Association between healthy eating in pregnancy and allergic status of the offspring in childhood

Over the past few decades there has been a steady increase in the prevalence of non-communicable diseases (NCD), including allergic disease. Changing lifestyle and subsequent diet may explain this increase seen in the prevalence of atopic disease. Epidemiological evidence also suggests that diet may be key in the prevention of allergic disease [1]. There are three important characteristics in terms of the maternal diet that has been investigated for the prevention of allergic disease: 1) the role of particular nutrients such as vitamins (A, D and E), zinc, fatty acids, or 2) the role of particular foods such as fruits and vegetables, fish, or 3) the total dietary intake such as a 'Mediterranean diet' or a healthy diet. Research utilising the healthy eating index tool, specific to the pregnancy diet, found no association between overall healthy eating score and recurrent wheeze in infants at the age of three [2]. However, maternal intake of celery and citrus fruit specifically has been associated with an increased risk of sensitisation to food allergens in two year olds [3]. One case control study found no effect of consumption of fish, butter and margarine on development of atopic sensitisation in the offspring of allergic mothers; however a protective effect of fish intake (2-3 times a week or more) was identified in the non-allergic mothers' group with the risk of food sensitisation in the offspring reduced by greater than a third [4]. Thus, the question is whether the associations seen are due to the individual nutrients/foods or whether it is part of an overall nutritional composition of the weaning diet. In this study we aimed to investigate if maternal diet, and specifically seafood intake during pregnancy, is associated with the infant's allergic outcomes in a well allergy-characterised birth cohort at three and ten years of age.

The FAIR study methodology has been described previously [5]. In short, pregnant women with an estimated delivery time between 1st September 2001 to 31st August 2002 were approached at antenatal clinics on the Isle of Wight. The study comprised a whole population birth cohort (FAIR). Ethical approval for the study was obtained from the Isle of Wight, Portsmouth and South East Hampshire Local Research Ethics Committee (REF 09/01) and the NRES South Central - Southampton B Research Ethics Committee (REF 10/H0504/11). Following consent, a validated food frequency

questionnaire (FFQ) was completed at 36 weeks gestation. At three, six and nine months, as well as one, two, three and ten years, information regarding feeding practices and reported symptoms of allergic disease in the offspring was obtained using a standardised questionnaire. We adapted the Alternative Healthy Eating Index (AHEI-P) [6], suited for pregnancy for our study. The AHEI-P is a 90 point scale with the following 9 components contributing 10 maximum points each: vegetables, fruit, ratio of white to red meat, fibre, trans fat, ratio of polyunsaturated to saturated fatty acids, folate, calcium and iron from foods. For the purpose of this study, an allergy-focused *healthy eating indicator* with a score of 70 was devised using the same scoring system as above for the following intake of nutrients which have been shown to influence allergy outcomes [1, 7]: (wheat/fibre=10, fruit/vegetables=10, calcium=10, iron=10, white fish=10, oily fish=10, omega=10).

The original birth cohort consisted of 969 pregnant women (91% of the target population). The age of the pregnant women ranged from 15 to 44 years old, with a mean age of 27 years and 10 months. Maternal history of allergy was reported in 558 (57.6%) of the mothers. Frequency of intake of foods during pregnancy, as determined by the validated FFQ was available from 937 mothers. The majority of mothers consumed white fish during pregnancy (85.2%), 44.8% consumed oily fish and 38.4% consumed shellfish. Healthy Eating indicator scores were low with the majority of mothers scoring between 10-20 points (79.3%) out of a possible 70. *Healthy eating indicator* (Table 1) as a continuous score was not significantly associated at three years of age with atopy (p=.739, OR 1.005) or allergic disease (p=.907, OR 1.001). This was also the case at ten years of age; atopy (p=.232, OR=1.013), allergic disease (p=.620, OR=1.004). White fish consumption and shellfish consumption by itself (Table 1) was not significantly associated with any of the allergy outcomes at three and 10 years of age. However, moderate to frequent consumption of oily fish was significantly associated with atopy at three years (p=.028, OR=1.751, 95% CI: 1.063-2.887).

In summary, maternal food intake and the consumption of white fish and shellfish were not found to be associated with sensitisation or allergic disease during childhood. However, maternal consumption of oily fish was shown to be a risk for atopy at three years of age, and allergic disease at ten years of age; this remained

significant after controlling for the presence of allergic history in the mother. In terms of healthy eating in pregnancy, Nurmatov [1] concluded that although epidemiological data is weak, there is support for vitamins A, D and E, zinc, fruits and vegetables, and a Mediterranean diet being preventative of asthma. However, similar to our results Lange [2] found no association with overall healthy eating during pregnancy and recurrent wheeze. With regards to the consumption of fish and shellfish it has been hypothesised that, as oily fish contains Eicosapentaenoic acid which inhibits the formation of prostaglandin E2, maternal consumption may be protective against allergic disease. Equally fatty fish consumption during pregnancy is hypothesised to reduce the child's allergy risk by modulating early life immune development [8]. In the present study, no associations of maternal white fish and shellfish consumption with risk of atopy, allergic disease in the offspring were found. Surprisingly, we found that moderate to frequent consumption of oily fish increased the risk of atopy at three years. These results conflict with previous studies, which mainly, however not solely, suggest maternal fish intake during pregnancy is protective against the development of asthma and atopy [3, 4, 8-10]. A possible explanation for this finding is that the beneficial effects of n-3 PUFAs could be counterbalanced with the harmful impact of pollution of seafood as the concentration of contaminants is higher in fatty fish and shellfish than in lean fish. Further research is needed to explore if the observed results could be replicated.

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