The Impact of Maternal Nutrition on the Offspring

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Preface

The nutrition of women before conception, during pregnancy and lactation has profound effects on reproductive outcome and infant development. Thus, nutrition before conception is not only related to fertility but, in fact, can affect early embryogenesis and determine life-long health. Nutrition during pregnancy and lactation clearly affects fetal growth and infant development. The evidence accumulated over the past two decades indicates that being of small size at birth or malnourished during infancy, especially when followed by rapid weight gain during recovery, carries an increased risk for the development of chronic diseases in adulthood. These associations further extend the importance of maternal nutrition for optimal growth and development of the offspring to life-long health and support the so-called ‘fetal origins of adult disease’ or ‘thrifty phenotype’ hypothesis. Thus, the susceptibility to develop chronic diseases such as coronary heart disease, type-2 diabetes mellitus, and hypertension can be the consequence of intrauterine adaptations to fetal undernutrition. These adaptations are thought to persist during adult life and become detrimental particularly if energy-dense diets are consumed and physical activity is low. The risk for certain chronic diseases may thus be ‘programmed’ or ‘imprinted’ by unbalanced nutrition during pregnancy. The importance of birth weight and postnatal nutrition on brain development and cognitive capacity have now been clearly established. Therefore, optimizing the nutrition of women during their reproductive period can be expected to have a profound influence on the health and well-being of the next generation, and likely contributes to enhancing health and possibly to a reduction in healthcare costs per year of healthy life.

During the 55th Nestlé Nutrition Workshop held at Beijing, the Peoples Republic of China, new aspects of the impact of maternal nutrition on the offspring were reviewed and discussed in depth, together with prospective areas of research in this particular field. Internationally renowned experts in the field reported on existing and new observational evidence concerning the potential role of maternal nutrition in the etiology of adverse pregnancy outcomes, pointed to the interactions between genotype, environmental factors like dietary behavior, and life style, and summarized the potential
importance of folic acid, vitamin A, and iodine as key nutrients during embryogenesis, a period of rapid cell replication. The metabolic processes of endogenous substrates also play an important role during this period. Special attention was given to the energy requirements and adaptations during pregnancy, and to the effects of deviations thereof on fetal outcome. In addition, potential mechanisms were discussed by which macro- and micronutrients may affect placental function and, consequently, fetal growth. The first day of the workshop was concluded by stipulating the importance of the relationship between nutrition – of children in particular – and economic development, with special emphasis on the Chinese situation.

The second day of the meeting was devoted to the importance of an adequate intake of essential fatty acids and their longer-chain, more-unsaturated derivatives during pregnancy, lactation, and infancy. Special attention was given to optimum early physical and mental development, certain aspects of pregnancy outcome, and the possible enhancement of cognitive performance, and prevention of metabolic derangements such as insulin resistance and obesity. The potential mechanisms involved in these effects were examined and discussed. Subsequently, animal studies showing that isocaloric, high carbohydrate diets given during infancy resulted in hyperinsulinemia and obesity in later life were analyzed. Under these conditions, the alterations affect future offspring supporting a transgenerational effect. The potential of dietary practice in early infancy for later disease prevention was further supported by these studies.

Observational studies in the Gambia were reported which strongly suggest that maternal malnutrition is associated with an increased risk of infections in later life of the offspring. Supporting evidence for this hypothesis was presented from studies in Pakistan, suggesting that antibody generation in response to immunizations can be compromised by fetal growth retardation.

On the last day of the workshop, evidence was summarized to suggest that the ‘fetal origins hypothesis’ needs readjustment, since the relationship between birth weight and later type-2 diabetes seems to be U-shaped, thus at both extremes of the birth weight distribution there appears to be an increased susceptibility for later disease. This may be dependent on the body composition of the fetus. In fact, the evidence from India suggests that low birth weight infants have increased abdominal adiposity. This may explain why Indian and other Asian populations with a high prevalence of low birth weight are now exhibiting the metabolic syndrome at lower values of the body mass index, considered normal for Western populations. Data from the Dutch famine study were presented suggesting that maternal malnutrition during early or late pregnancy have specific effects on the risk of later diseases. Furthermore, some results indicate that the nutritional status around the time of conception may be of importance for affecting later disease risks.

The negative impact of maternal obesity on reproductive function, pregnancy complications and pregnancy outcomes was also discussed. Especially with
respect to birth defects it was felt that further research is needed. Adverse pregnancy outcomes in teenagers were demonstrated to be at least partly due to inadequate nutrition before conception and during pregnancy. Although intervention programs exist to meet the nutritional needs of pregnant teenagers, it was felt that these interventions require optimization. More research is also required with respect to the impact of dietary antigens ingested by the mother during pregnancy on later allergic disease in the offspring. In addition, it was felt that dietary prevention of allergic disease during pregnancy will only have a borderline effect if not followed by adequate perinatal and postnatal interventions. Suboptimal nutrition during pregnancy and lactation is often associated with an inadequate micronutrient intake. Supplementation studies, however, demonstrate that there may be negative consequences that likely result from the multiple interactions among micronutrients and between micronutrients and other physiologic responses. More knowledge on this issue is required to design better strategies for eliminating micronutrient deficiencies and improving pregnancy and lactation outcome, both for women and their infants.

All presentations were followed by lively discussions, demonstrating the importance of the topics presented at this very well-organized workshop. We sincerely thank the competent staff of Nestlé (China) Ltd. for their great hospitality which made this event not only a scientific highlight, but a social pleasure as well.

G. Hornstra and R. Uauy
Foreword

For this 55th Nestlé Pediatric Nutrition Workshop, which took place in April 2004 in Beijing, the topic ‘The Impact of Maternal Nutrition on the Offspring’ was chosen. We know a lot about the appropriate nutrition of infants and children. When it comes to the point whether the nutritional status of a pregnant mother has an impact on the development of the fetus in the womb and subsequently on that of her child, there are little data except some very fundamental ones; most knowledge derives from animal studies. The intention of this workshop was to learn more about the effects of maternal nutrition on fetal growth, metabolic programming, the requirements of energy and various nutrients as well as the effects of under- and overnutrition during pregnancy. Finally, the question of whether a distinct diet during pregnancy could reduce food allergy in the offspring was addressed.

I would like to thank the three chairmen, Prof. Gerard Hornstra, Prof. Ricardo Uauy and Prof. Xiaoguang Yang, who are recognized experts in this field, for putting the program together and inviting the opinion leaders in the field of maternal and infant nutrition as speakers. Pediatricians from 18 countries contributed to the discussions that are published in this book.

Mrs. Kelan Liu and her team from Nestlé China provided all logistical support, enabling the participants to enjoy Chinese hospitality. Dr. Philippe Steenhout from Nestlé’s Nutrition Strategic Business Division in Lausanne, Switzerland, was responsible for the scientific coordination. His cooperation with the chairpersons was essential to the success of this workshop.

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