use drugs), or provide universal health insurance for populations of all ages, we address these only briefly; this is in no way intended to ignore their profound importance. The strategies are first described as general categories; we then draw on obesity to illustrate implications for intervention using a lifespan perspective.

General Categories of Intervention Strategies

Information strategies. These could be used to reach 1) the population at risk, 2) providers, and 3) those who influence the larger system(s). This includes finding ways to present data to influence health behaviors, health care practices, and health policy. Examples of such involve interventions to package information differently, to promote health literacy and empower-

	Child	Adolescent	20s	30+
Distal Factors				
Genetic	Assessment of family history		Genetic screening	
Physical Environment	Food security			
	School food policies, nutrition			
	Neighborhood safety to allow physical activity			
			Workplace promotion of physical activity	
Social Environment	Teach stress management		Workplace food policies, offerings	
			Insurance coverage for all women of reproductive age, regardless of pregnancy status	
			Teach health literacy and skills for navigating the health system	
			Weight reduction support networks	
				Address domestic violence
Proximal Factors				
Risk				
Biomedical	Training for pediatric, family practice, and obstetric clinicians			
	Screening and monitoring		Training for internists, other subspecialists	
Behavioral	School based education and interventions		College and workplace interventions	
Processes				
Pre- Inter Conceptional			Medication management	
			Training for exercise and diet clinicians	
			Screening and monitoring	
Pregnancy State			Medical information transfer, coordination of care	
			Medication management	
Postnatal			Breastfeeding education, support specific to weight management	

Figure 3. Lifespan approach to Safe Motherhood intervention as applied to obesity. Grason, H. Applying a Lifespan Approach to Safe Motherhood Interventions. Presented at “Expecting Something Better” Jacobs Institute Conference, Washington, DC. May 2005.

ment of women for navigating the health system, to use different venues for communicating such information to women over the lifespan, and interventions involving information transfer across health specialties for individual women, and over time (e.g., person-centered longitudinal health records).

Broadly conceptualized, information strategies might also include data-driven policy change. Regu-

latory strategies have been used to define the perinatal health care system. Currently, however, regulation is not politically popular because it is considered “anti-market.” A recent article in the *Journal of the American Medical Association* provides an overview of current efforts within the United States to utilize publicly reported performance data to stimulate quality improvement within the health care system (Marshall,

Shekelle, Leatherman, & Brook, 2000). Studies have shown that public reporting on quality of care does have an impact on institutional providers. Thus, information strategies might also be applied to circumvent current political conservatism that rejects use of governmental interventions in the marketplace.

Finally, an important information strategy could involve more careful attention to messages provided for policy makers and the media when seeking to communicate ideas about women's health, the health of adolescents, reproductive health, and maternal health. Efforts could be made to promote in the public discourse better understanding of the interrelationships among these areas while being acceptable to the full spectrum of political viewpoints.

Administrative strategies. Options in this category might entail changing the current categorical, disease- and population-defined organizational schemes and practices of state and local health agencies to improve content, availability, and delivery of services. Opportunity exists to prompt new and creative ways to meld the goals of public programs and stimulate new practices oriented to those shared goals if agencies are configured in ways that reflect the multiple determinants and life course framework. For example, the typical state/local public health agency often organizes program activities and staff very separately; chronic disease activities (e.g., hypertension, diabetes, cancer prevention) are administered independent of maternal and child health-related programming such as prenatal care, family planning, and school health. State initiatives focused on women's health also can be separate from public health altogether. This strategy arena also entails consideration of implementing targeted interventions in nontraditional (or typically nonpublic health) settings, such as colleges or workplaces. New linkages between public health efforts and those institutions where women spend their time are needed to bring coherence to these approaches.

Financing strategies. Although clearly politically and technically difficult to address, this area is important. Low-income women are particularly vulnerable in this regard, as public insurance programming to date has supported insurance strategies largely aimed at assisting pregnant and postpartum women through the first 6 weeks following delivery. This obviates preconception care and adequate postpartum and interconceptional care for the approximately 7 million women (in fiscal 2000) enrolled in Medicaid under the pregnancy-related category. In approximately 21 states, however, opportunities have been seized for extending Medicaid coverage to low-income women (through Family Planning or other waivers) and/or for providing family coverage through the State Children's Health Insurance Program (Gold, 2004). Notwithstanding im-

provements in public insurance programming over the past 25 years, Medicaid coverage can be precarious given both the states' latitude to determine/change many aspects of eligibility, enrollment, coverage, and provider payment policy, and in particular regard to current federal and state fiscal budget concerns. With respect to private, employer-sponsored insurance, women who are just beginning their careers earning entry-level wages, working part time, or working in the service sector may opt not to secure coverage, given the high and rising cost of insurance. In fact, in many such cases, insurance coverage is not even offered by the employer. This current financing scenario is of considerable concern for women in their 20s, given that they are newly entering the workforce and that there is high prevalence of health risk behaviors as well as pregnancy—planned or unplanned. Two additional concerns to address within the category of financing are 1) whether insurance plans (public or private) include coverage of services such as weight reduction programs and 2) whether, if covered, these services are adequately reimbursed.

Provider strategies. Publication of clinical research findings and provider guidelines are tools routinely applied to promote behavior change in physician practice. Nonetheless, experience shows that changing established physician behaviors appears to be particularly challenging (Davis, Thomson, Oxman, & Haynes, 1995). We will want physician and nonphysician clinical providers, whether practicing primary care or a subspecialty, to cross boundaries and to function in team settings. Medical specialists beyond those traditionally involved in obstetrics (e.g., endocrinologists, cardiologists.) could be required to attend to pregnancy and childbirth issues and pediatricians to enhance and extend prevention counseling. Needed are obstetricians who will talk with their clients about cardiovascular disease, and generalists and specialists who address pregnancy planning with their patients—both male and female. A focus on medical school and residency training, both with respect to knowledge base and process (e.g., team care), therefore might have merit.

As noted in the introduction to the framework, access and utilization of postpartum care and assessment of the quality and quantity of postpartum care have rarely been explored and data are neither routinely collected nor monitored on postpartum care. Consistent with the emphasis placed on the prenatal period, guidelines for perinatal care pay short shrift to postpartum visits. A provider-based strategy could focus on developing more comprehensive guidelines for postpartum care that are consistent with the life course perspective of our framework. This might include addressing linkages to ongoing care for women with chronic medical conditions and attain-

ment of healthy body weight in the interconceptional period.

If changing provider practice routines appears infeasible, other approaches might include 1) encouraging all providers of women's health care—not just physicians and nurse midwives—to address these issues (perhaps focus on nurses and nurse practitioners) (Committee on Perinatal Health, 1993), or 2) pursue changes that are not dependent (exclusively, or at all) on medical professionals. That is, starting from the standpoint of a woman's life experience, are there different leverage points and/or a different set of professionals who can be tapped for interventions? For example, might exercise and diet clinicians (personal trainers), or coaches of sports teams (appropriately trained) be engaged in ways that allow them to make important contributions to the health of women across the life course?

Nongovernmental strategies. Strategies could be community based and be undertaken by such varying groups as church congregations and the Girl Scouts. Methods used in nongovernmental strategies frequently include communication efforts utilizing mass market media. Groups such as the Media Project (a program of Advocates for Youth) and the Centers for Disease Control and Prevention work with the entertainment industry to accurately portray a variety of health issues. Health education interventions do not necessarily need to involve creation of costly new public programs, but might focus on integrating purposeful messages into already widely accessed media and entertainment sources, a strategy known as "entertainment education." This strategy has been used successfully around other health topics such as sexual and reproductive health. For example, as a part of a Viacom and Kaiser Family Foundation collaboration, HIV-themed programming has been woven into Viacom-produced series on its networks. Although television viewing has been linked with childhood overweight (Kaiser Family Foundation, 2004), media approaches to health promotion could capitalize on the prominence of television and other types of media in the lives of children, adolescents, and young adults. This type of strategy was used to target obesity in youth in New Zealand. Through a partnership between Auckland Healthcare and the TV2 Maitime program, directors and producers were given nutrition training and then incorporated healthy eating messages into programming (New Zealand Ministry of Health, 2001). Taking a cue from these examples, health organizations could work with the entertainment industry to craft scripts that contain accurate information about nutrition and exercise, and provide healthy role models. Following such programming with pertinent public service announcements that provide a way to contact resources may make this strat-

egy even more effective. Evaluation research suggests that entertainment education is successful in raising awareness about issues and, when linked with pertinent PSAs can also motivate people to take action in their personal lives (Kaiser Family Foundation, 2004).

Environmental strategies. Environmental strategies most familiar in the public policy arena are interventions such as clean up of toxic waste, or engineering the structural design of automobiles to make them more crash resistant. In many cases, what are considered to be environmental strategies are implemented through regulation, such as with food labeling. In recent years, there has been growing interest in focusing on urban planning or community design to influence behaviors with respect to safety and convenience for increased physical activity; in 2003, the American Public Health Association devoted an entire issue of its journal (*American Journal of Public Health*, Vol. 93, No. 9) to these strategies. A parallel application of environmental strategies is seen in efforts to address the health problem of tobacco use. The enactment of prohibitions of smoking in the workplace and other public venues has been shown to be feasible and effective in promoting broadscale behavior change over time.

Strategies to address framework by life course stage

Using obesity, we discuss selected strategies at each level of the multiple determinants life course framework and emphasize how public policies and public and private sector professional practice can be reexamined to improve outcomes for women in all time periods and aspects of reproductive potential, which in turn might enhance outcomes for their offspring, both at birth and beyond. Although evidence is accumulating that the prenatal period is an important window for exposures that may have independent influences on adult health, with some suggesting even further that fetal programming may occur during this critical period and determine postnatal growth and health resulting in adult health problems, we do not explicitly discuss strategies as they relate to this life course period. Although we recognize the importance of the prenatal period in this regard, we wish to avoid being circular and assert that this life course stage has long been the focus of attention, albeit for different reasons.

Girls in childhood. As seen in Figure 3, the emphasis in childhood is on distal determinants and reduction of biomedical and behavioral risk. Public health recently has begun to focus more intently on roles and efforts to make environments where children live are safe and amenable to physical activity (e.g., bike paths, open space, and "built communities" concepts) and to attend to enforcement of statutes (Title IX) to optimize

The Food on the Run program offered through California Project LEAN (Leaders Encouraging Activity & Nutrition) (California Project Lean) uses a community based approach to address the problem of obesity by encouraging healthy eating and physical activity. Through the program, high school students receive training on nutrition, physical activity, and media advocacy. They then work to make healthy changes in their schools such as the addition of healthier foods to cafeteria menus and increased opportunities for students to be active. As an example of their activities, in 2000, students involved with Food on the Run helped release the California High School Fast Food Survey (Samuels and Associates, 2000) to the media and then lobbied for policy change in the availability of fast food on campuses. Not only does it promote individual behavior change and environmental solutions to obesity, Food on the Run also provides young people with leadership experience and a forum for engagement that may reduce their time interacting with media. Recent research suggests that interventions that decrease media time may in itself be an effective strategy to address childhood obesity (Henry J. Kaiser Foundation, 2004).

Figure 4. Community-based project.

opportunities for girls to be engaged in sports. Clearly, more can and should be done in this regard. Focusing on an entirely different aspect, recognizing the role of genetic factors in obesity, consideration might be given to including taking a family history specific to obesity in pediatric health assessment, and providing ongoing anticipatory guidance and health monitoring where indicated. Such history taking could be incorporated in requirements for the Medicaid Early Periodic Screening, Diagnosis and Treatment (EPSDT) program, and in *Bright Futures* practice standards for pediatricians. Pediatric and family practice clinicians need to more fully understand the implications of obesity for maternal health so that they can strengthen their practices related to screening, monitoring, and communicating pertinent information (health counseling) to their patients.

Young girls spend much of their time in school settings, implicating the need for health professionals (particularly public health professionals) to become more influential with regard to school policies and interventions related to foods offered in school buildings (including vending machines) and physical exercise. Some work in this arena has begun under the leadership of the Centers for Disease Control and Prevention and the US Department of Agriculture Food and Nutrition Services (Team Nutrition, www.fns.usda.gov/tn/) (French, Story, Fulkerson, & Hannan, 2004; Gortmaker et al., 1999; Sallis et al., 1997; US Department of Health and Human Services, 2000).

There is further opportunity to enhance health education provided in schools by incorporating messages about the importance of weight management for maternal health and perinatal outcomes. Science can be used to shape the messages. Information strategies around breastfeeding could be particularly salient with regard to the issue of obesity for the next generation of mothers.

Adolescent girls. During adolescence, the need for attention to distal determinants continues. Given developmental changes, however, the teenage years imply different influences on behavior (peers rather than families), different activities, and different places where teens spend time (e.g., workplaces are added to schools). For example, school-sponsored activities would likely need to include peer support groups to any weight reduction programming, and school health curricula might include health education messages about the scientific links between obesity and compromised maternal and infant health and/or difficulty with childbearing. A community-based project focusing on developing media advocacy skills in adolescents around the issues of nutrition and physical activity is described in detail in Figure 4.

Information on the benefits of breastfeeding might also be considered (see Figure 5). There may also be a need to address potential problems in addressing obesity issues, issues that are concerns for all women but may be particularly salient in this age group. First, an unintended and undesirable consequence of focusing on obesity may be the development of negative body images for young women and possibly trigger eating disorders (Johnson & Misra, 2001). Second, obesity and depression may be associated; however, the direction of causality is unclear (Goodman & Whitaker, 2002). Adolescence may be when both conditions first emerge and attention could be paid to these comorbidities.

Consideration of the determinants and applicable strategies during the adolescent years also brings to bear those concerns related to access to the health care system, as well as the increased exposure to health risks and inclination toward risky behavior (especially related to use of tobacco, alcohol, and illicit drugs). Availability of and patterns of use of contraceptives might change where a teenager seeks care, thereby

Breastfeeding and its relationship to maternal health outcomes illustrates the necessity of a life course/multideterminant framework when promoting safe motherhood. Although increasing breastfeeding rates has been a national health goal (e.g., [US Department of Health and Human Services, 2000b](#)), interventions targeting women in pregnancy have had only limited success in increasing initiation and duration. Evidence shows that many women's attitudes toward breastfeeding have already formed and their infant feeding decisions are made before a pregnancy even occurs ([Goulet, Lampron, Marcil, & Ross, 2003](#); [Leffler, 2000](#); [Wiemann, DuBois, & Berenson, 1998](#)). The New York State Health Department's *Breastfeeding: First Step to Good Health (A Breastfeeding Education Activity Package for Grades K–12)* ([New York State Health Department, 2005](#)) provides an example of a school-based informational strategy to promote breastfeeding at a time during the life course when attitudes about benefits, barriers, and social norms are being formed. The *First Step to Good Health* integrates physiologic and psychosocial aspects of breastfeeding throughout variety of subjects across the curriculum, including health, science, and social studies. By working within the school setting, the program has the ability to reach young women who may be less likely to breastfeed if and when they do decide to parent (such as young women of color and those who were not breastfed themselves). Because adolescent mothers are less likely to breastfeed than their adult counterparts ([Peterson & DaVanzo, 1992](#); [Wiemann et al., 1998](#)), this early exposure is especially important. By exposing students to breastfeeding at an early age and educating both males and females, the program may change perception of social norms and increase partner support. Support of a woman's partner (usually male) is correlated with increased breastfeeding initiation and duration ([Baranowski et al., 1983](#); [Ineichen, Pierce, & Lawrenson, 1997](#); [Isabella & Isabella, 1994](#)).

Figure 5. Curriculum example.

affecting the ability to deliver services and information resources to her. Moreover, the emerging strong push to promote abstinence only as a primary means of contraception may ultimately contribute to decreased use of health services by teen girls. Interventions for communicating health messages and intervening with adolescents who commit to abstinence pledges need to be extended. Beliefs about oral contraceptive use leading to weight gain may also need to be addressed vis-à-vis the increasing prevalence of obesity in adolescent and young women. Although the "lore" of oral contraceptive-induced weight gain is discussed among teen girls, in a recent review of the literature, Gallo and colleagues reported that there is insufficient evidence linking weight gain and oral contraceptive use and that a large effect seems unlikely ([Gallo, Grimes, Schulz, & Helmerhorst, 2004](#)).

The need for attention to preconceptional concerns begins in this age range as well. We can anticipate that, at some future point, genetic testing for obesity will become available and will be targeted in this age stage, because obesity-related conditions are increasingly appearing in adolescent populations ([Barsh, Farooqi, & O'Rahilly, 2000](#); [Segal, Sankar, & Reed, 2004](#)).

A particular focus on a woman-centered medical information transfer approach among medical professionals may be especially important in the adolescent age period. Pediatric histories need to be relayed to family practice and internal medicine physicians and reproductive health providers. For example, if type 2 diabetes develops during adolescence as a result of a

child's obese state, then medication/disease management information and strategies need to be planned and communicated across medical specialties and over time. Both the young woman, and each of her health care providers, need to be aware of the implications should she plan to, or actually, become pregnant.

Young women in their 20s. The highest rates of child-bearing occur among women in their 20s. Hence, the focus in this time period extends to all levels of the framework. Although attention to distal determinants continues, there is an increased need to focus on risk, and on processes of care. First, a woman-centered, life course approach calls for different foci of public health interventions and venues for communicating health information than for young girls and teens. Over half of undergraduate students are now female ([National Center for Education Statistics, 2002](#)). Many reside on campus in addition to spending the largest share of their daytime hours there. Many young women also or alternatively participate in the workforce. Places of employment and college environments need to be engaged in examining opportunities to initiate health promoting policies and interventions (e.g., incentives to promote/allow physical activity and appropriate food choice opportunities), again with a strong emphasis on the links between their behavior and maternal health and pregnancy outcomes. A number of large employers have sought to address issues specific to pregnant employees, as well as

lifestyle health for all female employees (see [Washington Business Group on Health, 1996](#), for references and examples). Public health partnerships might be pursued to enhance messages and expand the reach of interventions like these.

The provider base for health interventions might be expanded by providing training for exercise and diet clinicians (physical trainers, etc.) that would enable them to incorporate screening and monitoring into routine interactions with their clients. Young women in their 20s, although less likely than young girls or teens to participate in team sports (like little girls or adolescents), are likely to be found spending time in gyms/athletic clubs. A provider-based strategy might be undertaken to explore new types of providers and places for providing health information, screening, and guidance.

At the risk level, the strategy to ensure information transfer across providers over time is important (family planning, primary care, specialists, obstetrician/gynecologist). Within a period of just a few years, a woman in her 20s is likely to experience many changes in providers. This is largely developmental in its genesis both medically and with respect to social roles. Older adolescents/young women transition from having a pediatric primary care provider only to also using a provider who delivers family planning services (obstetrician/gynecologist or other). They additionally transition from having a pediatric/adolescent primary care provider to an internist or family practitioner for primary care. Hence, from the outset of adulthood, primary health care for women involves multiple providers and is often fragmented because of the separation of reproductive and nonreproductive health services (CDC, 2001b; Clancy & Massion, 1992; Henderson, Weisman, & Grason, 2002; Weisman, 1998; Weisman, Cassard, & Plichta, 1995). Moreover, young women tend to change jobs and/or relocate geographically more frequently. They therefore experience insurance coverage changes resulting in changing care providers. Because infrequent and/or disrupted use of health services and/or frequent changes in providers may be the norm for many young women, all health care providers need to be educationally and attitudinally ready to provide some level of assessment/screening, counseling, and follow-up as necessary.

At the process level, information transfer across providers in real time is of high importance. Women often see multiple providers and yet and none of the providers may be considering all of the woman's needs. Prepregnancy and periconceptional management of chronic diseases may minimize the effects of the condition on both mother and fetus. Particular treatments for chronic disease that are used in nonpregnant women may also be teratogenic and

therapies may need to be modified for women who are pregnant or at risk for conception. For example, a number of anticonvulsant drugs used to treat epilepsy have been found to increase risk of birth defects (reviewed by [Samuels, 1991a](#)). Similar issues arise for other pharmacologic treatments. Ongoing and prepregnancy consultation for such patients can allow for selection of an appropriate therapeutic regimen that will be effective in managing the woman's condition both during and prior to pregnancy. Issues of medication management and optimization of management for both mother and fetus could be emphasized in training for family planning providers, internists, and medical specialists such as endocrinologists so they understand what to look for in terms of how certain conditions (obesity and sequelae like diabetes) put women at greater risk with respect to pregnancy. Innovations such as electronic portable patient records (see paper by Gregory et al. in this issue) or restructuring payment schemes to incentivize team and/or multidisciplinary care could also enhance care that treats a woman in a more holistic fashion to ensure safe motherhood.

Conclusions

As illustrated in these examples, the lifespan multiple determinants approach demands attention to consistency and continuity with respect to health information and health care. Policies and program and practice interventions can be envisioned along the age continuum that would contribute to improved maternal health. As noted, however, the system of health care for women is characterized by fragmentation, with women accessing preventive and primary care from multiple providers. Moreover, continuity of care as we have known it—having providers with whom long-term therapeutic relationships exist—appears to no longer be possible. Such arrangements have been systemically disrupted in recent decades, owing to increasing specialization among medical professions and disruption of long-term patient–primary care provider relationships frequently driven by constantly changing managed care plan provider panels and employer cost-containment initiatives. Therefore, the medical system and providers can not be solely relied on to address the issues raised in this life course framework. Gaps across the lifespan in the frequency with which women interface with the health system for primary care put women at risk if we do not find other approaches to addressing factors across the life course. Patient-based approaches complemented by population-based efforts to reach women across their life course are

critical to ensuring safe motherhood. Although we suggest a number of specific interventions that can be derived by such analysis of the framework, it really argues for a multicomponent approach applied consistently over time to yield the greatest potential for sustainable positive impact.

Acknowledgments

The ideas put forward in this article were greatly enhanced by colleagues who collaborated with us in its' presentation at the Jacob's Institute "Expecting Something Better" conference in May 2005. We are deeply grateful for the contributions of Mary Applegate (New York State Department of Health), Annette Phelps (Florida Department of Health), Wanda Nicholson (Johns Hopkins Bloomberg School of Public Health), Michele Curtis (University of Texas—Houston Health Sciences Center), Andrea Gelzer (CIGNA Healthcare, Inc.), Kay Johnson (Johnson Group Consulting, Inc.), and Carol Weisman (Penn State College of Medicine). Also, we wish to acknowledge the contributions of Bernard Guyer, Adam Allston, and Ann Koontz in the formative stages of this work. Finally, we thank our anonymous reviewers for their insights and guidance regarding refining the initial manuscript.

References

- AbouZahr, C., & Wardlaw, T. (2003). *Maternal mortality in 2000: Estimates developed by WHO, UNICEF, and UNFPA*. New York: The Alan Guttmacher Institute.
- Astolfi, P., & Zonta, L. (2002). Delayed maternity and risk at delivery. *Paediatric and Perinatal Epidemiology*, 16, 67–72.
- Atrash, H., Alexander, S., & Berg, C. (1995). Maternal mortality in developed countries: Not just a concern of the past. *Obstetrics and Gynecology*, 86, 700–705.
- Atrash, H., Koonin, L., Lawson, H., Franks, A., & Smith, J. (1990). Maternal mortality in the United States, 1979–1986. *Obstetrics & Gynecology* 76, 1055–1060.
- Baeten, J., Bukusi, E., & Lambe, M. (2001). Pregnancy complications and outcomes among overweight and obese nulliparous women. *American Journal of Public Health*, 91, 436–440.
- Baker, J., Michaelsen, K., Rasmussen, K., & Sorensen, T. (2004). Maternal prepregnant body mass index, duration of breastfeeding, and timing of complementary food introduction are associated with infant weight gain. *American Journal of Clinical Nutrition*, 80, 1579–1588.
- Ballard-Barbash, R., & Swanson, C. (1996). Body weight: Estimation of risk for breast and endometrial cancers. *American Journal of Clinical Nutrition*, 63 (Suppl.), 437S–431S.
- Baranowski, T., Bee, D., Rassin, D., Richardson, C., Brown, J., N, & Nader, P. (1983). Social support, social influence, ethnicity, and the breastfeeding decision. *Social Science & Medicine*, 17, 1599–1611.
- Barsh, G., Farooqi, I., & O'Rahilly, S. (2000). Genetics of body-weight regulation. *Nature*, 404, 644–666.
- Bennett, T., & Adams, M. (2002). Safe Motherhood in the United States: Challenges for surveillance. *Maternal and Child Health Journal*, 6, 221–226.
- Bennett, T. A., Kotelchuck, M., Cox, C. E., Tucker, M. J., & Nadeau, D. A. (1998). Pregnancy-associated hospitalizations in the United States in 1991 and 1992: A comprehensive view of maternal morbidity. *American Journal of Obstetrics and Gynecology*, 178, 346–354.
- Berg, C. J., Atrash, H. K., Koonin, L. M., & Tucker, M. (1996). Pregnancy-related mortality in the United States, 1987–1990. *Obstetrics and Gynecology*, 88, 161–167.
- Bruce, F., & The Safe Motherhood Working Group. (2002). Highlights from the National Summit on Safe Motherhood: Investing in the health of women. *Maternal and Child Health Journal*, 6, 67–69.
- Cedergren, M. (2004). Maternal morbid obesity and the risk of adverse pregnancy outcome. *Obstetrics and Gynecology*, 103, 219–224.
- Centers for Disease Control and Prevention (CDC). (2001a). Pregnancy-related deaths among Hispanic, Asian/Pacific Islander, and American-Indian/Alaska Native women—United States, 1991–1997. *Morbidity and Mortality Weekly Report*, 50, 361.
- Centers for Disease Control and Prevention (CDC). (2001b). Utilization of ambulatory medical care by women: United States, 1997–98. *Vital and Health Statistics*, 13(149).
- Chang, J., Elam-Evans, L., Berg, C., Herndon, J., Flowers, L., Seed, K., et al. (2003). Pregnancy-related mortality surveillance—United States, 1991–1999. *Morbidity and Mortality Weekly Report*, 52 (SS-2), 1–8.
- Clancy, C., & Massion, C. (1992). American women's health care: A patchwork quilt with gaps. *Journal of the American Medical Association*, 268, 1918–1920.
- Colditz, G., Willett, W., Stampfer, M., Manson, J., Hennekens, C., Arky, R., et al. (1990). Weight as a risk factor for clinical diabetes in women. *American Journal of Epidemiology*, 132, 501–513.
- Committee on Perinatal Health (1993). *Towards Improving the Outcome of Pregnancy. The 1990s and Beyond. (TIOPII)*. White Plains, NY: March of Dimes Birth Defects Foundation.
- Cunningham, F. G., & Leveno, K. J. (1995). Childbearing among older women—The message is cautiously optimistic. *New England Journal of Medicine*, 333, 1002–1004.
- Danel, I., Berg, C., Johnson, C., & Atrash, H. (2003). Magnitude of maternal morbidity during labor and delivery: United States, 1993–1997. *American Journal of Public Health*, 93, 631–634.
- Davis, D., Thomson, M., Oxman, A., & Haynes, R. (1995). Changing physician performance. A systematic review of the effect of continuing medical education strategies. *Journal of the American Medical Association*, 274, 700–705.
- Dietz, P., Callaghan, W., Morrow, B., & Cogswell, M. (2005). Population-based assessment of the risk of primary cesarean delivery due to excess prepregnancy weight among nulliparous women delivering term infants. *Maternal and Child Health Journal*, 9, 237–244.
- Donanth, S., & Amir, L. (2000). Does maternal obesity adversely affect breastfeeding initiation and duration? *Journal of Paediatrics and Child Health*, 36, 482–486.
- Ehrenberg, H., Durnwald, C., Catalano, P., & Mercer, B. (2004). The influence of obesity and diabetes on the risk of cesarean delivery. *American Journal of Obstetrics and Gynecology*, 191, 969–974.
- Evans, R. G., & Stoddart, G. L. (1990). Producing health, consuming health care. *Social Science & Medicine*, 31, 1347–1363.
- Felson, D. (1996). Weight and osteoarthritis. *American Journal of Clinical Nutrition*, 63 (Suppl.), 430S–432S.
- Flegal, K., Carroll, M., Ogden, C., & Johnson, C. (2002). Prevalence and trends in obesity among U.S. adults, 1999–2000. *Journal of the American Medical Association*, 288, 1723–1727.
- Franks, A., Kendrick, J., Olson, D., & Atrash, H. (1992). Hospitalization for pregnancy complications, United States, 1993–1997. *American Journal of Obstetrics and Gynecology*, 166, 1339–1344.
- French, S., Story, M., Fulkerson, J., & Hannan, P. (2004). An environmental intervention to promote lower-fat food choices in secondary schools: Outcomes of the TACOS study. *American Journal of Public Health*, 94, 1507–1512.
- Gallo, M., Grimes, D., Schulz, K., & Helmerhorst, F. (2004). Combination estrogen-progestin contraceptives and body weight: Systematic review of randomized controlled trials. *Obstetrics and Gynecology*, 103, 359–373.

- Galtier-Dereure, F., Boegner, C., & Bringer, J. (2000). Obesity and pregnancy: Complications and cost. *American Journal of Clinical Nutrition*, 71 (Suppl.), 1242S–1248S.
- Galtier-Dereure, F., Montpeyrou, F., Boulot, P., Bringer, J., & Jaffiol, C. (1995). Weight excess before pregnancy: Complications and cost. *International Journal of Obesity and Related Metabolic Disorders*, 19, 443–448.
- Gold, R. (2004). Medicaid family planning expansions hit stride. *The Guttmacher Report on Public Policy*, 6. New York: The Allan Guttmacher Institute.
- Goodman, E., & Whitaker, R. (2002). A prospective study of the role of depression in the development and persistence of adolescent obesity. *Pediatrics*, 110, 497–504.
- Gortmaker, S., Cheung, L., Peterson, K., Chomitz, G., Cradle, J., Dart, H., et al. (1999). Impact of a school-based interdisciplinary intervention on diet and physical activity among urban primary school children. *Archives of Pediatrics & Adolescent Medicine*, 153, 975–983.
- Goulet, C., Lampron, A., Marcil, I., & Ross, L. (2003). Attitudes and subjective norms of male and female adolescents toward breastfeeding. *Journal of Human Lactation*, 19, 402–410.
- Gunderson, E., & Abrams, B. (1999). Epidemiology of gestational weight gain and body weight changes after pregnancy. *Epidemiologic Reviews*, 21, 261–275.
- Guyer, B., Freedman, M., Strobino, D., & Sondik, E. (2000). Annual summary of vital statistics: Trends in the health of Americans during the 20th century. *Pediatrics*, 106, 1307–1317.
- Haas, J. S., Berman, S., Goldberg, A. B., Lee, L. W. K., & Cook, E. F. (1996). Prenatal hospitalization and compliance with guidelines for prenatal care. *American Journal of Public Health*, 86, 815–819.
- Heck, K., Schoendorf, K., Ventura, S., & Kiely, J. (1997). Delayed childbearing by education level in the United States, 1969–1994. *Maternal and Child Health Journal*, 1, 81–87.
- Hedley, A., Ogden, C., Johnson, C., Carroll, M., Curtin, L., & Flegal, K. (2004). Prevalence of overweight and obesity among U.S. children, adolescents, and adults, 1999–2002. *Journal of the American Medical Association*, 291, 2847–2850.
- Henderson, J., Weisman, C., & Grason, H. (2002). Are two doctors better than one? Women's physician use and appropriate care. *Women's Health Issues*, 12, 138–149.
- Henry J. Kaiser Family Foundation (2004). *The role of media in childhood obesity*. Washington, DC: Henry J. Kaiser Family Foundation.
- Hilson, J., Rasmussen, K., & Kjolhede, C. (1997). Maternal obesity and breast-feeding success in a rural population of white women. *American Journal of Clinical Nutrition*, 66, 1371–1378.
- Holohan, J., & Ghosh, A. (2004). *The economic downturn and changes in health insurance coverage, 2000–2003*. Washington, DC: Kaiser Family Foundation.
- Holt, V., Cushing-Haugen, K., & Daling, J. (2002). Body weight and risk of oral contraceptive failure. *Obstetrics and Gynecology*, 99, 820–827.
- Ineichen, B., Pierce, M., & Lawrenson, R. (1997). Teenage mothers as breastfeeders: Attitudes and behavior. *Journal of Adolescence*, 20, 505–509.
- Institute of Medicine Committee on the Consequences of Uninsurance (2002). *Care without coverage: Too little, too late*. Washington, DC: National Academy Press.
- Isabella, P., & Isabella, R. (1994). Correlates of successful breastfeeding: A study of social and personal factors. *Journal of Human Lactation*, 4, 257–264.
- Israel, S., & Deutschberger, J. (1964). Relation of the mother's age to obstetric performance. *Obstetrics and Gynecology*, 24, 411–417.
- Jensen, D., Damm, P., Sorensen, B., Molsted-Pedersen, L., Westergaard, J., Ovesen, P., et al. (2003). Pregnancy outcome and prepregnancy body mass index in 2459 glucose-tolerant Danish women. *American Journal of Obstetrics and Gynecology*, 189, 239–244.
- Johnson, C., & Misra, D. (2001). Mental health. In D. Misra (Ed.), *Women's health data book* (3rd ed.). Washington, DC: Jacobs Institute of Women's Health, Kaiser Family Foundation.
- Kaiser Family Foundation (2004). *Women's health insurance coverage*. Menlo Park, CA/Washington, DC: Kaiser Family Foundation.
- Kannel, W., D'Agostino, R., & Cobb, J. (1996). Effect of weight on cardiovascular disease. *American Journal of Clinical Nutrition*, 63 (Suppl), 419S–422S.
- Kogan, M. D., Martin, J. A., Alexander, G. R., Kotelchuck, M., Ventura, S., & Frigoletto, F. D. (1998). The changing pattern of prenatal care utilization in the U.S., 1981–1995: A Comparison of prenatal care indices. *Journal of the American Medical Association*, 279, 1623–1628.
- Kugyelka, J., Rasmussen, K., & Frongillo, E. (2004). Maternal obesity is negatively associated with breastfeeding success among Hispanic but not black women. *Journal of Nutrition*, 134, 1746–1753.
- Kushner, K., & Ange, E. (2005). *Women's health: Successes and challenges in prevention and promotion*. Washington, DC: National Institute of Health Care Management.
- Lambrew, J. (2001). *Diagnosing disparities in health insurance for women: A prescription for change*. New York: The Commonwealth Fund.
- Landon, M., & Samuels, P. (1991). Cardiac and pulmonary disease. In S. Gabbe, J. Niebyl & J. Simpson (Eds.), *Obstetrics: Normal and problem pregnancies* (2nd ed., pp. 1062–1070). New York: Churchill Livingstone.
- Leffler, D. (2000). U.S. high school age girls may be receptive to breastfeeding promotion. *Journal of Human Lactation*, 16, 36–40.
- Li, R., Jewell, S., & Grummer-Strawn, L. (2003). Maternal obesity and breast-feeding practices. *American Journal of Clinical Nutrition*, 77, 931–936.
- Lu, G., Rouse, D., DuBard, M., Cliver, S., Kimberlin, D., & Hauth, J. (2001). The effect of the increasing prevalence of maternal obesity on perinatal morbidity. *American Journal of Obstetrics and Gynecology*, 185, 845–849.
- Manson, J., Willett, W., Stampfer, M., Colditz, G., Hunter, D., Hankinson, S., et al. (1995). Body weight and mortality among women. *The New England Journal of Medicine*, 333, 677–685.
- Marshall, M., Shekelle, P., Leatherman, S., & Brook, R. (2000). The public release performance data: What do we expect to gain? A review of the evidence. *Journal of the American Medical Association*, 283, L1866–L1874.
- Martin, J., Hamilton, B., Sutton, P., Ventura, S., Menacker, F., & Munson, M. (2003). Births: Final data for 2002. *National Vital Statistics Report*, 52, 1–94.
- Martin, J., Kochanek, K., Strobino, D., Guyer, B., & MacDorman, M. (2005). Annual summary of vital statistics—2003. *Pediatrics*, 115, 619–634.
- Misra, D. (2001). *Women's health data book* (3rd ed.). Washington, DC: Jacobs Institute of Women's Health/Kaiser Family Foundation.
- Misra, D. P., & Guyer, B. (1998). Benefits and limitations of prenatal care. From counting visits to measuring content. *Journal of the American Medical Association*, 279, 1661–1662.
- Misra, D., Guyer, B., & Allston, A. (2003). Integrated perinatal health framework: A multiple determinants model with a life-span approach. *American Journal of Preventive Medicine*, 25, 65–75.
- Morrison, I. (1975). The elderly primigravida. *Obstetrics and Gynecology*, 121, 465–470.
- Must, A., Spadano, J., Coakley, E., Field, A., Colditz, G., & Dietz, W. (1998). The disease burden associated with overweight and obesity. *Journal of the American Medical Association*, 282, 1523–1529.
- Naeye, R. L. (1983). Maternal age, obstetric complications, and the outcome of pregnancy. *Obstetrics and Gynecology*, 61, 210–216.
- National Center for Education Statistics. (2002). *Digest of education statistics, 2002, based on Higher Education General Information Surveys, "Fall Enrollment in Colleges and Universities" surveys, and*

- Integrated Postsecondary Education Data System Enrollment surveys.* Washington, DC: U.S. Department of Education.
- New York State Health Department. (2005). Breastfeeding: First step to good health. A breastfeeding activity package for grades k-12. Available: www.health.state.ny.us. Accessed November 1, 2005
- New Zealand Ministry of Health. (2001). *New Zealand Health Strategy: DHB Toolkit: Obesity*. Available: www.newhealth.govt.nz. Accessed April 19, 2005.
- Nucci, L., Schmidt, M., Duncan, B., Fuchs, S., Fleck, E., & Britto, M. (2001). Nutritional status of pregnant women: Prevalence and associated pregnancy outcomes. *Revista de Saude Pública*, 35, 502–507.
- Parker, J., & Abrams, B. (1993). Differences in postpartum weight retention between black and white mothers. *Obstetrics and Gynecology*, 81, 768–774.
- Peipert, J. G., & Bracken, M. B. (1993). Maternal age: An independent risk factor for cesarean delivery. *Obstetrics and Gynecology*, 81, 200–205.
- Perinatal Health Strategies for the 21st Century (1992). *Perinatal Health Strategies for the 21st Century*. Providence, RI: National Perinatal Information Center.
- Peterson, S., & DaVanzo, J. (1992). Why are teenagers in the United States less likely to breast-feed than older women? *Demography*, 29, 431–450.
- Poole, V., & Kushner, K. (2005). *Women's health prevention and promotion* (No. Action Brief 13). Washington, DC: National Institute for Health Care Management.
- Robinson, H., O'Connell, C., Joseph, K., & McLeod, N. (2005). Maternal outcome in pregnancies complicated by obesity. *Obstetrics and Gynecology*, 106, 1357–1364.
- Rooney, B., & Schauburger, C. (2002). Excess pregnancy weight gain and long-term obesity: One decade later. *Obstetrics and Gynecology*, 100, 245–252.
- Rooney, B., Schauburger, C., & Mathiason, M. (2005). Impact of perinatal weight change on long-term obesity and obesity-related illnesses. *Obstetrics and Gynecology*, 106, 1349–1356.
- Rosenberg, T., Garbers, S., Chavkin, W., & Chiasson, M. (2003). Prepregnancy weight and adverse perinatal outcomes in an ethnically diverse population. *Obstetrics and Gynecology*, 102, 1022–1027.
- Sallis, J., McKenzie, T., Alcaraz, J., Kolody, B., Faucette, N., & Hovell, M. (1997). The effects of a 2-year physical education program (SPARK) on physical activity and fitness in elementary school students: Sports, Play and Active Recreation for Kids. *American Journal of Public Health*, 87, 128–134.
- Samuels, P. (1991a). Neurologic disorders. In S. Gabbe, J. Niebyl & J. Simpson (Eds.), *Obstetrics: Normal and problem pregnancies* (2nd ed., pp. 1183–1189). New York: Churchill Livingstone.
- Samuels, P. (1991b). Renal disease. In S. Gabbe, J. Niebyl & J. Simpson (Eds.), *Obstetrics: Normal and problem pregnancies* (2nd ed., pp. 1088–1092). New York: Churchill Livingstone.
- Sebire, N., Jolly, M., Harris, J., Wadsworth, J., Joffe, M., Beard, R., et al. (2001). Maternal obesity and pregnancy outcome: A study of 287 213 pregnancies in London. *International Journal of Obesity*, 25, 1175–1182.
- Segal, M., Sankar, P., & Reed, D. (2004). Research issues in genetic testing of adolescents for obesity. *Nutrition Reviews*, 62, 307–320.
- Stein, Z. (1985). A woman's age: Childbearing and childrearing. *American Journal of Epidemiology*, 121, 327–342.
- US Department of Health and Human Services. (2000a). *School health index for physical activity and health eating: A self-assessment and planning guide*. Atlanta, GA: Centers for Disease Control and Prevention.
- US Department of Health and Human Services (2000b). *Healthy People 2012*. Washington, DC.
- Vahratian, A., Zhang, J., Troendle, J., Savitz, D., & Siega-Riz, A. (2004). Maternal pre-pregnancy overweight and obesity and the pattern of labor progression in term nulliparous women. *Obstetrics and Gynecology*, 104, 943–951.
- Ventura, S. J. (1989). Trends and variations in first births to older women 1970–1986. *Vital and Health Statistics*, 21, 47.
- Ventura, S., Curtis, S., & Mathews, T. (1999). Births: Final data for 1998. *National Vital Statistics Reports*, 47(18).
- Ventura, S., Mosher, W., Curtin, S., Abma, J., & Henshaw, S. (1999). Highlights of trends in pregnancies and pregnancy rates by outcome: Estimates for the United States, 1976–96. *National Vital Statistics Reports*, 47(29), 1–12.
- Walker, L., Freeland-Graves, J., Milani, T., Hanss-Nuss, H., George, G., Sterling, B., et al. (2004). Weight and behavioral and psychosocial factors among ethnically diverse, low-income women after childbirth: I. Methods and context. *Women and Health*, 40, 1–34.
- Washington Business Group on Health (1996). *Business, Babies and the Bottom Line—Corporate Innovation and Best Practices in Maternal and Child Health*. Washington, DC.
- Weisman, C. (1998). *Women's health care: Activist traditions and institutional change*. Baltimore, MD: The Johns Hopkins University Press.
- Weisman, C., Cassard, S., & Plichta, S. (1995). Types of physicians used by women for regular health care: Implications for services received. *Journal of Women's Health*, 4, 407–416.
- Weiss, J., Malone, F., Emig, D., Ball, R., Nyberg, D., Comstock, C., et al. (2004). Obesity, obstetric complications and cesarean delivery rate—A population-based screening study. *American Journal of Obstetrics and Gynecology*, 190, 1091–1097.
- Wiemann, C., DuBois, J., & Berenson, A. (1998). Racial/ethnic differences in the decision to breastfeed among adolescent mothers. *Pediatrics*, 101, E11.
- Wilcox, L. (2002). Pregnancy and women's lives in the twenty-first century: The United States Safe Motherhood movement. *Maternal and Child Health Journal*, 6, 215–219.
- Williams, M. A., & Mittendorf, R. (1993). Increasing maternal age as a determinant for placenta previa: More important than increasing parity? *Journal of Reproductive Medicine*, 38, 425–428.

Author Descriptions

Holly Grason, MA, is an Associate Professor in the Department of Population and Family Health Sciences, Johns Hopkins Bloomberg School of Public Health and Director of the Women's and Children's Health Policy Center (WCHPC).

Dawn Misra, MHS, PhD, is an Associate Professor in the Department of Health Behavior and Health Education at the University of Michigan School of Public Health. She is an epidemiologist whose work emphasizes the integration of social and biologic factors in understanding perinatal health.
