NAUSEA AND VOMITING IN PREGNANCY, MATERNAL NUTRITION AND PREGNANCY OUTCOME

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ABSTRACT

Nausea and vomiting in pregnancy (NVP), which is known to affect nearly 70% of all pregnant women, has been associated with favourable pregnancy outcomes such as decreased risk of miscarriage, low birth weight and premature delivery.

The aim of this research was to determine the mechanism by which these protective effects of NVP may be brought about. Women suffering from NVP may decrease their intake due to the symptoms, may increase their intake to alleviate symptoms, or may change the quality of their diet.

Both a retrospective questionnaire survey (n=201) and a prospective cohort study (n=52) were carried out between April 1999 and August 2001. Women were recruited mainly from two GP clinics in Guildford.

It was found from both studies that the prevalence of NVP in the Guildford area is similar to that reported in other studies. Although this study found no relationship between NVP and birth weight and gestational age, women with NVP had higher cord IGF-1 levels compared to women without NVP (p=0.044). In addition, duration of NVP was inversely related to birthweight to placental ratio (p=0.011).

Forty three women provided complete dietary information. It was found that energy intakes did not differ between women who had NVP compared with women who had no NVP, however the quality of diet varied between women with NVP and those without NVP. This is probably due to the fact that women with NVP had a high risk
of cravings and aversions in pregnancy, leading to the difference in intake of certain nutrients such as riboflavin, calcium, zinc and copper. The strong association between NVP and aversions in pregnancy \((P=0.026)\) found in the retrospective study could lend further support to the “Embryo protection” hypothesis, which states that NVP is a protective mechanism, which has evolved to prevent the mother from the ingestion of foods that could be harmful to the fetus.

Further studies using larger sample sizes, covering a range of socio-economic status and different regions are needed before definite conclusions can be drawn.
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1. INTRODUCTION

Nausea and vomiting in pregnancy (NVP) is one of the most common complaints in pregnancy, affecting 50-90% of all pregnant women during the first 20 weeks of gestation (Broussard and Richter, 1998). NVP usually begins at 4-6 weeks gestation, peaks at 8-12 weeks gestation and diminishes by week 20 gestation (Anderson, 1994). NVP is usually limited to the first trimester of pregnancy, but in 20% of women, symptoms continue throughout pregnancy (Broussard and Richter, 1998). It is recommended that if a woman experiences symptoms beyond 20 weeks gestation, other causes of nausea and vomiting should be investigated and excluded (Broussard and Richter, 1998).

1.1 Terminology and classification

NVP is usually known by the lay term “morning sickness”, which stems from the typical onset of symptoms in the morning with improvement during the day. However, this is not a universal pattern as symptoms may be experienced during the night, all day or as biphasic peaks at the beginning and end of the day (Gadsby et al, 1993). A study by Gadsby et al (1993) found that although the period from 6:00 a.m to 12:00 noon was the most common time for symptoms to occur, only 4% of women experienced only morning sickness. The term nausea and vomiting in pregnancy (NVP) is the preferred term. Although the term may be bland, it has several advantages. First, it is unbiased towards any putative cause, second, it allows for a
spectrum of severity, and third, it differentiates between the subjective symptom of nausea and objective sign of vomiting (Deuchar, 1995).

Within the term NVP, symptoms can be classified as mild (nausea only), moderate (nausea and vomiting), and severe (hyperemesis gravidarum) (Deuchar, 1995). Mild to moderate is a normal physiological condition rather than a pathological state associated with pregnancy.

Hyperemesis gravidarum (HG) occurs in 0.3-2% of women (Broussard and Richter, 1998). HG can be defined as the extreme of NVP resulting in dehydration, ketosis and electrolyte and metabolic disturbances (Broussard and Richter, 1998). In this thesis, the main emphasis will be on mild to moderate NVP.

1.2 Factors affecting NVP

Correlations with NVP are controversial, which could be due to methodological and analytical variations, such as statistical methods used. Moreover, factors that are associated with increased risk of NVP are inter-related, and only a few studies have identified independent risk factors for NVP (Broussard and Richter, 1998).

In separate studies, NVP has been positively associated with a number of maternal factors, such as primigravidas (Klebanoff et al, 1985), NVP in previous pregnancies (Gadsby et al, 1997), multiple gestation (Jarnfelt-Samsioe et al, 1983), intolerance of oral contraceptives (Jarnfelt-Samsioe, 1983), women with less than 12 years education (Klebanoff et al, 1985), mother’s experience of NVP (Gadsby et al, 1997),
non smokers (Gadsby et al, 1997, Klebanoff et al, 1985), heavier placenta (Gadsby et al, 1997), younger women (Klebanoff et al, 1985) and women weighing at least 170lb (Klebanoff et al, 1985).

It has been reported that NVP is more common in Westernized countries, particularly in rural populations, and is rare in African, Native American, Eskimo, and some Asian populations except for Japan (Broussard and Richter, 1998). NVP has also been associated with large and infrequent meals and stress associated with pregnancy, notably poor communication with partner and health carers (Iatrakis et al, 1988). Women reporting their occupation as housewife have also been found to be at increased risk for NVP (Wiegel and Wiegel, 1988).

### 1.3 Aetiology of NVP

The recorded association of NVP with pregnancy goes back as far as 2000 B.C (Broussard and Richter, 1998), however, it is surprising to note that the exact aetiology of NVP has not yet been elucidated. A number of physiological and psychological factors have been implicated.

#### 1.3.1 Metabolic and endocrine factors

There is strong evidence to suggest a link between human chorionic gonadotrophin hormone (hCG) and NVP (Forbes, 2002). The principle reason being the fact that serum hCG levels peak during the first trimester when the frequency of NVP peaks (Masson et al, 1985). Several studies failed to find this association, this could be due to small sample sizes, no clear definition of NVP (Forbes, 2002), or due to the fact that there is varying biologic activity of different hCG isoforms (Goodwin, 2002).
Other endocrine factors investigated include progesterone and oestrogen. As for oestrogen, Jarnfelt-Samsioe et al (1983) found that women who did not tolerate oral contraceptives due to side effects such as nausea had a higher incidence of NVP. Further support for this effect is the association between NVP and nulliparous, overweight and non-smoking women, all of whom have elevated urinary and circulating oestrogen levels (Depue et al, 1987). Again, the role of oestrogen remains controversial (Broussard and Richter, 1998). The effect of progesterone on gastric motility, as will be seen in section 1.3.1.2, makes it seem as an important factor in the aetiology of NVP. Progesterone levels rise rapidly during the first trimester when symptoms of NVP peak (Broussard and Richter, 1998).

Another hormone studied is thyroxine. Mori et al (1988) measured the serum levels of free thyroxine (T4), thyroid stimulating hormone (TSH) and hCG in 132 women in early pregnancy and in non pregnant women. They found that there was a significant decrease in serum TSH and an increase in free T4 in early pregnancy compared to the non-pregnant controls. They found that the increased free T4 and hCG and decrease in TSH correlated with the severity of morning sickness. They also found that there was a positive correlation between the levels of hCG and free T4 and a negative correlation with TSH. Mori et al (1988) postulated that the thyroid gland may be physiologically activated in early pregnancy, possibly by hCG, and may induce NVP. The levels of the thyroid hormones returned to normal after improvement of emesis. The authors reported that the increase in T4 and decrease in TSH during pregnancy are not indications of thyrotoxicosis and may not necessitate treatment. Broussard and
Richter (1998) reported that results remained controversial regarding the relationship between the thyroid hormones and HG.

Responses to the main trigger of NVP may be varied due to the increased receptor sensitivity or increased susceptibility of the mother to the stimulation of the major pathways to NVP. The main pathways include vestibular, gastrointestinal and olfactory (Goodwin, 2002).

1.3.1.1 Vestibular

It has been reported that women with motion sickness are more likely to have NVP (Goodwin, 2002). The vestibular system may participate in the pathogenesis of NVP either because pre-existing sub-clinical vestibular dysfunction renders the women more susceptible to the hormonal trigger for NVP or because the normal vestibular system is adversely affected by a strong hormonal trigger for NVP. In a study by O’Brien and Naber (1992), twenty-five percent of one hundred and forty-seven women reported recumbent rest as a method of improving NVP. This provides some evidence that the vestibular system may have a role to play in NVP.

1.3.1.2 Gastro intestinal tract (GIT)

The hormone progesterone causes relaxation of smooth muscles; this has an effect on the oesophagus, stomach and small bowel. In the oesophagus, elevated progesterone levels alter the lower oesophageal sphincter function, which contributes to heartburn and NVP. Progesterone also causes delays in gastric emptying, also contributing to NVP. In addition, progesterone has an effect on small bowel transit time, which could also be an explanation for NVP (Broussard and Richter, 1998). Gastric motor dysfunction has been implicated in NVP (Goodwin, 2002). Jednak et al (1990) using
the electrogastrogram found a mixture of bradygastrias and tachygastrias in women with symptoms. In their study, Jednak et al (1990) demonstrated that protein-dominant meals, especially in liquid form, reduced NVP possibly by reducing gastric slow wave dysrhythmias. However, Maes et al (1999) found that gastric emptying of solids was not significantly delayed in pregnant women and suggested that gastric dysrhythmias were not a causative factor of NVP.

1.3.1.1 Taste and olfaction

Goodwin (2002) reports that one of the most common observations of clinicians caring for women with NVP is that they develop aversions to certain smells and tastes. Spatial taste patterns and taste acuity was studied in sixty women with twenty one high vomit and thirty nine low vomit based on obstetric histories. Women in the high vomit group were less likely to be non-tasters and more likely to have high perception of bitterness on the posterior tongue (Sioporra, 2000). Flaxman and Sherman (2000) documented more than twenty studies of women with cravings and aversions, however, few describe these changes and NVP. Cravings and aversions will be discussed in section 1.6.

1.3.2 Psychological factors

In the early 1970s over 50% of obstetricians contributed NVP to psychological factors (Semmens, 1971). Adverse psychological factors such as unresolved conflict, undesired pregnancies, denial of pregnancy and negative relationships with the pregnant woman's mother were associated with NVP (Fitzgerald, 1984).
1.4 Management of NVP

NVP is usually self-limiting; management depends on severity of symptoms experienced and ranges from conservative dietary modifications and lifestyle changes in mildly symptomatic women to drug therapy and total parenteral nutrition (TPN) in women with HG (Broussard and Richter, 1998).

1.4.1 Non-Pharmacological treatment (conservative)


1.4.2 Pharmacologic treatment

Since the thalidomide disaster in the late 1950s and early 1960s, pharmacologic interventions used to treat women suffering from NVP have been viewed with great
trepidation (Mazzotta et al, 1999). Pharmacologic therapy should be considered in women who have continued nausea and vomiting despite conservative measures. The risk-to-benefit ratio must justify the use of any drug during pregnancy (Broussard and Richter, 1998). All drugs should generally be avoided in the first twelve weeks of pregnancy when fetal organs are still developing (Anderson, 1994).

Today, common pharmacologic agents used for the treatment of NVP include antiemetics, antihistamines and anticholinergics, promotility agents, other agents such as corticosteroids, droperidol, diphenhydramine, ondansetron and Bendectin (dicyclomine hydrochloride, doxylamine succinate and pyridoxine hydrochloride) (Broussard and Richter, 1998). Bendectin was first marketed in the USA in 1956 and was the only drug approved by the FDA, however, it was taken off the market in 1983 due to anecdotal reports of possible congenital malformations associated with its use. In Canada, the equivalent of Bendectin, marketed as Dilectin is still in use and is often used as first line therapy for NVP (Broussard and Richter, 1998). According to a study of 26 European countries, Einarson et al (1998) found that in the UK, dietary changes and the consumption of ginger were the most frequently recommended therapies for mild nausea, promethazine and metoclopromide for moderate NVP and intra-venous fluids, 5HT3 antagonists and domperidone for severe NVP.

1.4.3 Alternative therapies

Alternative therapies are becoming more popular to pregnant women, yet there is a dearth of research to support or refute the efficacy of alternative therapies (Ziedenstien, 1998). The main studied therapies are
1.4.3.1. Acupressure

This involves stimulation of or pressure on an acupuncture point known as preicardium 6 or the Neiguan point, on the volar surface of the forearm approximately three fingerbreadths above the wrist (Murphy, 1998).

Acupressure wrist bands (Seabands) are usually used for this purpose. Several clinical trials have been conducted, such as that carried out by Belluomini et al (1994) on 60 women for 3 days, where manual acupressure on the P6 point was tested against a dummy point. They found a significant decrease in symptoms of nausea in the treatment group, however, no difference was seen in frequency and severity of vomiting. Another study was carried out by O'Brien et al (1996) on 161 women for 7 days, where they compared wrist bands on the P6 point, wrist bands on a dummy point and no intervention. They found no differences across the groups. Thus, the results remain equivocal (Murphy, 1998). In addition, Murphy (1998) reported that although beneficial effects may have been seen, the placebo effect cannot be ruled out.

1.4.3.2. Ginger

The first clinical trial carried out using ginger was to test its effect on motion sickness. Mowrey and Clayson (1982) found that 1 gram of powdered ginger was more effective in the prevention of motion sickness than the standard anti-histamine treatment diemenhydrinate. Fischer-Rasmussen et al (1990) conducted a double-blind cross-over study on 27 women in Denmark to investigate the effect of ginger in
women with NVP. They showed that 1 gram of ginger was superior to a placebo in relieving symptoms in women with HG. Murphy (1998) reported that the efficacy of ginger was due to its aromatic, carminative and absorbent properties. According to Mowrey and Clayson (1982), the action of ginger is unlike antiemetics, which act on the CNS. The authors speculated that ginger had its action on the gastrointestinal tract itself, probably by increasing gastric motility.

Ginger root contains a thromboxane synthetase inhibitor, which may affect testosterone receptor binding in the fetus (Broussard and Richter, 1998). However, the evidence is still weak as for its benefits, therefore further studies are needed before any definite conclusions can be drawn (Jewell and Young, 2000).

Other herbal remedies include chamomile, peppermint and raspberry leaf, however results are still contradictory, and there are not enough studies carried out related to their safety, therefore, they should be taken with caution (Wilkinson, 2000).

1.4.3.3 Vitamin B6 (Pyridoxine)

Two main studies examined the effect of vitamin B6 on NVP. Vutyavanich et al (1995) conducted a double-blind placebo-controlled trial on 336 women, where a dose of 30 mg/day was used. They found that although symptoms of nausea seemed to improve, there was no effect on vomiting. The other study was carried out by Sahakian et al (1991), was of similar design, and conducted on 59 women. The authors found a beneficial effect in women with severe nausea and vomiting, but not
in cases of mild NVP. Thus there could be a dose response (Jewell and Young, 2000). Although evidence seems to show a beneficial effect, further work is still needed.

1.9.3.4. Other treatments

Other treatments include hypnosis, sensory afferent stimulation and homeopathy. However, further studies are needed before any definite conclusions about hypnosis and sensory afferent stimulation can be drawn (Broussard and Richter, 1998). As for homeopathy, in her review, Murphy (1998) did not find any trials that were conducted to test the effect on NVP.

1.5 Effects of NVP

A number of human, clinical studies have reported that NVP in the first 20 weeks of gestation is associated with favourable outcomes such as reduced risk of miscarriage (Wiegel and Wiegel, 1989), reduced perinatal death (Teirson et al, 1986, Wiegel and Wiegel, 1989), higher birth weight (Teirson et al, 1986), and reduced premature delivery (Teirson et al, 1986). However, some studies found no relationship between NVP and pregnancy outcome. In a retrospective study carried out by Wiegel and Wiegel (1989) on 903 women in Los Angeles, they found that there was a decreased incidence of miscarriage in women who had experienced vomiting during pregnancy, but no other statistically significant associations between NVP and other outcomes of pregnancy were reported. We can see that the results of different studies are somewhat varied, these differences could be due to differences in sample size, experimental design or definition of NVP (Wiegel and Wiegel, 1989). Although results are conflicting, on the whole, there seems to be some benefit from NVP. The
absence of symptoms may be due to either a decreased sensitivity to alterations in hormone levels or due to abnormal pregnancies (Broussard and Richter, 1998).

Another possible outcome of NVP has been shown by Crystal et al (1999). College students, who could provide information about their mothers’ symptoms of NVP during pregnancy, either completed a survey or rated and consumed 10 snack foods. The authors found that offspring of women who reported to have experienced moderate or severe vomiting showed a statistically significant greater preference for snack foods rated as saltiest than those whose mothers reported no or mild vomiting. They also ate more foods that contained higher sodium levels in the test period. Effects were found to be stronger in Caucasian subjects compared to Asians. Crystal et al (1999) concluded that moderate to severe vomiting during pregnancy can be associated with significantly higher salt intake in offspring and that a gestational event such as volume depletion or electrolyte loss due to maternal vomiting may be an important determinant of salt intake and preference in adulthood.

Boneva et al (1999) carried out a case-control study in Atlanta on over 4,000 infants. The authors found that symptoms of nausea that started within the first two months of pregnancy, and occurred on a daily basis, or more frequently, was associated with a reduced risk of giving birth to a child with congenital heart defect. This effect tended to disappear with less severe levels of NVP. In addition, the group of mothers who took anti-nausea medication, especially Bendectin, had a lower risk of giving birth to a child with a congenital heart defect than did those who did not use medication or those who did not have nausea during pregnancy, suggesting that pregnancy hormones and factors, or alternatively, a component of Bendectin (possibly pyridoxine) may be important for normal heart development (Boneva et al, 1999).
Martin et al (1999) found that women who continued to suffer from NVP during the second and third trimesters, were at increased risk of having a child with lower sensory thresholds and emotional intensity in infancy, and were reported to be lower in task persistence at age five. At age twelve, these children were viewed by teachers as more careless with their work and having more attention and learning problems.

Enger et al (1997) studied 450 women in America who were diagnosed with breast cancer before the age of forty, and healthy controls without cancer. They found that women who required medical treatment for severe nausea and vomiting during pregnancy were twice as likely to be diagnosed with breast cancer within five years as women who required no such treatment or did not suffer from NVP. They speculated that this could be due to the high levels of oestrogen which some authors believe is associated with NVP (see section 1.5.1).

Although many different effects have been reported, Gadsby et al (1993) reported that most of the studies on NVP were carried out retrospectively, and were likely to be biased towards more severe symptoms and less accurate because of their retrospective nature. Thus a lot of further work is still needed to elucidate the true effects of NVP.

### 1.6 Cravings and aversions during pregnancy

Cravings were defined by Dickens and Trethowan (1971) as ‘a compulsive urge for a food or drink not previously disliked’. Aversions were defined by Dickens and Trethowan (1971) as ‘a definite revulsion against food or drink not previously
disliked’. Pica were described by Schwab and Axelson (1984) as ‘the craving for and ingestion of substances not usually considered appropriate for human consumption, such as baking soda, corn meal, and ice’.

The occurrence of dietary cravings and aversions during pregnancy is well known, yet relatively little is known of the aetiology or epidemiology of this complex of symptoms (Tierson et al, 1985).

According to a study conducted by Dickens and Trethowan (1971) on 100, primiparous, married, British women, the incidence of cravings in these women was 51%, and aversions was 62%. Dickens and Trethowan (1971) also found that the most craved food items were fruit and fruit drinks, sweets, chocolates, ice-cream, milk and dairy products. Tea, coffee, cocoa, vegetables, meat, fish and eggs were the most common food items avoided. In this study, the authors found that cravings and aversions occurred more frequently in those women with a history of pica in childhood, of appetite change in response to emotional stress and in women who smoked before pregnancy. The authors also found a trend for higher reportings of cravings and aversions in those women who drank alcohol before pregnancy compared to those who were teetotal. There was also a statistically increased incidence of cravings in those women with a history of food fads in childhood. Dickens and Trethowan (1971) also reported that aversions and cravings occurred more commonly together than separately.

As for the time of onset of these symptoms during pregnancy, Dickens and Trethowan (1971) found that aversions were more commonly experienced during the first trimester and progressively less so in the second and third trimester. The same was
true for cravings although the time of onset were more evenly distributed. The authors found that once begun, the duration of the symptoms were similar, with a slightly higher tendency for aversions as opposed to cravings to persist over two or more trimesters, which is probably due to the fact that aversions usually appeared earlier on in pregnancy compared to cravings.

A study carried out by Hook (1978) on 250 women in New York found that the most craved foods were ice-cream, sweets, candy and chocolate, fruits, milk and fish. Aversions included meats, poultry, alcohol, coffee and sauces flavoured with oregano.

The aetiology of cravings and aversions has several explanations. One explanation for cravings is the metabolic energy requirement associated with the developing fetus. However, Hook (1980) states that despite an increased need for protein, many women reported an aversion to meats and poultry.

Hook (1980) suggests that with respect to aversions, an important fraction appears to be mediated by the development of NVP as a response to ingestion of specific foods. However, Dickens and Trethowan (1971) found that neither the absence nor presence of cravings and/or aversions was shown to bear any relationship to the occurrence of NVP during pregnancy whether mild, moderate or severe. Diminished ingestion of some specific foods also appears to be mediated by less specific symptoms such as lack of desire for them, non-specific heart burn or increased sensitivity to its side effects such as alcohol (Hook, 1980).

Another theory put forward is that aversions are a result of mechanisms, which have evolved to protect the fetus from factors selectively toxic to it. The drop in intakes of
alcohol, coffee and smoking that occur in early pregnancy, result in lowering fetal
exposure to embryotoxins (Hook, 1980). The reasons cited by women is a change in
desire for them, rather than concern for the infant, or due to the doctor’s advice.

Other explanations include the alteration in the sense of taste and smell of pregnant
women (Dickens and Trethowan, 1971). There is an impaired sense of taste in
pregnancy thus pregnant women tends to crave strong tasting substances, which could
be sweet, sour or savoury (Dickens and Trethowan, 1971). It has been shown that
there are differences in bitter-taste perception in women with a history of severe
vomiting during pregnancy (Sipiora et al, 2000).

Tierson et al (1985), suggested that cravings and aversions may not be biologically
determined at all, instead simply learned behaviours due to factors such as cultural
practices.

The most common explanation for pica is that it is due to a vitamin or mineral
deficiency (Dickens and Trethowan, 1971). However, Dickens and Trethowan (1971)
reported that in view of the extraordinary substances craved, such as soap, coal,
petrol, moth balls and metal polish, it may not be due to a need to compensate for a
dietary deficiency, but some other unknown factor.

Whatever the cause of the aversions and cravings, it can be seen that they are not
limited to a few isolated individuals, but affect a large proportion of the pregnant
population.
1.7 Maternal nutrition and pregnancy outcome

There has been increased interest in maternal nutrition since Barker and his colleagues showed strong associations between infant and placental size and the risk of later chronic diseases, such as cardiovascular disease, hypertension and non-insulin dependent diabetes. The early in utero period is especially important as it represents a period of rapid cell division, occurring at different times in different tissues. During these critical periods of selective tissue growth, the nutritional and hormonal environment may result in reduction in cell number, changes in the distribution of cell type and in the resetting of hormonal feedback. This is the basis of the fetal origins hypothesis put forward by Barker and his colleagues, which contends that undernutrition during these critical periods of fetal development may lead to changes which program later health risks (Scott, 2002).

The importance of maternal nutrition in developing countries is widely recognised. In industrialised countries, although the effect of maternal nutrition may not be as obvious, studies have shown pregnancy outcomes to be affected by maternal nutrition. One example is the severe famine that affected the Netherlands in the winter of 1944-1945, and occurred in a society which had been generally adequately nourished (Lumey, 1998). Compared to pre-famine controls, there was a decrease of about 300g in birth weight and 80g in placental weight in those infants exposed in the third trimester of pregnancy. Although there was no effect on birth weight in infants exposed in the first trimester, there was an increase in placental weight, thus placental weight to birth weight ratio was also increased (Lumey, 1998). The increase in placental weight was interpreted as compensatory for the reduction in maternal energy.
intake (Lumey, 1998). We have seen that nutrient restriction in early to mid gestation does not have an effect on birth weight, this provides evidence for the historical notion that during pregnancy, nutrient partitioning favours the conceptus at the expense of the dam (Wallace, 2000). Although this shows that the fetus is little affected by changes in maternal nutrition, several studies challenge this view. For example, Godfrey et al (1996) have shown that women who consume high energy intakes in early pregnancy (expressed by carbohydrate intake) had infants with lower birth weights and smaller placentas, especially if combined with low intakes of animal protein in late pregnancy (Godfrey et al, 1996).

It can be seen that maternal nutrition in early pregnancy may have a role to play in fetal development, and since NVP may affect a nutritional challenge in early pregnancy, it may seem paradoxical that NVP is associated with a favourable pregnancy outcome. Some possible mechanisms will be discussed in the following sections.

### 1.8 Possible mechanisms

One possible mechanism by which NVP may be associated with a favourable outcome of pregnancy is that despite causing discomfort and distress associated with food, NVP may not result in reduced intake but may actually increase it (Taggart, 1961).

Another possibility is that NVP may lead to a reduced energy expenditure, and hence will alter the balance in favour of maternal and fetal tissue growth.
Alternatively, quality of diet may be altered. Pregnancy is a period in the life cycle of women in which changes in food-related behaviour may occur through contact with health professionals or their own beliefs about pregnancy (Shwab and Axelson, 1984). In addition to modifications in customary diets such as increases and decreases in usual food intake and avoidances of some foods, certain appetite compulsions such as cravings, aversions and pica have been associated with pregnancy (Schwab and Axelson, 1984).

Another possibility could be that NVP, which coincides with the most sensitive periods of embryonic organogenesis, protects the developing embryo by causing women to reject or avoid foods containing potentially harmful teratogens or abortifacents (Hook, 1980; Profet, 1988). Actively metabolizing tissues are more vulnerable to toxins than dormant ones, and differentiating cells are more vulnerable than cells that reproduce more of the same type. Hence, it is thought that the embryonic and fetal tissues may be vulnerable to lower concentrations of toxins than adult tissues. Vulnerability rises rapidly from the level characteristic of a quiescent egg in an ovary, to a peak in the critical stage of organ formation and tissue differentiation, then declines slowly towards the adult level at term (Nesse and Williams, 1994).

The vulnerability curve corresponds almost exactly to the course of NVP. This led Profet (1995) to hypothesize that nausea and food aversions in pregnancy evolved to impose dietary restrictions on the pregnant woman and thereby minimize exposure to toxins. Profet (1995) reported that the food the pregnant woman chose to eat was usually bland and without the strong odours and flavours provided by "toxic"
compounds. However, Profet was criticized by Brown et al (1997) who found no relationship between NVP and the intake of vegetables and other foods that Profet described as harmful. In addition, the adverse effects such as miscarriage and congenital abnormalities associated with these foods (according to Profet) were not observed. However, Flaxman and Sherman (2000) investigated the concept further and hypothesized that NVP causes women to avoid foods that were more likely to be contaminated with parasites and pathogens at a time when pregnancy caused immunosuppression, leaving women more vulnerable to infection. This was supported by the findings that societies such as Bhil, Mbundu, Omaha, Papago, Siriono, Tarahumara and Woleai, where NVP had never been observed, were more likely to have only plants as their staple diet. Flaxman and Sherman (2000) analyzed the results of 20 studies and found that the most common aversions were to meat and non-alcoholic beverages.

A further explanation could be that NVP leads to a decreased intake which causes placental compensation.

1.8.1 Placental compensation

The effect of maternal nutrition on fetal and placental growth has mostly been studied in animals. Fetal and placental responses to undernutrition in ewes depend on the magnitude, timing and duration of nutrient restriction (Symonds et al, 2001). Maternal nutrient restriction in early gestation tends to increase placental weight at term. In a study carried out by Heasman et al (1999) where ewes were fed 50% of their requirements during early to mid pregnancy, there was a reduction in placental weight at 80 days gestation, which was followed by an increase in placental weight close to
term, although no effect on birth weight was seen. However, they did find that fetuses of nutrient restricted ewes had longer crown-rump lengths compared to controls. Experiments performed in sheep have demonstrated that severe undernutrition reduces placental mass but lesser reductions in maternal intake have the opposite effect (Robinson et al, 1995; Gadd et al, 2000). It seems that the placenta undergoes an adaptive compensatory response to mild maternal undernutrition during this period of rapid placental growth thus optimizing transplacental exchange efficiency. In animal farming, it is common practice to transfer sheep from a good pasture to poorer pasture just for the early period of gestation in order to promote fetal growth by stimulating placental development. This practice is called “flushing” (McCrabb et al, 1992). It could be that NVP is associated with a favourable pregnancy outcome because maternal nutrient restriction early in gestation favours placental development.

1.9 Factors associated with pregnancy outcome

Changes in maternal and fetal endocrine status in early pregnancy may mediate the inverse relationship between energy intake in early gestation and enhanced placental growth (Huxley, 2000). The mechanisms by which maternal nutrient intake affect fetal and placental growth seem to be mediated by the insulin-like growth factor axis.

The insulin-like growth factors (IGF)- I and II are low molecular weight, single chain peptides with structural homology to proinsulin. The IGFs promote cellular mitosis and differentiation in a variety of cell types and have been particularly implicated in fetal and placental growth (Kleffens et al, 1998). The IGFs mediate these effects by binding to specific IGF receptors (type 1 and 2) on target cell surfaces (Kleffens et al,
1998). Both IGF-1 and 2 have their effect primarily through type 1 receptors
(Gluckman and Harding, 1997). The IGFs circulate bound to a family of binding
proteins. Six IGF binding proteins (IGFBPs) have been determined, and characterized
IGFBP 1 through 6 (Kleffens et al, 1998).

IGF-I and IGF-II are found in most fetal and placental tissues as early as the pre-
implantation stages of embryonic development (Robinson et al, 1995). There have
been numerous reports that IGF-1 levels are low in the cord blood of term neonates, in
comparison to adult serum values, when measured by bio- or radioimmunoasay
(Ashton et al, 1985, Gluckman, 1995). Levels of IGF-1 are positively correlated with
fetal weight (Aston, 1985, Gluckman, 1995), length (Ashton, 1985) and placental
weight (Ashton, 1985). Gluckman (1995) reported that the lower values of IGF-1 in
the cord blood were associated with reduced concentrations of IGFBP-3 and high
concentrations of IGFBP-2 and 1 relative to the adult.

In intra-uterine growth retardation (IUGR), circulating levels of IGF-1 are reduced in
cord blood samples, and in humans this is associated with a reduction in IGFBP-3 and
elevation in IGFBP-1 and 2 (Gluckman, 1995). Gluckman (1995) reported that the
dominant influence on fetal IGF-1 levels, at least in the second half of pregnancy
seemed to be nutrient status, in particular glucose availability to the fetus. Similarly,
the IGFBPs are affected by nutritional status, with IGFBP 3 falling and IGFBP 1 and
2 rising with nutrient restriction. According to Gluckman (1995), fetal mice
homozygous for dysfunctional IGF-1 have profound embryonic and fetal growth
retardation.
IGF-2 mRNA is higher in fetal tissues compared to postnatal tissues (Gluckman, 1995). Allelic disruption experiments in mice show that knockout of IGF-2 causes embryonic growth retardation only at embryonic days 11-16, after which this has no effect. It is postulated that IGF-2 has a role in early embryonic development, when IGF-1 levels may be insignificant, however, later on IGF-1 becomes the dominant IGF (Gluckman, 1995). The reason why there is a developmental switch from IGF-2 to IGF-1 is not clear. One explanation is that IGF-2 appears to require greater degrees of nutritional and hormonal change for it to be affected. Thus, during early development, when it may be desirable for the fetus to be less sensitive to environmental influences, such as substrate limitation, IGF-2 is the dominant influence. Whereas in late gestation, where it is appropriate that the fetus responds to substrate limitation with reduced growth, IGF-1 is the primary influence (Gluckman and Harding, 1997).

The placenta is a source of both IGFs and IGFBPs and is a target for IGF action (Gluckman, 1995). It may be that IGF-1 and IGF-2 play a role in the paracrine regulation of placental development. However, mice with a disrupted IGF-1 do not have impaired placental growth, whereas, IGF-2 gene disruption does cause placental growth retardation (Gluckman, 1995).

The supply of nutrients from the mother to the fetus is an important factor in late gestation fetal growth (Gluckman, 1995). Elevations in IGF-1 seem to partition nutrients between the placenta and fetus in favour of the fetus (Gluckman, 1995). Gluckman (1995) suggested that maternal IGF-1 may also play a role in determining nutrient supply to the fetus. Maternal serum levels of IGF-1 increase during pregnancy, but there is no relationship between maternal and cord serum IGF-1,
suggesting that there is no significant transfer across the placenta (Wihman et al, 1988). This suggests that the effects of maternal IGF-1 are mediated by the placenta (Wihman et al, 1998). Caufriez et al (1993) reported that maternal IGF-1 could regulate placental transfer of nutrients to the fetus. This in turn could increase fetal IGF-1 secretion and bioavailability and thus promote fetal growth. Maternal IGF-1 concentrations correlate with birth weight (Cufriez et al, 1995), and in pregnancies complicated by IUGR, maternal IGF-1 levels are reduced (Gluckman, 1995).

Thus we can see that both IGF 1 and 2 have an effect on fetal growth. The dominant influence on IGF-1 in late gestation is nutrient supply to the fetus. This effect seems to be mediated by insulin release by the fetus.

Both IGF-1 and 2 may act in a paracrine way to affect fetal organ and placental growth. Fetal IGF-1 is the major determinant of fetal partitioning to favour fetal growth. Placental function is affected by both maternal and fetal IGF-1. Placental IGF-1 may influence both placental growth and function (Gluckman, 1995).

Godfrey et al (1996) reported that mothers with high energy intakes in early pregnancy and low protein intakes in late pregnancy produced smaller babies with smaller placentas. They found that this was associated with a reduction in concentrations of insulin, proinsulin and IGF-1 in cord blood. They speculated that this may be mediated by the effect maternal diet has on placental growth.

An important point to consider is that cord levels of IGF-I and II in neonates may not be indicative of fetal life, and may have changed markedly during the later stages of
gestation (Ashton et al, 1985). Another point is that cord levels are influenced by the
found no changes in their results even when taking into account type of labour onset
and mode of delivery.

To summarise, NVP may be associated with a favourable pregnancy outcome,
especially increased birth weight through adaptation to a reduced nutrient intake in
ergyation favouring compensatory placental development which subsequently
optimises fetal development. During the early stages of development, when
trophoblastic invasion is occurring and the placenta is establishing, the predominant
growth factor involved in promoting growth via the type-1 receptor is IGF-1, which
is fairly resistant to fluctuations in maternal nutrient intake so placental growth is
maintained. However, IGF-2 levels remain unchanged as they are not affected by
nutrition, thus ensuring embryonic and placental growth (Huxley, 2000). NVP usually
stops by the second trimester, which coincides with the time of transition from IGF-2
to IGF-1 in the maintenance of fetal growth. IGF-1 is sensitive to nutritional intake,
and thus will cause a reduction in fetal size if there is a reduction in intake (Huxley,
2000).

It is necessary to be cautious when drawing conclusions from mechanisms elucidated
in different species, as the structure of the primate discoid placenta and the
cotyledonous placenta of ruminants are very different (Coad et al, 2002). In addition,
none of the species studied share identical expressions of IGFs and IGFBPs (Coad et
al, 2002). In addition, placental weight per se is a gross measurement; weight alone
does not necessarily indicate placental efficiency of nutrient transfer (Coad et al, 2002).

Another explanation could be that NVP affects nutrient partitioning via altered metabolism. During the first half of pregnancy, increased sensitivity to insulin promotes maternal anabolism. In the second half of pregnancy, increasing insulin resistance stimulates maternal catabolism and maintains higher substrate levels, favouring placental transport when fetal growth is high. Altering intake in early gestation could moderate the extent of deposition of maternal stores (Coad et al, 2002).

It could be that by causing reduced energy intake in early gestation, NVP could lower maternal insulin levels and IGF-1 levels thus ensuring nutrient partitioning to the placenta and therefore the fetus (Huxley, 2000). As insulin potentially inhibits hCG production (Barnea et al, 1993), reducing maternal insulin levels would optimise hCG production. Mori et al (1988) have reported that hCG could activate the thyroid, stimulating the release of thyroxine, which stimulates placental growth (Huxley, 2000). Mori et al (1988) report that both hCG and thyroxine concentrations correlate with the onset and severity of NVP. Msuzaki et al (1997) reported that a high abundance of mRNA for leptin has been shown in the human placenta, with the highest amounts found in the chorionic villi at 8 weeks of gestation (cited by Symonds et al, 1998). This led Huxley (2000) to hypothesize that since the peak of leptin production correlates with the peak incidence of NVP, then placental leptin production in early pregnancy may act through the maternal hypothalamus to suppress appetite and reduce maternal energy intake. Maternal dietary intake is also inversely
related to peripheral progesterone concentration so a lower nutrient intake in early gestation facilitates progesterone production which has positive effects on growth of the embryonic inner cell mass (Wallace, 2000).

It is important to remember that as well as severity and timing of undernutrition, maternal nutritional status pre-pregnancy is also important. Symonds et al (1998) reviewed studies in sheep and reported that maternal body weight had a large influence on placental weight and that the placental response to maternal nutrient restriction was determined by maternal body weight pre-conceptionally. Symonds et al (1998) reported that underfeeding of heavy ewes resulted in a larger placenta, whilst in light ewes, placental mass was reduced. This has some similarity in human studies. A retrospective study carried out in Jamaica by Thame et al (1997), found that mothers who were thin had babies with a lower birth weight, shorter, smaller head circumference, lighter placenta and lower placenta:birth weight ratio.

Huxley (2000) also put forward the concept that maternal BMI pre-pregnancy could determine whether a woman experienced NVP or not. Huxley (2000) reported that in women with a normal BMI, the body fat stores are sufficient and demands of the developing placenta override the maternal drive to anabolic synthesis of fat in early gestation. Huxley (2000) postulated that these women will experience symptoms of NVP that may lead to a reduction in nutrient intake and lower fat accretion. Huxley (2000) cited a study carried out by Lindsay et al (1997) which found that in women with a normal BMI, only 29% fat accumulation occurred during early pregnancy. Moreover, Klebanoff et al (1985) found that NVP was reported more often in women weighing more than 170lb compared to those weighing less than 170lb. As a result of
the decreased intake in women with NVP, Huxley (2000) suggested that circulating levels of maternal insulin and IGF-1 fall, inhibiting anabolic maternal synthesis and fat deposition, ensuring a more favourable nutrition partitioning in favour of the placenta.

On the other hand, Huxley (2000) suggested that women with a low BMI, will have less experiences of NVP, due to a stronger maternal anabolic drive to fat accretion, overriding the needs of the placenta. Huxley (2000) cited a study by Allen (1994) which found that women in the lowest tertile of BMI increase their energy intake and gain more weight throughout gestation, whereas women in the highest tertile of BMI, decrease their energy intake and lose substantial amount of peripheral fat throughout pregnancy. In their study to assess changes in skinfolds during pregnancy, Taggart et al (1967) found that the increase in skinfolds during pregnancy was greater in underweight than in overweight women. In support of this, Symonds et al (1998) cited a study by Masuzaki et al (1997) where the authors reported that there was a positive correlation between circulating levels of leptin and BMI in non-pregnant women. Schubring et al (1997) found that leptin concentration were correlated with BMI only when gestational age was taken into account (cited by Symonds et al, 1998). Thus an interpretation could be that in underweight women, reduced levels of leptin cause an increase in appetite and therefore an increase in weight. Huxley (2000) proposed that increased intakes in these women caused impaired placental development and elevated maternal insulin levels. This in turn resulted in a reduced production of hCG and thyroxine, leading to the absence of symptoms of NVP.
1.10 Maternal nutrition and health outcomes in the offspring

Maternal nutrition during pregnancy plays a pivotal role in the regulation of fetal and placental development in sheep, and therefore has the potential to influence both short- and longer-term health outcomes.

In sheep, Symonds et al (1998), found that following caesarean section, light ewes who were nutrient restricted during pregnancy delivered lambs who were at increased risk from hypothermia compared with offspring of heavy ewes. A caesarean section is known to significantly compromise the ability of newborn lambs to thermoregulate, and also causes a decrease in the amount and activity of brown adipose tissue. Light ewes that had to mobilize body stores during pregnancy deliver lambs that possess less brown adipose tissue compared to heavy ewes.

Longer-term outcomes were considered by Kelly and Ralph (1988) who found that poor nutrition during fetal life reduced the potential for both the quality and quantity of wool in young Merino sheep.

In humans, the incidence of morbidity and mortality during the neonatal period is known to be higher in LBW babies. Furthermore, many epidemiological studies have shown that LBW babies are also at increased risk of certain diseases in adulthood (Barker, 1994). Studies have also shown that alterations in conformation at birth, irrespective of birth weight, may also play a role in the programming of future health outcomes (Barker, 1994). For example, proportionately small babies are at increased
risk of raised adult blood pressure, but do not have an increased risk of developing CHD. By down regulating growth in response to early undernutrition, the fetus may reduce its demands for nutrients, making it less likely to subsequently experience relative undernutrition in later gestation (Godfrey, 1998). As adults, disproportionately short babies tend to have abnormalities of systems controlled by the liver, including clotting factor synthesis, cholesterol metabolism, and are at increased risk of CHD (Godfrey, 1998). This may due to the fact that in utero, nutrient restriction may have evoked the brain sparing reflex later in gestation, where nutrients are diverted to the brain at the expense of the trunk, limbs and abdominal viscera (Godfrey, 1998). Thin babies are at increased risk of insulin resistance and CHD in later life. Their thinness reflects reduced subcutaneous fat and skeletal muscle due to undernutrition in the weeks prior to delivery (Godfrey, 1998)

Effects on placental growth may also have long term consequences. In a retrospective study on 449 men and women in Preston, Barker et al (1990) found that highest blood pressures occurred in those who had been small babies with large placentas.

1.11 The Research Problem

NVP is a very common symptom of early pregnancy, and has been associated with positive outcomes of pregnancy such as increased birth weight and gestational age. The reason behind this positive effect remains unknown; several possible mechanisms have been hypothesised.
Firstly, NVP may cause women to decrease their intake. Both human and animal studies have shown placental compensation as a response to maternal undernutrition in early pregnancy. This may or may not be accompanied by an effect on birthweight. However, Gadsby et al (1997) was alone in showing that women with NVP had larger placentas, thus this area requires further investigation. In addition, it is important to remember that placental size may not reflect placental function. Heasman et al (1999) showed that although birth weight may not be affected by maternal nutrition, there was an effect on fetal conformation. This may have long term consequences as Barker and his colleagues have shown that a thin baby is at greater risk of non-insulin dependent diabetes and coronary heart disease (CHD) in later life, whereas the short baby is at greater risk of hypertension, abnormal cholesterol metabolism and CHD.

Alternatively, NVP may cause women to increase their intake. Taggart (1961) reported an investigation that she conducted in Aberdeen on appetite in pregnancy. Although poor appetite and reduced food intake was reported to sometimes accompany NVP, it was much more usual for appetite to be normal or even increased.

NVP can also result in dietary changes affecting quality of diet. There have been very few studies, that have looked at the type of diet consumed by women with NVP. A lot of controversy remains in the area of maternal nutrition, NVP and pregnancy outcome. The role of this study is to try and find some of the answers.

Elucidating the mechanisms by which NVP has a positive effect on birth weight will help identify what nutritional advice is appropriate. In addition, it will help to identify whether women with NVP should be treated to prevent symptoms or encouraged to
endure them, as if NVP had an effect on pregnancy outcomes, this is important for the prevention of future diseases.

1.12 The Hypothesis

The null hypothesis is “NVP does not have a beneficial effect on pregnancy outcome in terms of the infant and his/her potential for development”.

1.13 The Aim of the Study

The aim of the study is to assess

- the incidence of NVP in the Guildford area
- whether NVP does or does not have a beneficial effect on pregnancy outcome
- how NVP may have a beneficial effect on outcome of pregnancy

1.14 The study objectives

The study was divided into two phases: The first phase involved the administration of a questionnaire survey and the second phase involved a prospective survey.

1.14.1 The Questionnaire Study

The retrospective questionnaire survey was conducted to:

1) Gain some background information about the incidence and nature of NVP in pregnant women living in the Guildford area, and to compare the results with those in the literature.

2) Assess the feasibility of carrying out a prospective study
To this end, the questionnaire allowed information to be gained about:
1) The incidence of mild, moderate and severe NVP in the Guildford area.
2) The birth weight, head circumference and length of those babies born to mothers with NVP and those without it.
3) Dietary cravings and aversions during pregnancy.
4) Dietary remedies and treatments used to reduce symptoms of NVP.
5) Maternal weight gain in women with and without NVP.
6) Factors that could affect NVP.
7) Whether women with NVP are more likely to change their diet during pregnancy compared to women without NVP.

1.14.2 The Prospective Study

In the prospective study, women were monitored during pregnancy in order to determine why NVP may have a beneficial effect. The objectives of this study were to assess whether the beneficial effects of NVP were associated with one or more of the following factors:

Women who experience NVP may:
1) Increase their intake to alleviate their sickness.
2) Reduce their intake.
3) Change the quality of the diet to reduce NVP.
2. SUBJECTS AND METHODS (QUESTIONNAIRE SURVEY)

2.1 Study Design

A retrospective questionnaire survey was conducted in order to obtain some background information about NVP in the Guildford area.

Questionnaires are used in all forms of epidemiological studies to measure exposures both to possible causal agents e.g. nutrient intake and to confounding variables e.g. age or gender. They may also be used to measure outcomes e.g. disease status in cross-sectional studies (Margetts and Nelson, 1997). There are two different methods for administering questionnaires; self-administered or interviewer administered. In this study, self-administered questionnaires were used. These have the advantage of being lower in cost and provide no scope for interviewer bias. However, they have the disadvantage of tending to partial completion, unresolved or unidentified problems, and they require the subject to be literate (Margetts and Nelson, 1997).

The outcomes which it was hoped the questionnaire survey would show were the incidence of NVP in the Guildford area, the mean differences in pregnancy outcomes between women with NVP and those without NVP and the maternal and other factors
in relation to occurrence of NVP, and the relationship between those factors and pregnancy outcomes.

2.2 Development of Questionnaire

2.2.1. Questionnaire Format

The questionnaire should be designed to ask the minimum amount about a subject’s experiences, which will provide sufficient information to investigate the research question (Margetts and Nelson, 1997). Wording should avoid any suggestion that a particular answer is preferred i.e. leading questions should be avoided. Questions should follow a logical sequence, as far as possible; it should be the sequence that the respondents might expect to follow. Each question must be justified in terms of the objectives of the study (Margetts and Nelson, 1997).

In this study, the questionnaire consisted of thirty-nine questions over ten A4 pages (See Appendix I), which were divided into three parts:

1) Part 1: Information about the woman (consisting of twenty-seven questions)
2) Part 2: Information about the partner (consisting of seven questions)
3) Part 3: Information about the baby (consisting of five questions)

The questionnaire contained both open and closed questions. Open questions are those which allow the respondents to answer in their own terms. These were used for non-categorical data. Closed questions are those, which specify in detail the possible answers (Margetts and Nelson, 1997). Margetts and Nelson (1997) suggests that
epidemiological questionnaires usually should contain a majority of closed questions to reduce the possibility of interview, response, interpretation and coding bias, and to facilitate processing. Examples of closed and open questions used in this study are:

1) Open question: Did any foods, medication or alternative remedy help to alleviate the symptoms? Please explain.
2) Closed question: Were you hospitalised due to the nausea and vomiting. Yes/No

The researcher generated questions with advice from the supervisors, based on the literature. The questionnaire designed provided information on the following aspects:

1) Women’s details e.g. weight, height, birth weight, parity, ethnic origin, education, socioeconomic status (based on occupation and level of education), smoking and alcohol use both before and during pregnancy, exercise pre-pregnancy and during pregnancy, diseases during pregnancy. These are factors known to affect birth weight and placental weight, and are also associated with NVP.

2) Partner’s details e.g. height, birth weight, education, socio-economic status (based on both occupation and level of education), and smoking habits. These were asked as they are known to affect pregnancy outcome and to also to get the family’s socio-economic status.

3) Babies’ details e.g. birth weight, head circumference, length, and length of gestation, gender. The women provided the growth data from the “Red” baby book.

4) Types of NVP, duration of NVP, treatments used for NVP, diet in pregnancy and change due to NVP, cravings and aversions. These were asked in order to find out
about NVP and dietary changes during pregnancy in women living in the Guildford area.

5) Main person providing dietary advice. This question was adapted from that used by the OPCS in the infant feeding survey. The aim of this question was to identify the main provider of dietary advice to the women. The main advice giver could then be targeted in the future with updated advice about NVP.

2.2.2. Questionnaire evaluation

Piloting is an essential part of the development of any questionnaire, as it allows questions which are poorly understood or ambiguous, or which evoke hostile or other undesirable responses to be identified. Thus questionnaires can then be modified until the researcher is sure that the response is a true response as far as the subject is able to provide it (Margetts and Nelson, 1997).

In this study, 10 questionnaires were sent to women in the EIHMS department at the University of Surrey. These women had all given birth to a baby in the previous year. Once the questionnaires were received, the comments made were used to modify the questionnaire to the final version that was then sent out to the women who were recruited from the GP clinics. The principle modifications made were:

1) Modifications made to the pilot information sheet
   - The pilot information sheet advised that the time taken to complete the questionnaire was 10 minutes, however from the pilot study, the women reported
that it took them about 15 minutes to complete, so the information sheet was modified.

2) Modifications made to the questionnaire

- In the pilot questionnaire, information about the woman was divided into two sections, one pre-pregnancy and the other experience during pregnancy. This caused confusion and was thus changed to one section about the woman, asking questions about both pre and during pregnancy.

- In the pilot questionnaire, the women were asked at what age they had completed full time education and what qualifications they had obtained. Some women misunderstood this as they had gone back to education later on in life. The question was changed to ask which qualifications the woman had obtained.

- The pilot instruction sheet was too detailed. It was simplified as it made the questionnaire seem too difficult to answer.

- The pilot questionnaire had a line to put the baby’s date of birth, this was changed to boxes, and to match the format used for the woman’s date of birth.

- The pilot questionnaire asked about work during pregnancy, then the women were asked to explain this. This was unclear, so the question was changed to make it clear that the question was asking about the number of hours worked per day and the stage in pregnancy the woman stopped working.

- In the pilot questionnaire, questions regarding when nausea started and for how long it lasted were closed questions, giving the woman a choice of specific times during pregnancy. It was found that the women had different answers to those provided, so the questions were changed to open questions.

- In the pilot questionnaire, the women were asked whether NVP caused them to change their diet in any way. This question was not well answered in the pilot
study, so it was changed to ask whether NVP caused them to eat more of a certain food, and another question which asked whether NVP caused them to eat less of a certain food. In this fashion, it was made clearer what the question wanted.

- In the pilot questionnaire, the women were asked how NVP affected their weight during pregnancy. However it was found that women were not usually weighed throughout pregnancy, and therefore the question was omitted.

- In the pilot questionnaire, dietary aversions and cravings were asked about in one open question. This was changed into two open questions in order to get more information about the cravings and aversions during pregnancy.

2.3 Subjects and Recruitment

2.3.1. Subject Numbers

In order for the study to have 80% power at the 5% significance level, it was estimated that 200 women were needed. The sample size calculations were undertaken by Dr Ioannis Vlachonikolis, Reader in Medical Statistics, University of Surrey. These were based on the expected endpoints of the study, which was birth weight in this case. The calculations took into account the mean birth weight and standard deviation, which were obtained from the literature, and the degree of change in birth weight expected due to NVP. In this study, the mean birth weight was taken as 3500g (500g), and an expected change in birth weight of 150g.
2.3.2. Subject Characteristics

Women with and without NVP who had delivered in the past year who consented to take part in the study were recruited from Fairlands Medical Centre, Guildford and St.Luke’s Medical Centre, Guildford, until the target of 200 women was met.

2.3.3. Recruitment Method

Dr. John Nichols at Fairlands Medical Centre provided a computer printout of all the women belonging to the surgery, who had delivered in the past year. The printout provided only the women’s name and address, no further information about the women was given. At St.Luke’s Medical Centre, the health visitors provided the list of women, with only the women’s name and address. At both surgeries, the midwives and health visitors advised the researcher if there were any women who were unsuitable for the study, such as those women who had miscarried, or whose baby had died.

Each woman was sent:

1) An information sheet which provided details of the study. It also stressed the confidentiality and anonymity with which all data would be treated. (See Appendix II). The information letter was adapted from that used in the OPCS survey of Infant Feeding.

2) Two consent forms. One was to be retained by the women, and the other was to be sent back to the researcher (See Appendix III).

3) Two pre-paid envelopes, one for the consent form and the other for the questionnaire, as they had to be sent in separate envelopes for reasons of confidentiality.
4) One questionnaire.

Recruitment began in April, 1999. Originally 276 questionnaires were sent which was the total number of women provided by the two surgeries, excluding any unsuitable women. Questionnaires were sent out using first class stamps. Each woman was asked to complete the questionnaire within one month’s time, and to send it in the pre-paid envelope provided. The pre-paid envelopes had second class stamps and were addressed to the surgery the women belonged to. A box was placed at both surgeries to collect questionnaires and consent forms, and the researcher emptied these once a week. Each questionnaire had a reference number in order to maintain confidentiality. The researcher had a list of the women’s names and the corresponding reference number, thus allowing a record of the women who sent back the questionnaires to be kept. A reminder letter (See appendix IV) was sent to those women who did not respond within one month’s time, asking the women to respond within two weeks. In order to achieve the target of 200 questionnaires, recruitment continued until December, 2000. The total number of questionnaires sent out during the recruitment period was four hundred and forty.

2.4 Data Entry of Questionnaires

The strictest rules of data handling and anonymity were observed in all data handling. As the questionnaires were returned, the data was entered into the Statistical Package for Social Sciences Version 10 (SPSS) by reference number only, in a secured personal computer, which was accessed by the researcher only. The questionnaires were stored in a locked cabinet.
Margetts and Nelson (1997) report that coding a questionnaire is vital and space must be allocated for code numbers. They suggest that the coding scheme be decided upon prior to administration as this often highlights problems with question design and helps to ensure that appropriate variables are being collected for analysis. In this study, coding of the questionnaire was not carried out initially, it was done after the responses were received, as the coding was based on the type of answers received. However most questions were formatted in a way that they would be able to be coded easily.

Each closed question was assigned a variable name. The variable name was unique to the question, and helped in the identification of the corresponding questions. Each answer was given a number e.g. 1= yes, 2=no. A coding guide was then constructed (See Appendix V), which showed the meaning of all the numerical responses. This was then used to clarify the output from the SPSS analysis.

Most of the answers were inputted in numerical form, which is the preferred way of inputting data, according to Margetts and Nelson (1997).

Open questions had separate spreadsheets for each question. They cannot be added to main database as there were a variety of responses, which made it difficult to code. The responses to the first questionnaire received were put as separate variables in the spreadsheet, then as the next questionnaires were opened, more variables were added if it was an item not already mentioned.
2.5 Data Analysis

Initially, descriptive statistical analysis was undertaken. The mean values, standard deviations and ranges were obtained for data such as maternal weight, height, birth weight. Frequency distributions were also obtained for data such as percentages of women suffering from NVP. Following this, comparative statistics were carried out using appropriate parametric or non-parametric tests.

For relationships between categorical variables, such as maternal characteristics and occurrence of NVP, Chi-square tests were used. In 2 X 2 tables, Yates’ Correction for continuity was used, as this compensates for the overestimate of the chi-square value when used with a 2 X 2 value (Pallant, 2001). With some categories, e.g., socio-economic status, level of education and level of income, the numbers in some cells were too small to carry out the Chi square tests, so the categories were re-arranged into 2 equal groups, based on the fifty percentile cut-off points, calculated using SPSS. For associations between continuous variables, such as between birth weight and length, Pearson correlation was used. Wherever a positive significant correlation was determined, a scatter plot of the two correlates was generated to assess whether or not the association was spurious. Independent samples t-tests were used to compare the outcome from two different groups, such as the birthweight of babies born to women with NVP compared to those born to women without NVP. To compare the outcome of three or more groups, such as the birth weight of babies born to housewives, part-time workers or women working full-time, One way analysis of variance (ANOVA), and the Tukey post hoc test was used. For relationships between continuous variables and categorical variables, such as maternal weight, height and occurrence of NVP, Pearson correlations were used.
The results of the statistical tests were considered significant at $p<0.05$.

For the open questions, only descriptive statistics could be carried out. Frequency tables were generated and graphs produced.

### 2.6 Categorisation of sample population

i) Socio-economic status

Both mother and partner's occupations were included in the questionnaire as open questions, and the responses were used to classify the socio-economic status for each family. The socio-economic status of each family was determined by comparing the job description of the main family breadwinner (household reference person) with the Standard Occupational Classification (OPCS, 1991). This task was completed using guidelines compiled by OPCS (OPCS, 1991). There are six different social classes:

- **I** Professional occupations e.g. lawyers, doctors and accountants
- **II** Managerial occupations e.g. teachers, nurses and managers
- **IIIN** Skilled occupations non-manual e.g. typist, shop assistant
- **IIIM** Skilled occupations manual e.g. miner, bus driver
- **IV** Partly skilled occupations e.g. farm worker, bus conductor
- **V** Unskilled occupations e.g. cleaner, labourer

An additional category was used in this study for families where, both members were unemployed. Only resident parents were included in the assessment of social class. In
the case of families with two full-time employed parents, the parent with the
occupation with the higher rated social class was deemed the household reference
person.

ii) Education
Information about both maternal and paternal education was requested using closed
questions, which had 5 different groups

1) None
2) GSCE
3) A-Levels
4) Degree
5) Post degree

The level of education was sometimes used to clarify the socio-economic status, as
sometimes the job title provided by the woman or her partner may be misunderstood,
and equated to a higher or lower social class. Thus the researcher always compared
the profession to the level of education in order to make a more accurate judgement
about the individual’s social class.

iii) Income
Household income per annum (before tax is deducted) was divided into 5 categories

1) less than £9,999 (per annum)
2) £10,000-£19,999 (per annum)
3) £20,000-£29,999 (per annum)
4) £30,000-£39,999 (per annum)
5) over £40,000 (per annum)
This was adapted from the questionnaire for mothers of low birth weight babies used by Lynne Marriott (2001) in the study titled: A Dietary Intervention Strategy to Foster Optimum Growth and Development in Preterm Infants after Hospital Discharge

iv) Information about NVP

Information about NVP was requested and divided into three categories (Deuchar, 1995)

1) Mild (nausea only)
2) Moderate (both nausea and vomiting)
3) Severe (leading to weight loss)

Women who reported being hospitalised due to NVP were put into a fourth category (Hyperemesis gravidarum) when the data was inputted into the computer.

2.7 Ethical Approval

2.7.1 Main study

The study protocol, together with the information letter for the women, a letter of consent for the women, a copy of the questionnaire, letters of approval from the two surgeries, as well as the ethics application form was submitted to the South West Surrey Local Research Ethics Committee on 23.11.99. The Ethics Committee met on 07.12.99. The Committee made some comments about the study. Modifications were made to the information letter, consent form and questionnaire as advised by the Ethics committee, and re-submitted to the ethics committee on 15.12.99. The Chairman of the Ethics Committee approved the study subject to ratification by the full Committee and this was granted on 25.01.00 (See Appendix VI). The reference number of this study was EC118/99
2.7.2 University of Surrey

An application for an endorsement of the approval for the questionnaire study was made to the Advisory Committee on Ethics of the University of Surrey on 18.01.00. The study protocol, information letter to the women, consent form, a copy of the questionnaire, a copy of the approval letter by the South West Surrey Local Research Ethics Committee and the application form were submitted. The committee made some comments about the study. The necessary changes were made and the application was re-submitted. Permission by the Advisory Committee on Ethics was granted on 15.02.00 (See Appendix IV). The reference number of this study was ACE/2000/11/EIHMS
3. RESULTS OF QUESTIONNAIRE STUDY

3.1 Study Population

A total of four hundred and forty questionnaires were sent out between April, 1999 and December, 2000. Two hundred and twenty one questionnaires were returned; a response rate of 50%. Of the two hundred and twenty one questionnaires, eight had to be excluded, as they were incomplete. Eight questionnaires belonged to women of non-white ethnic origin, these were excluded as it has been reported that cultural, dietary and other factors associated with country of origin may produce results not comparable with those obtained from British subjects (Dickens and Trethowan, 1971). In addition, four questionnaires were excluded as they belonged to women who had multiple gestations, and the progress and outcome of these pregnancies differs from single gestations. Two hundred and one questionnaires were assessed as suitable for analysis.

3.1.1 Descriptive Characteristics

The mean age of the women at the time of delivery was 32 years SD 4.61, the youngest women being 17 years and the oldest 44 years. The mean pre-pregnancy BMI was 27.8 kg/m² SD 3.45. Of the two hundred and one women, one hundred and eighty six (93%) were married or living with their partner. 95 (47.3%) women were first time mothers.
Thirteen women (6.5%) reported smoking during pregnancy, nine women smoked between one and nine cigarettes per day and four women smoked between ten and twenty per day. As for alcohol intake, ninety six (47.8%) women reported drinking alcohol during pregnancy, with two women drinking less than one unit a week, fifty four women drank one to two units a week, ten women drank three to four units a week and twenty nine women drank more than four units a week. One hundred and seventy six women (88%) consumed nutritional supplements. As might be expected, Folic acid was the most common supplement, taken by one hundred and twenty six women (71.6%).

As for socio-economic status, 79% of the women were of social classes I and II. This may not reflect the National average (Figure 3.1.a), however the women all lived in Guildford, which is known to be an affluent area.
Tables 3.1.a and 3.1.b show the descriptive characteristics of the study population in terms of n (the total number of responses to the question) and n% (the number and percentage of the total respondents ticking each option). For some characteristics, data was not provided by every respondent.
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>13</td>
<td>(6.5%)</td>
</tr>
<tr>
<td>Living with husband/partner</td>
<td>186</td>
<td>(93.5%)</td>
</tr>
<tr>
<td>Smoking pre-pregnancy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>32</td>
<td>(15.9%)</td>
</tr>
<tr>
<td>No</td>
<td>169</td>
<td>(84.1%)</td>
</tr>
<tr>
<td>Smoking during pregnancy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>13</td>
<td>(6.5%)</td>
</tr>
<tr>
<td>No</td>
<td>188</td>
<td>(93.5%)</td>
</tr>
<tr>
<td>Alcohol pre-pregnancy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>157</td>
<td>(78.1%)</td>
</tr>
<tr>
<td>No</td>
<td>44</td>
<td>(21.9%)</td>
</tr>
<tr>
<td>Alcohol during pregnancy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>96</td>
<td>(47.8%)</td>
</tr>
<tr>
<td>No</td>
<td>105</td>
<td>(52.2%)</td>
</tr>
<tr>
<td>Supplements pre-pregnancy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>123</td>
<td>(61.2%)</td>
</tr>
<tr>
<td>No</td>
<td>78</td>
<td>(38.8%)</td>
</tr>
<tr>
<td>Supplements during pregnancy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>176</td>
<td>(88%)</td>
</tr>
<tr>
<td>No</td>
<td>24</td>
<td>(12%)</td>
</tr>
<tr>
<td>Number of children</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(excluding this pregnancy)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>95</td>
<td>(47.3%)</td>
</tr>
<tr>
<td>One</td>
<td>73</td>
<td>(36.3%)</td>
</tr>
<tr>
<td>Two</td>
<td>28</td>
<td>(13.9%)</td>
</tr>
<tr>
<td>Three</td>
<td>4</td>
<td>(2%)</td>
</tr>
<tr>
<td>Five</td>
<td>1</td>
<td>(0.5%)</td>
</tr>
<tr>
<td>Household Income per annum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;£9,999</td>
<td>4</td>
<td>(2.1%)</td>
</tr>
<tr>
<td>£10,000-19,999</td>
<td>11</td>
<td>(5.7%)</td>
</tr>
<tr>
<td>£20,000-29,999</td>
<td>29</td>
<td>(15%)</td>
</tr>
<tr>
<td>£30,000-39,999</td>
<td>39</td>
<td>(20.2%)</td>
</tr>
<tr>
<td>&gt;£40,000</td>
<td>110</td>
<td>(57%)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>2</td>
<td>(1%)</td>
</tr>
<tr>
<td>GSCE</td>
<td>55</td>
<td>(27.9%)</td>
</tr>
<tr>
<td>A-Level</td>
<td>34</td>
<td>(16.9%)</td>
</tr>
<tr>
<td>Degree</td>
<td>88</td>
<td>(43.8%)</td>
</tr>
<tr>
<td>Post degree</td>
<td>18</td>
<td>(9%)</td>
</tr>
<tr>
<td>Socioeconomic status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployed</td>
<td>8</td>
<td>(4%)</td>
</tr>
<tr>
<td>Unskilled occupations (V)</td>
<td>1</td>
<td>(0.5%)</td>
</tr>
<tr>
<td>Partly skilled occupations (IV)</td>
<td>2</td>
<td>(1%)</td>
</tr>
<tr>
<td>Skilled occupations- manual (IIIM)</td>
<td>12</td>
<td>(6%)</td>
</tr>
<tr>
<td>Skilled occupations- non manual (IIIN)</td>
<td>20</td>
<td>(10%)</td>
</tr>
<tr>
<td>Managerial occupation (II)</td>
<td>84</td>
<td>(41.8%)</td>
</tr>
</tbody>
</table>
Professional occupations (1) | 74(36.8)
---|---
Occupation of women | 201
Full-time | 103(51.2)
Part-time | 40(19.9)
Housewife | 58(28.9)

**Table 3.1.b Age and anthropometric data of study population**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>Mean (SD)</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>197</td>
<td>32.08(4.61)</td>
<td>17</td>
<td>44</td>
</tr>
<tr>
<td>Pre-pregnancy weight (kg)</td>
<td>201</td>
<td>63.22(11.35)</td>
<td>44.5</td>
<td>112.0</td>
</tr>
<tr>
<td>Weight gain in pregnancy (kg)</td>
<td>183</td>
<td>13.76(5.05)</td>
<td>4</td>
<td>31.6</td>
</tr>
<tr>
<td>Mother's birth weight (kg)</td>
<td>166</td>
<td>3.34(0.59)</td>
<td>1.0</td>
<td>4.6</td>
</tr>
<tr>
<td>Height (m)</td>
<td>200</td>
<td>1.67(0.07)</td>
<td>1.5</td>
<td>1.83</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>200</td>
<td>22.76(3.45)</td>
<td>17.34</td>
<td>36.37</td>
</tr>
</tbody>
</table>

**3.2 NVP**

**3.2.1 Symptoms of NVP**

Of the two hundred and one women in this sample, one hundred and forty six (72.6%), reported having experienced NVP. Within this, eighty-four women (57.5%) reported suffering from mild NVP (nausea only), forty-three (29.5%) moderate (nausea and vomiting) and seventeen women (11.6%) reported severe NVP. Two women (1.4%) had to be hospitalised due to the severity of NVP and in this study have been classed as suffering from Hyperemesis Gravidarum.(Figure 3.2.a).
3.2.2 Onset and Duration of NVP

Of the one hundred and forty six women with symptoms, 95.9% of women reported symptoms of NVP to have started by week 10 gestation. For 32.4% of women, symptoms started immediately or before 4 weeks gestation. (Figure 3.2.b)
The mean length of duration of symptoms was 12.73 weeks SD 8.34, ranging from 2 weeks gestation to 38 weeks.

73.6% of women ceased having symptoms by 20 weeks gestation. In thirteen women (9.3%) symptoms lasted for the duration of pregnancy. (Figure 3.2.c)

**Figure 3.2.c Distribution of cessation of NVP**

Type of NVP was positively related to both onset and duration of NVP ($P= 0.034$) and ($P = 0.012$) respectively.

### 3.2.3 Episodic Nature of Symptoms

The times throughout the day when episodes of nausea occurred are shown in Figure 3.2.iv. Sixty one women (41.8%) reported symptoms to have occurred for a few hours a day, fifty six women (27.9%) reported symptoms lasting throughout the day, eighteen women (12.3%) had symptoms only in the mornings and eleven women (7.5%) reported symptoms solely in the evenings. (Figure 3.2.d)
3.2.4 Factors Related to NVP

The factors investigated in relation to occurrence of NVP are shown in Tables 3.2.a and 3.2.b. The relationships between categorical maternal characteristics and occurrence of NVP was examined by the Chi squared test. Analysis showed that women who smoked pre-pregnancy were less likely to suffer from NVP ($P = 0.040$) (Figure 3.2.e). This was also true for women who smoked during pregnancy ($P = 0.001$) (Figure 3.2.f). There was a trend for women who drank alcohol during pregnancy to be at higher risk from NVP ($p = 0.068$), however, this relationship failed to reach the significance at the 5% level.

For income, level of education, socio-economic status and parity, the variables had to be examined by subgroup to enable statistical analysis (Chi squared test) to be performed, as some cells did not meet the minimum expected cell frequency. Thus
two equal sized groups were created based on the 33.33 percentile and the 66.67 percentile cut-off points calculated using SPSS. Household income was divided into less than £40,000 and more than £40,000. Level of education was divided into A-levels or lower and degree and higher. Socio-economic status was divided into socio-economic group II and below and socioeconomic group I.

NVP was more likely to occur in multiparous women \((P= 0.039)\) (Figure 3.2.g) and in women of higher education levels \((P= 0.024)\) (Figure 3.2.h).

Table 3.2.a Relationship of NVP with different categorical variables

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Significance</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marital status</td>
<td>0.337</td>
<td>199</td>
</tr>
<tr>
<td>Occupation</td>
<td>0.669</td>
<td>201</td>
</tr>
<tr>
<td>Smoking pre-pregnancy</td>
<td>0.031*</td>
<td>201</td>
</tr>
<tr>
<td>Smoking during pregnancy</td>
<td>0.001*</td>
<td>201</td>
</tr>
<tr>
<td>Alcohol pre-pregnancy</td>
<td>0.186</td>
<td>201</td>
</tr>
<tr>
<td>Alcohol during pregnancy</td>
<td>0.068</td>
<td>201</td>
</tr>
<tr>
<td>Supplement use pre-pregnancy</td>
<td>0.959</td>
<td>201</td>
</tr>
<tr>
<td>Supplement use during pregnancy</td>
<td>0.158</td>
<td>200</td>
</tr>
<tr>
<td>Parity</td>
<td>0.039*</td>
<td>201</td>
</tr>
<tr>
<td>Income</td>
<td>1.000</td>
<td>201</td>
</tr>
<tr>
<td>Socio-economic status</td>
<td>1.000</td>
<td>201</td>
</tr>
<tr>
<td>Education</td>
<td>0.036*</td>
<td>201</td>
</tr>
<tr>
<td>Exercise pre-pregnancy</td>
<td>1.000</td>
<td>201</td>
</tr>
<tr>
<td>Exercise during pregnancy</td>
<td>0.499</td>
<td>201</td>
</tr>
<tr>
<td>Infant Gender</td>
<td>0.608</td>
<td>200</td>
</tr>
</tbody>
</table>
Figure 3.2.e Relationship between smoking pre-pregnancy pregnancy and NVP

![Bar chart showing the relationship between smoking pre-pregnancy and NVP.]

Figure 3.2.f Relationship between smoking during pregnancy and NVP

![Bar chart showing the relationship between smoking during pregnancy and NVP.]

57
Pearson product-moment correlation was used to investigate the relationship between NVP and different continuous variables; no correlations were found.
### Table 3.2.b Relationship of NVP with different continuous variables

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Correlation coefficient (P value)</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>-0.026 (0.721)</td>
<td>197</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>-0.084 (0.238)</td>
<td>200</td>
</tr>
<tr>
<td>Weight gain in pregnancy (kg)</td>
<td>0.064 (0.391)</td>
<td>183</td>
</tr>
<tr>
<td>Pre-pregnancy weight (kg)</td>
<td>-0.015 (0.830)</td>
<td>201</td>
</tr>
</tbody>
</table>

#### 3.2.5 Effect of NVP on Intake

**3.2.5.1 Women's perception of effect of NVP on intake**

Fifty-eight women (28.9%) perceived their intake to have decreased due to NVP, 45 women (31%) perceived their intake to have increased and the remaining 42 women (20.9%) perceived that their intake was not affected by NVP.

**3.2.5.2 Foods which alleviated symptoms**

When asked in an open question whether there were any foods which the woman consumed more of as they helped reduce symptoms of NVP, 68.1% (n= 98) reported consuming more of at least one food. The majority of women found that grains and starches helped reduce symptoms of NVP. This was followed by fruit, sweets and non-alcoholic beverages (Figure 3.2.i).
Figure 3.2.1 Foods found to alleviate symptoms of NVP

Food category abbreviations: “Sweets” is sweets, desserts and chocolate, “Fruit” is fruits and fruit juices, “G&S” is grains and starches, “Dairy” is dairy products and ice-cream, “Meat” is meats, fish, poultry, eggs and meat alternatives, “Veg” is vegetables, “Other” is for foods that do not fit into the categories, “N-A” is nonalcoholic beverages, “Fried” is fried foods and junk foods, “Stim” is stimulating drink such as tea, coffee, “Alcohol” is alcoholic beverages, “ESS” is ethnic, strong and spicy foods.
3.2.5.3 Foods which exacerbated symptoms

When the women were asked in an open question whether they had reduced the consumption of specific foods as they worsened the symptoms of NVP, 70.1% (n=101) reported consuming less of some specific foods. Ethnic foods, strong flavoured foods and spicy foods were reported most often to worsen symptoms of NVP. This was followed by stimulating drinks and vegetables (Figure 3.2.j).
Food category abbreviations: “Sweets” is sweets, desserts and chocolate, “Fruit” is fruits and fruit juices, “G&S” is grains and starches, “Dairy” is dairy products and ice-cream, “Meat” is meats, fish, poultry, eggs and meat alternatives, “Veg” is vegetables, “Other” is for foods that do not fit into the categories, “N-A” is nonalcoholic beverages, “Fried” is fried foods and junk foods, “Stim” is stimulating drink such as tea, coffee, “Alcohol” is alcoholic beverages, “ESS” is ethnic, strong and spicy foods.

3.2.6 Advice sought for NVP

Only twenty-three women (15.8%) of the one hundred and forty six suffering from NVP reported seeking professional advice for their symptoms. Eight women asked
their general practitioner (GP) for help. Table 3.2.c shows the type of advice given by the GP.

Table 3.2.c Advice given by doctors to women suffering from NVP

<table>
<thead>
<tr>
<th>Number</th>
<th>Advice</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Anti-sickness medication and pressure bands</td>
</tr>
<tr>
<td>2</td>
<td>Eating little and often</td>
</tr>
<tr>
<td>3</td>
<td>Antisickness medication and hospitalisation</td>
</tr>
<tr>
<td>4</td>
<td>Anti-sickness medication and hospitalization</td>
</tr>
<tr>
<td>5</td>
<td>Rest</td>
</tr>
<tr>
<td>6</td>
<td>Anti-sickness medication and acupuncture</td>
</tr>
<tr>
<td>7</td>
<td>Acupuncture and pressure bands</td>
</tr>
<tr>
<td>8</td>
<td>Rest</td>
</tr>
</tbody>
</table>

Two women asked their midwives for help, one midwife advised pressure bands and ginger, the other only pressure bands.

The remaining thirteen women sought alternative medical help, nine women were advised to try pressure bands only, one woman both pressure bands and aromatherapy, one woman ginger and aromatherapy, and the third ginger and wrist bands.

The Chi-squared test was used to assess whether there was a relationship between severity of NVP and asking for advice. A significant relationship was found, where women with more severe NVP were more likely to ask for advice compared to those with mild or moderate NVP ($P < 0.001$) (Figure 3.2.k).
3.2.7 Methods used to alleviate symptoms

In the survey, the women were asked about the methods that they found to be most useful in alleviating symptoms of NVP. Eating little and often and carbohydrates were found to be the most effective methods of alleviation (Figure 3.2.1). Other methods not shown in the diagram include fresh air, stopping vitamins, fasting and intravenous fluids, lavender cushion, being in water, indigestion tablets, milk and maintaining a good level of hydration. Each of these was reported only once.
Figure 3.2.1 Methods used to alleviate symptoms of NVP

(The numbers by the pie chart represent percentages of women reporting these methods)

3.2.8 Effect of NVP on Outcome of Pregnancy

Independent-samples t-tests were conducted to compare the birth weight, length and head circumference of infants born to women with NVP and without NVP. There was no significant differences in the birth weight, in women with NVP (mean = 3.48kg, SD = 0.56) and without NVP (mean = 3.43kg, SD = 0.56) ($P = 0.583$). No significant differences were found in the infant length in women with NVP (mean = 51.67cm, SD = 2.3) and women without NVP (mean = 51.30cm, SD = 2.20) ($P = 0.361$). Finally, no significant differences were found in the head circumference of infants born to in women with NVP (mean = 35.19cm, SD = 1.6) and women without NVP (mean = 35.17cm, SD = 1.5) ($P = 0.184$).
3.3 Dietary Cravings and Aversions in Pregnancy

3.3.1 Incidence of cravings and aversions in pregnancy

One hundred and two (51.3%) women reported at least one craving during pregnancy.
As for aversions, eighty-two women (41.4%) reported avoiding at least one food
during the course of pregnancy.

3.3.2 Foods craved and avoided during pregnancy

The most commonly craved food category during pregnancy was sweets. This was
followed by fruit, grains and starches and dairy products (Figure 3.3.a). In this
sample, there were three reportings of pica, one for coal, and two for ice-cubes.

As for aversions, the most commonly avoided foods were stimulating drinks such as
teas and coffees. This was followed by vegetables and ethnic, strong and spicy foods
(Figure 3.3.b).
Figure 3.3.a Distribution of foods craved during pregnancy

Food category abbreviations: “Sweets” is sweets, desserts and chocolate, “Fruit” is fruits and fruit juices, “G&S” is grains and starches, “Dairy” is dairy and ice-cream, “Meat” is meats, fish, poultry, eggs and meat alternatives, “Veg” is vegetables, “Other” is for foods that do not fit into the categories, “N-A” is nonalcoholic beverages, “Pica” is for foods not normally considered edible, “Fried” is fried foods and junk foods, “Stim” is stimulating drink such as tea, coffee, “Alcohol” is alcoholic beverages, “ESS” is ethnic, strong and spicy foods.
3.3.2.1 Reasons cited for cravings and aversions

Out of the one hundred and two women reporting cravings, only thirty-nine gave an answer when asked about possible reasons for the cravings. Nineteen women said that...
they did not know why they craved some foods other than it being a definite urge for a food item. The remaining ten women gave a variety of reasons which are shown in Table 3.3.i. The most common reasons cited for cravings of specific food groups were hunger NVP, the food was bland, and to make up for a reduction in the consumption of tea.

Table 3.3.a Reasons cited for cravings of specific foods groups

<table>
<thead>
<tr>
<th>Reason</th>
<th>CHO (n)</th>
<th>Sweets (n)</th>
<th>N-A (n)</th>
<th>Meat (n)</th>
<th>Dairy (n)</th>
<th>Fruit (n)</th>
<th>Fried (n)</th>
<th>Stim (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hunger/ NVP</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dizzy</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy/ comfort</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strong Taste</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin/mineral</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cold</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Easy to eat</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Fresh Taste</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Make up for veg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Settle stomach</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bland</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Should not have it</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Same cravings with periods</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Make up for tea</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(CHO is carbohydrates, N-A is non-alcoholic beverages, stim is stimulating drinks such as tea, coffee)
As for aversions, thirty-nine women gave reasons for avoiding certain food groups. These are shown in Table 3.3.b. The most common reason cited for the avoidance of specific food groups was NVP.

<table>
<thead>
<tr>
<th>Reason</th>
<th>CHO</th>
<th>Sweets</th>
<th>Alc</th>
<th>Meat</th>
<th>Dairy</th>
<th>Fruit</th>
<th>Fried</th>
<th>ESS</th>
<th>Veg</th>
<th>Stim</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart burn</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Nausea</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>7</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Smell</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bad taste</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal taste</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Headache</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Dislike</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

### 3.3.3 Factors related to cravings and aversions in pregnancy

The factors investigated in relation to cravings in pregnancy are shown in Tables 3.1.c and 3.1.d. The Chi-squared test were used to investigate the relationship between cravings in pregnancy and the categorical variables. A significant relationship was found between NVP and cravings, where cravings were more likely to occur in women with NVP compared to those without NVP (P = 0.022) (Figure 3.3.c)
Table 3.3.c Maternal characteristics investigated in relation to occurrence of cravings in pregnancy (categorical variables)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marital status</td>
<td>197</td>
<td>0.928</td>
</tr>
<tr>
<td>Occupation</td>
<td>199</td>
<td>0.401</td>
</tr>
<tr>
<td>Smoking pre-pregnancy</td>
<td>199</td>
<td>0.307</td>
</tr>
<tr>
<td>Smoking during pregnancy</td>
<td>199</td>
<td>0.925</td>
</tr>
<tr>
<td>Alcohol pre-pregnancy</td>
<td>199</td>
<td>0.081</td>
</tr>
<tr>
<td>Alcohol during pregnancy</td>
<td>199</td>
<td>0.608</td>
</tr>
<tr>
<td>Parity</td>
<td>199</td>
<td>0.928</td>
</tr>
<tr>
<td>Income</td>
<td>199</td>
<td>0.769</td>
</tr>
<tr>
<td>Education</td>
<td>199</td>
<td>0.143</td>
</tr>
<tr>
<td>Socio-economic status</td>
<td>199</td>
<td>1.000</td>
</tr>
<tr>
<td>NVP</td>
<td>199</td>
<td>0.022*</td>
</tr>
</tbody>
</table>
Figure 3.3.c Relationship between cravings and NVP

Figure 3.3.d shows the percentage distribution of cravings of women with NVP compared to those without NVP. The foods most commonly craved by women with NVP were sweets, grains and starches, fruit and dairy products. In women without NVP, the most commonly craved foods were fruit and dairy products, followed by meat, vegetables and sweets.
Figure 3.3.d Distribution of foods craved during pregnancy by women with and without NVP

Food category abbreviations: “Sweets” is sweets, desserts and chocolate, “Fruit” is fruits and fruit juices, “G&S” is grains and starches, “Dairy” is dairy and ice-cream, “Meat” is meats, fish, poultry, eggs and meat alternatives, “Veg” is vegetables, “Other” is for foods that do not fit into the categories, “N-A” is nonalcoholic beverages, “Fried” is fried foods and junk foods, “Stim” is stimulating drink such as tea, coffee, “Alcohol” is alcoholic beverages, “ESS” is ethnic, strong and spicy foods.

Pearson product correlations were used to investigate whether there were any relationships between some maternal continuous variables and cravings during pregnancy. No significant correlations were found.
Table 3.3.d Maternal factors investigated in relation to cravings (continuous variables)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>Correlation coefficient (P Value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>196</td>
<td>-0.060 (0.402)</td>
</tr>
<tr>
<td>Pre-pregnancy weight (kg)</td>
<td>199</td>
<td>-0.060 (0.391)</td>
</tr>
<tr>
<td>Weight gain in pregnancy (kg)</td>
<td>181</td>
<td>0.015 (0.843)</td>
</tr>
<tr>
<td>BMI (kg/m2)</td>
<td>198</td>
<td>-0.079 (0.200)</td>
</tr>
</tbody>
</table>

The factors investigated in relation to occurrence of aversions in pregnancy are shown in Tables 3.3.e and 3.3.f.
Table 3.3.e Maternal factors investigated in relation to occurrence of aversions
(categorical variables)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marital status</td>
<td>196</td>
<td>0.275</td>
</tr>
<tr>
<td>Occupation</td>
<td>198</td>
<td>0.420</td>
</tr>
<tr>
<td>Smoking pre-pregnancy</td>
<td>198</td>
<td>0.768</td>
</tr>
<tr>
<td>Smoking during pregnancy</td>
<td>198</td>
<td>0.272</td>
</tr>
<tr>
<td>Alcohol pre-pregnancy</td>
<td>198</td>
<td>0.101</td>
</tr>
<tr>
<td>Alcohol during pregnancy</td>
<td>198</td>
<td>0.362</td>
</tr>
<tr>
<td>Parity</td>
<td>198</td>
<td>0.776</td>
</tr>
<tr>
<td>Income</td>
<td>198</td>
<td>0.989</td>
</tr>
<tr>
<td>Education</td>
<td>198</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Socio-economic status</td>
<td>198</td>
<td>0.115</td>
</tr>
<tr>
<td>NVP</td>
<td>198</td>
<td>0.026*</td>
</tr>
</tbody>
</table>

Chi-square tests were used to investigate relationships between some maternal
categorical characteristics and aversions in pregnancy. Aversions were found to occur
more in women with NVP compared to those without NVP (P = 0.026) (Figure 3.3.e)
The foods most commonly avoided by women with NVP were stimulating drinks such as tea and coffee. This was followed by ethnic, strong and spicy foods, vegetables and meat. As for women without NVP, stimulating drinks were the most commonly avoided products, followed by ethnic, strong and spicy foods and fried foods (Figure 3.3.f).
Figure 3.3.f Distribution of foods avoided during pregnancy in women with and without NVP.

Food category abbreviations: “Sweets” is sweets, desserts and chocolate, “Fruit” is fruits and fruit juices, “G&S” is grains and starches, “Dairy” is dairy and ice-cream, “Meat” is meats, fish, poultry, eggs and meat alternatives, “Veg” is vegetables, “Other” is for foods that do not fit into the categories, “N-A” is nonalcoholic beverages, “Fried” is fried foods and junk foods, “Stim” is stimulating drink such as tea, coffee, “Alcohol” is alcoholic beverages, “ESS” is ethnic, strong and spicy foods.
Chi-square analysis also showed a positive correlation between maternal education and aversions, where aversions were more likely to occur in women of higher education level ($P < 0.001$) (Figure 3.4.g)

**Figure 3.3.g Relationship between aversions and maternal education**

There were no significant correlations between the continuous maternal characteristics investigated and occurrence of aversions.

**Table 3.3.f Maternal factors investigated in relation to aversions (continuous variables)**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>Correlation coefficient ($P$ Value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>194</td>
<td>-0.072 (0.318)</td>
</tr>
<tr>
<td>Pre-pregnancy weight (kg)</td>
<td>198</td>
<td>-0.008 (0.912)</td>
</tr>
<tr>
<td>Weight gain in pregnancy (kg)</td>
<td>181</td>
<td>0.089 (0.234)</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>197</td>
<td>-0.043 (0.552)</td>
</tr>
</tbody>
</table>
3.4 Pregnancy outcomes

Of the two hundred and one infants born, one hundred and sixteen were male (58%) and eighty-four were female (42%). Male infants had a mean birth weight of 3.49kg (SD 0.56), a mean length of 51.65cm (SD 2.25), a mean head circumference of 35.46cm (SD 1.51) and a mean gestational age of 39.35 weeks (SD 1.76). Female infants had a mean birth weight of 3.43kg (SD 0.57), a mean length of 51.48cm (SD 2.34), a mean head circumference of 34.83cm (SD 1.57) and a mean gestational age of 39.30 weeks (2.06). There were no significant differences between the sexes in birth weight (P = 0.447), length (P = 0.667) and gestational age (P = 0.849).

However, the difference in head circumference between males and females was found to be significant (P = 0.021) with the male infants having a significantly higher mean head circumferences than the female. The descriptive characteristics of all infants are shown in Table 3.4.a.

Table 3.4.a Descriptive characteristics of infants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>Range</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth weight (kg)</td>
<td>201</td>
<td>1.4-4.7</td>
<td>3.47(0.56)</td>
</tr>
<tr>
<td>Length (cm)</td>
<td>128</td>
<td>46-57</td>
<td>51.58(2.28)</td>
</tr>
<tr>
<td>Head circumference (cm)</td>
<td>132</td>
<td>31-38</td>
<td>35.19(1.56)</td>
</tr>
<tr>
<td>Gestational age (weeks)</td>
<td>200</td>
<td>29-42</td>
<td>39.33(1.89)</td>
</tr>
</tbody>
</table>

The relationship between birth weight and both length and head circumference was investigated using Pearson product moment correlation coefficient. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity. There was a strong positive correlation between birth weight and length (r = 0.753, P <0.001) (Figure 3.4.a). There was also a strong
positive correlation between birth weight and head circumference ($r = 0.730$, $P < 0.001$) (Figure 3.4.b). Length and head circumference also showed a strong correlation ($r = 0.645$, $P < 0.001$) (Figure 3.4.c). These correlations were significant in both male and female infants.

Partial correlation was used to explore the relationship between length and head circumference, while controlling for birth weight. There was a significant positive partial correlation between length and head circumference ($r = 0.21$, $P = 0.028$). However, an inspection of the zero order correlation ($r = 0.645$) suggests that birth weight had a strong effect on the strength of the relationship between the two variables.

**Figure 3.4a Variation in length at birth with birth weight**
The relationship between gestational age and birth weight, length and head circumference was investigated using Spearman’s rank order correlation as gestational age was not normally distributed. There was a positive correlation between gestational age and birth weight ($r = 0.404, P<0.001$) (Figure 3.4.d). There was also a positive correlation between gestational age and length ($r = 0.400, P <0.001$) and
between gestational age and head circumference \( (r = 0.428, P < 0.001) \). These correlations were significant in both male and female infants.

**Figure 3.4.d Variation in birth weight in relation to gestational age.**

Partial correlation was used to explore the relationship between gestational age and both length and head circumference, while controlling for birth weight. No correlation was seen between gestational age and length \( (r = 0.130, P = 0.141) \) and between gestational age head circumference \( (r = 0.160, P = 0.075) \). Thus birth weight had a large effect in the strength of the relationships between gestational age and both length and head circumference.
3.4.1 Factors related to pregnancy outcomes

3.4.1.1 Maternal characteristics

Tables 3.4.b and 3.4.c show the list of variables tested in relation to pregnancy outcomes.

**Table 3.4.b Maternal characteristics investigated in relation to pregnancy outcome (continuous variables)**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Correlation coefficient (P value)</th>
<th>Birth weight (kg)</th>
<th>Length (cm)</th>
<th>Head circumference (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal birth weight (kg)</td>
<td>0.241 (0.002)*</td>
<td>0.345 (&lt;0.001)*</td>
<td>0.217 (0.023)*</td>
<td></td>
</tr>
<tr>
<td>Maternal height (m)</td>
<td>0.105 (0.140)</td>
<td>0.166 (0.063)</td>
<td>0.125 (0.154)</td>
<td></td>
</tr>
<tr>
<td>Maternal BMI (kg/m²)</td>
<td>0.202 (0.004)*</td>
<td>0.076 (0.396)</td>
<td>0.157 (0.074)</td>
<td></td>
</tr>
<tr>
<td>Maternal age (years)</td>
<td>0.050 (0.482)</td>
<td>0.036 (0.687)</td>
<td>0.079 (0.373)</td>
<td></td>
</tr>
<tr>
<td>Pre-pregnancy weight (kg)</td>
<td>0.260 (&lt;0.001)*</td>
<td>0.168 (0.058)</td>
<td>0.228 (0.008)*</td>
<td></td>
</tr>
<tr>
<td>Weight gain in pregnancy (kg)</td>
<td>0.186 (0.012)*</td>
<td>0.295 (0.001)*</td>
<td>0.253 (0.005)*</td>
<td></td>
</tr>
</tbody>
</table>

Pearson correlation coefficients were used to investigate the relationships between maternal age and height and birth outcomes. No positive relationships were found.

Spearman rank correlations were used to investigate the relationship between maternal birth weight, pre-pregnancy weight, weight gain in pregnancy and maternal BMI. There was a positive correlation between maternal BMI and birth weight (Figure 3.4.e). Pre-pregnancy weight was correlated with both birth weight and head circumference (Figure 3.4.f). However, when Partial correlation was conducted to
investigate the relationship between pre-pregnancy weight and head circumference, while controlling for birth weight, the relationship ceased to be significant ($P = 0.133$). Weight gain in pregnancy was positively correlated with birth weight, length and head circumference (Figure 3.4.g). Again once partial correlation was conducted to control for birth weight, the relationship between weight gain and both length and head circumference ceased to be significant ($P = 0.136$) and ($P = 0.516$) respectively.

Maternal birth weight was also positively correlated with infant birth weight, length and head circumference (Figure 3.4.h). Once birth weight was controlled using partial correlations, the relationship with infant length remained significant ($P = 0.046$, $r = 0.19$). As for head circumference, the relationship ceased to be significant ($P = 0.848$, $r = 0.019$).

**Figure 3.4.e Infant’s birth weight in relation to mother’s BMI**
Figure 3.4.f Infant’s birth weight in relation to mother’s pre-pregnancy weight

Figure 3.4.g Infant’s birth weight (kg) in relation to weight gain during pregnancy
Figure 3.4.h Infant’s birth weight (kg) in relation to mother’s birth weight
Table 3.4. Maternal characteristics investigated in relation to pregnancy outcome (categorical variables)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Birth weight (kg)</th>
<th>Length (cm)</th>
<th>Head circumference (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marital status</td>
<td>0.765</td>
<td>0.590</td>
<td>0.791</td>
</tr>
<tr>
<td>Occupation</td>
<td>0.002*</td>
<td>0.022*</td>
<td>0.131</td>
</tr>
<tr>
<td>Smoking pre-pregnancy</td>
<td>0.488</td>
<td>0.457</td>
<td>0.204</td>
</tr>
<tr>
<td>Smoking during pregnancy</td>
<td>0.745</td>
<td>0.667</td>
<td>0.392</td>
</tr>
<tr>
<td>Alcohol pre-pregnancy</td>
<td>0.545</td>
<td>0.139</td>
<td>0.787</td>
</tr>
<tr>
<td>Alcohol during pregnancy</td>
<td>0.594</td>
<td>0.936</td>
<td>0.692</td>
</tr>
<tr>
<td>Parity</td>
<td>&lt;0.001*</td>
<td>0.004*</td>
<td>0.033*</td>
</tr>
<tr>
<td>Income</td>
<td>0.764</td>
<td>0.679</td>
<td>0.490</td>
</tr>
<tr>
<td>Education</td>
<td>0.353</td>
<td>0.769</td>
<td>0.967</td>
</tr>
<tr>
<td>Socio-economic status</td>
<td>0.878</td>
<td>0.835</td>
<td>0.922</td>
</tr>
</tbody>
</table>

A one-way between-groups analysis of variance was conducted to explore the impact of maternal occupation on pregnancy outcome, as measured by birth weight, length and head circumference. Subjects were divided into those in full-time occupation, part-time occupation and housewives. There was a statistically significant difference in both birth weight and length for the three groups ($P = 0.002$) and ($P = 0.022$) respectively. Post-hoc comparisons using Tukey HSD test indicated that the mean birth weight for mothers in full-time occupation (mean = 3.34, SD = 0.55) was...
significantly different from the mean birth weight for housewives (mean = 3.66, SD = 0.52). Birthweight in mothers in Part-time occupation (mean 3.51, SD = 0.58) did not differ significantly from either group Figure 3.4.i). The same was seen for birth length, where the mean length for those in full-time occupation (mean 51.07 SD = 2.25) was significantly different from the mean length for housewives (mean 52.31 SD = 2.23) but the mean length of those in part-time occupation (mean = 51.94, SD 2.18) did not differ significantly from either group.

Figure 3.4.i Variation in birth weight with maternal occupational status

A one-way between groups analysis of covariance was conducted to compare the effect of maternal occupation on length. Birth weight was used as the covariate in this analysis. Preliminary checks were conducted to ensure that there was no violation of the assumptions of normality, linearity, homogeneity of variances, homogeneity of
regression slopes and the reliable measurement of the covariate. After adjusting for
birth weight, there was no significant difference between the three groups and length
($P = 0.344$).

Independent sample t-tests were conducted to compare the categorical characteristics
and pregnancy outcomes. There was a significant difference in birth weights in
primiparous (mean = 3.31 SD 0.55) and multiparous women (mean = 3.61 SD 0.54) ($P$
< 0.001) (Figure 3.4.j). Significant differences were also seen between length in
primiparous women (mean 50.98 SD 2.29) and multiparous women (mean 52.14 SD
2.14) ($P = 0.004$). In addition, the mean head circumference was significantly
different between primiparous women (mean 34.90 SD 1.48) and multiparous women
(mean 35.48 SD 1.60) ($P = 0.033$).

However once a one way between groups analysis of covariance was conducted to
compare the effect of parity on both length and head circumference while adjusting
for birth weight, the differences ceased to be significant for both length ($P = 0.513$)
and head circumference ($P = 0.217$).
3.4.1.2 Paternal characteristics

Table 3.4.d and e show some of the paternal characteristics, which were requested in the survey.
### Table 3.4.d Paternal characteristics (categorical variables)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking</td>
<td>198</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>43</td>
<td>21.7</td>
</tr>
<tr>
<td>No</td>
<td>155</td>
<td>78.3</td>
</tr>
<tr>
<td>Education</td>
<td>198</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>4</td>
<td>2.1</td>
</tr>
<tr>
<td>GSCE</td>
<td>54</td>
<td>28.6</td>
</tr>
<tr>
<td>A-Level</td>
<td>25</td>
<td>13.2</td>
</tr>
<tr>
<td>Degree</td>
<td>79</td>
<td>41.8</td>
</tr>
<tr>
<td>Post degree</td>
<td>27</td>
<td>14.3</td>
</tr>
<tr>
<td>Ethnic origin</td>
<td>198</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>195</td>
<td>98.5</td>
</tr>
<tr>
<td>Black African</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Indian</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Pakistani</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Occupation</td>
<td>198</td>
<td></td>
</tr>
<tr>
<td>Full-time</td>
<td>194</td>
<td>98</td>
</tr>
<tr>
<td>Unemployed</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

### Table 3.4.e Paternal characteristics (continuous variables)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (m)</td>
<td>195</td>
<td>1.63</td>
<td>1.96</td>
<td>1.8 (0.063)</td>
</tr>
<tr>
<td>Birth weight (kg)</td>
<td>109</td>
<td>2</td>
<td>4.7</td>
<td>3.49 (0.59)</td>
</tr>
</tbody>
</table>
Independent t-tests were carried out to investigate the effect of smoking on infant's birth weight, length and head circumference. There were no differences in the mean birth ($P=0.666$), mean length ($P = 0.446$) or mean head circumference ($P =0.791$) in infants whose fathers smoked compared to those who did not smoke.

Pearson product correlation coefficient was used to investigate the relationships between father's height and pregnancy outcome. There was a positive correlation between father's height and infant length ($P = 0.015$, $r = 0.217$) (Figure 3.4.k). However, there were no significant relationships found between fathers height and birth weight or head circumference ($P= 0.063$, $r = 0.133$) and ($P=0.474$, $r = 0.064$) respectively.
Father’s birth weight was also analysed with regard to pregnancy outcome using Pearson product correlations. There was a positive correlation between the father’s birth weight and the infant’s birth weight ($P<0.001$, $r = 0.343$) (Figure 3.4.I), length ($P=0.036$, $r=0.241$) and head circumference ($P=0.004$, $r = 0.324$). However, once partial correlations were conducted to investigate the relationship between father’s birth weight and both infant length and head circumference while controlling for the infant’s birth weight, both relationships ceased to be significant ($P= 0.813$) and ($P = 0.323$) respectively.
3.5 Dietary advice during pregnancy

The women in this survey were asked whether they had received any dietary advice during pregnancy. Of the survey sample, one hundred and fifty two women (75.6%) had received some sort of dietary advice. The women were also asked who had offered the advice. It was found that the midwife was the main source of dietary advice in these women (Figure 3.5.a)
Figure 3.5.a Distribution of dietary advice providers

![Bar chart showing the distribution of dietary advice providers.](image)

- Midwife: 80.4%
- Books: 44.4%
- Magazine: 33.3%
- Doctor: 31.4%
- Leaflets: 28.1%
- Friend: 15%
- Relative: 14.4%
- Dietitian: 3.3%
4. DISCUSSION OF QUESTIONNAIRE STUDY

4.1 NVP

4.1.1 Symptoms of NVP

In this study, 72.6% of the subjects experienced symptoms of NVP. This compares well with other studies that noted that 69%-89.4% of the sample experienced NVP (Brandes, 1967, Little and Hook, 1979, Jarnefelt-Samsioe et al, 1983, Tierson et al, 1986, Vellacott et al, 1988, Wiegel and Wiegel, 1988, Wiegel and Wiegel, 1989, Gadsby et al, 1993, Lacroix et al, 2000, Furneaux et al, 2001).

Of the women who had symptoms of NVP, it was found that 42.5% of women had symptoms of both nausea and vomiting. Again this compares well with other studies which reported vomiting in 32.2%-56% of women (Klebanoff et al, 1985, Vellacott et al, 1988, Teirson et al, 1986, Wiegel and Wiegel, 1988, Wiegel and Wiegel, 1989, Andrews and Whitehead, 1990, Gadsby et al, 1993, Lacroix et al, 2000).

4.1.2 Onset and duration of NVP

It is generally believed that symptoms of NVP are only experienced during the first trimester (Vellacott et al, 1988, Lacroix et al, 2000), however, this study as well as others show that NVP continued into the second trimester.
In this study, it was seen that symptoms of NVP are reported to start early on in pregnancy, with 32.4% of women experiencing symptoms by 4 weeks gestation, i.e., even before most women are even aware that they are pregnant, thus, NVP is usually the first sign of pregnancy. By 10 weeks the majority of women (95.9%) had experienced symptoms of NVP. NVP lasted a mean of 3 months and by 20 weeks gestation, 73.6% ceased having symptoms.

This is supported by a study carried out by Jarnfelt-Samsioe et al. (1983) who reviewed questionnaires mailed twice to women who had at least three children, the last being delivered between 1980 and 1981 at a university hospital in Sweden. They found that in 91% of women, the onset of NVP was within the first trimester of pregnancy and in 75% of cases, symptoms lasted approximately three months.

Vellacott et al. (1988) who carried out a study on 500 women who were recruited from antenatal clinic at St. Thomas' Hospital, found that 87% of women had symptoms by 8 weeks gestation, with 8% being affected even before the first missed period. However by the 12th week gestation symptoms had ceased only in 27% of the sample.

Similar findings have also been reported by Wiegel and Wiegel (1989) in their study of a cohort of women in Los Angeles who had delivered a single baby between 1st April 1983 and 31st March 1984. They found that symptoms started by 4-6 weeks, peaked at 8-12 weeks and diminished thereafter until by 20 weeks relatively few women experienced either nausea or vomiting.
Similarly, Lacroix et al (2000) found that among the 160 women studied prospectively, nausea was recorded as early as 3 weeks gestation, with the mean gestational age of onset being 5.7 weeks. Vomiting began as early as 4 weeks gestation. They found that symptoms were greatest at 11 weeks gestation and the severity in those affected peaked at 11 to 13 weeks. Although the prevalence gradually declined in the second trimester, only half the women with NVP were completely relieved by 14 weeks gestation, and it was not until week 22 that nausea had resolved in 90% of all affected women.

Two other studies also found NVP to persist into the second trimester. Teirson et al (1986) who studied 414 upper middle class women from New York, prospectively during pregnancy, found that although NVP had resolved in 50% by week 15, 25% still experienced by week 20. Klebanoff et al (1985) using data collected for the Collaborative Perinatal Project which involved 56,000 pregnancies from 1959-1966, found that in 9% of women, vomiting continued even after week 22 gestation.

Thus it can be seen that in some women, symptoms seem to persist even beyond week 20, and it is important that pregnant women are made aware of this to avoid anger, worry and disappointment if symptoms persist.

In this retrospective questionnaire study, women who had symptoms of nausea only started symptoms earlier (5.3 weeks) compared to those who had both nausea and vomiting (6.3 weeks). In addition, in women with mild NVP, symptoms lasted for a shorter duration that women with both nausea and vomiting. Also within the severity of symptoms, those women with more severe NVP had symptoms for a longer duration than those with nausea only. Two studied support these findings. Both
Tierson et al (1986) and Zhou and O’Brien et al (1999) found that women with both nausea and vomiting had longer duration of symptoms compared to women with nausea only.

These findings imply that mild to moderate NVP is

- Common
- Usually the first sign of pregnancy
- Persistent
- A natural state of pregnancy rather than a pathological condition.

4.1.3 Episodic nature of symptoms

Of the women reporting symptoms of NVP, this study found that 41.8% reported symptoms to have occurred for a few hours per day, 27.9% reported symptoms lasting throughout the day, 12.3% had symptoms in the mornings only and 7.5% reported symptoms to have occurred only in the evenings. Thus it can be seen that nausea and vomiting are experienced beyond the morning hours and some women complain of symptoms throughout the day. This finding is supported by other studies, suggesting that the term “Morning Sickness” is misleading and preferably should be avoided when referring to symptoms of NVP.

Jarnfelt-Samsioe et al (1983) surveyed 244 multigravida who had delivered at least 3 children regarding their experiences of pregnancy, which had occurred within the previous two years. The researchers found that the intensity of nausea showed a diurnal variation with 50% of the women experiencing worst nausea in the morning,
7% in the evening and 36% all day with no peak period. The remaining 7% had peaks of nausea both in the morning as well as in the evening.

In a study of 500 women at St. Thomas’ Hospital, London by Vellacott et al (1988), information was obtained about symptoms and possible associated factors by a comprehensive questionnaire, which was applied at the booking-in appointment. The patients were then followed up regularly throughout the pregnancy repeating those questions relevant, and a final postnatal questionnaire evaluated outcome. The authors reported that although 80% of women complained of NVP in the morning, only 19% indicated that NVP was confined to this time. The usual pattern was for symptoms to persist throughout the day, with 46% complaining of NVP in the afternoon, 55% in the evening and 12% at night.

Dilorio’s study in 1985 on 92 pregnant teenagers found that early morning hours were the most common time of day for symptoms to occur. 20% of respondents however noted that they were most likely to experience symptoms in the evening and another 20% indicated that NVP lasted all day long.

In the studies mentioned above, as well as the one we conducted, subjects were asked to recall symptoms, with the period of recall ranging from a few hours, to a few days for those currently pregnant, to several years such as the study by Jarnfelt-Samsioe et al (1983). The problem with recall is that only the intense periods of NVP are likely to be remembered, whereas, moderate and mild nausea may be forgotten (Dilorio et al, 1992).
However, in studies that were conducted prospectively with the women recording the symptoms as they felt them, similar results were found, suggesting that recall of symptoms of NVP is good, and women do not “forget” their symptoms.

In a prospective study carried out by Dilorio et al (1992) on 19 women in America, the women were asked to keep a 7-day diary of their symptoms. It was found that although NVP was slightly more likely but not significantly to occur in the mornings, its occurrence is not confined to this time, afternoon and evenings were also peak times for NVP to occur. The authors suggest that there are four major peak times for NVP to occur, morning peak nausea, evening peak nausea, bimodal nausea and all day nausea.

In another prospective study carried out by Gadsby et al (1993) on 363 women in Leicester, who were asked to keep a diary of their symptoms until the symptoms ceased, it was found that although the most common time for symptoms to occur was in the morning, only 4% of the women had only morning sickness, while 95% had symptoms before and after midday. The authors reported a fairly equal distribution of symptoms throughout the day.

More recently, Lacroix et al (2000) carried out a prospective study on 160 women in Canada. Subjects were asked to keep daily recordings of frequency, duration and severity of symptoms. It was found that although 80.2% of women reported nausea in the morning, only 1.8% reported that nausea was limited to the morning only. In 3.7% nausea lasted until the afternoon, until after suppertime in 4.7% of women and all day
long in 80%. In 10% of women, symptoms were not experienced in the morning at all, but they had symptoms at various times throughout the day.

Results from different studies in different locations, using both retrospective and prospective methods showed that NVP was not confined to the mornings. Thus the continued reference to NVP as “morning sickness” may be confusing for pregnant women, especially those who are pregnant for the first time and experiencing symptoms at other times of the day.

4.1.4 Factors related to NVP

4.1.4.1 Smoking pre-pregnancy

Women who smoked pre-pregnancy are less likely to suffer from NVP than those women who did not smoke pre-pregnancy. This finding is supported by many studies which found the same association (Little and Hook, 1979, Jarnfelt-Samsioe et al, 1983, Klebanoff et al, 1985, Vellacott et al, 1988, O’Brien and Zhou, 1995, Gadsby et al, 1993).

Several authors have put forward hypotheses to try and explain this association. Smoking could stimulate gastric motility and activity, which is, known to diminish nausea (Jarnfelt-Samsioe et al, 1983). Smoking could have a tranquilizing effect on the women making them less prone to NVP (Vellacott et al, 1988). O’Brien and Zhou (1995) cite a study by Bremme (1990) which found that women who smoked had lower serum estriol and prolactin levels during the first 20 weeks of pregnancy than did non-smokers. In addition to the effect of smoking on the endocrine system, O’Brien and Zhou (1995) speculate that smoking tends to blunt olfactory and
gustatory senses. All sensory stimulation, particularly those such as odours and alterations in taste perception were troublesome for those who reported moderate to severe symptoms in another study carried out by the same authors in 1997. Flaxman and Sherman (2000) also speculate that smoking may reduce symptoms of NVP by interfering with the underlying neuroendocrine system or by damaging placental cells that may be responsible for triggering NVP. Possible aversion to smoking could again be part of the embryo protection hypothesis as cigarette smoking is a known reproductive toxin known to adversely affect both fertility and fetal weight (O’Brien and Zhou, 1995).

4.1.4.2 Education

The incidence of NVP was associated with the level of education. Again this finding is not supported by other studies. Vellacott et al (1988) and Pettiti (1986) did not find a relationship between NVP and level of education. Klebanoff et al (1985) and Lacroix et al (2000) found the opposite effect, where the risk of vomiting increased with decreased level of education. This possible variation in results could be due to differences in the methodologies between the studies. Moreover, in this study, the majority of women had a degree or higher and thus could have biased the results. An explanation for our findings though is that the more educated the women, the more interest they took in their pregnancy, and concentrated more on what was happening, which could have psychologically caused the symptoms of NVP.
4.1.4.3 Parity

Finally, we have observed that NVP occurred more often in multiparous as opposed to primiparous women. Pettiti (1986) in her post-pregnancy survey of 7,767 pregnancies, found that the risk of NVP increased with increased parity. Vellacott et al (1988), Gadsby et al (1993) and Bayley et al (2002) did not find an association between parity and NVP, while the opposite effect was observed by Klebanoff et al (1985) who found that first time mothers were more likely to suffer from NVP. O'Brien and Zhou (1995) in their prospective study on 126 women also found that vomiting was more common in nulliparous women. O'Brien and Zhou (1995) report that multiparous women have lower levels of circulating and urinary oestrogens and that there is some evidence that oestrogen production and metabolism are altered by a woman's first full term pregnancy so that the amount of free oestradiol is lower in subsequent pregnancies.

4.1.5 Effect of NVP on intake

In this study, 31% of women with NVP perceived their intake to have increased, while 28.9% perceived their intake to have decreased. As for the remaining 20.9%, they reported no change in intake.

In a study by Robinson et al (2001) on 494 women who were interviewed at fifteen weeks gestation, 34% of women reported increased intake and 35% reported a decreased intake. Of the women who reported an increase in intake, 64% attributed the change to increased hunger, whilst 26% reported that increasing their intake helped alleviate nausea. On the other hand, those who reported a decreased intake, 39% attributed this to being less hungry, whilst 53% reported that this was due to
NVP. Robinson et al (2001) concluded that with the exception of women with severe nausea, there was no clear pattern of change in intake in relation to the degree of NVP, and that appetite changes during pregnancy strongly influence intake, independently of NVP.

In our study we specifically asked the women with NVP about how they perceived NVP to have affected their intake, and roughly equal proportions of women reported an increase, decrease or no change in intake due to NVP. However, as the study was based on recall, and there was no specific question asking whether the change in intake could be due to other factors, these results cannot be taken for certain.

4.1.6 Advice sought for NVP

Only twenty-three women (15.8%) in this study reported seeking professional help for their NVP. Ten women reported asking their GP or midwife for help. Both medication and pressure bands were the most common relief measure advised. Hospitalisation, rest, eating little and often, acupuncture and ginger followed this. The remaining thirteen women reported seeking alternative medical therapy. The majority of women were recommended pressure bands, two women were advised to try aromatherapy and one woman ginger.

In a survey carried out on one hundred and thirty clinicians who treated women with NVP, by Dilorio et al (1994), it was found that clinicians generally recommend eating small frequent meals, eating crackers and avoiding greasy and spicy foods. The respondents were least likely to recommend supportive therapies such as reassurance, rest and alternative therapies such as acupressure and relaxation. Dilorio et al (1994)
state that these measures recommended are in accordance with what is found in midwifery and medical textbooks. However, this study and others such as that carried out by DiLorio (1985) found that resting and lying down was a very effective measure in relieving symptoms. Rest and lying down was not mentioned in any of the clinical textbooks reviewed by the researchers. This could be due to the fact that rest is not a specific relief strategy for nausea. The clinicians studied perceived that antiemetics were the most effective measure, however, though studies have shown that the most frequently mentioned remedies were eating little and often and rest. Although clinicians perceived eating frequently to be effective, they did not perceive rest to be. This could be due to the fact that the clinicians do not ask their patients about the effectiveness of rest and lying down (DiLorio et al, 1994). The clinicians reported that the main source of information about effectiveness of remedies was from the women themselves, thus clinicians should encourage women to share their experience of NVP (DiLorio et al, 1994).

In a study carried out by Power et al (2001) on four hundred and eighty eight physicians about “Nutrition in Pregnancy”, the most frequently recommended remedy was eating small frequent meals (95.5%), eating crackers (88.5%), avoiding strong odours (75.6%), antiemetics (71.3%) ginger (51.8%) and stopping iron supplements (50%). It was seen that women physicians were more likely to recommend ginger and herbal teas and less were less likely to prescribe other treatments like vitamin B6 and acupressure. The authors concluded that the physicians seemed to be well informed about the current opinion on management of NVP, including the use of alternative remedies. The fact that over 70% of physicians prescribed anti-emetics shows that obstetricians and gynaecologists are willing to treat this condition.
aggressively. However, Vellacott et al. (1986) reported that only fifty out of four hundred women with NVP in their study had actually taken medication for NVP. This could be due to the increased awareness of possible side effects of the medication, or due to the fact the interest was being shown in the women’s symptoms, making the women feel better.

In this study a very small number of women with symptoms of NVP actually asked for help to ease the symptoms. Many women feel that it is a normal process and that they have to put up with it, or they do not know that something can be done to relieve the symptoms. It is up to the caregivers to ask about the symptoms. We have seen that the clinicians are aware of the treatments available if they are asked. However, as this study is based on the women reporting whether help was asked for and what advice was being given, these results may not be very accurate in judging the doctors knowledge or the percentage of clinicians offering help for NVP. In addition, it may be up to the researchers in this field to increase the clinicians awareness about these symptoms and treatments available. A study in Canada on one hundred and two women carried out by Lee et al. (2000) showed that since 1995 a campaign to increase awareness of NVP and its treatment among health care professionals, using newsletters, articles, publications, video presentations, conferences and continuing medical education programs, there had been an increase in the percentage of clinicians offering treatment to women with NVP. In addition, before the campaign, clinicians were offering Gravol (dimenhydrinate) as the first line of treatment, whereas after the campaign, Dilactin, which is the medicine recommended specifically for NVP was used by 95% of clinicians. Other treatments offered were herbal products, pressure bands and ginger. Lee et al. (2000) put forward the argument
that there is a definite potential role for evidence based interventions to ensure optimal therapy for women while protecting the unborn child. On the other hand, we have seen from this study and that reported by Power et al (2001) that clinicians seem to be well informed about the treatments available, but since there is still a lack of understanding regarding the pathophysiology of this condition, effective clinical management cannot be found. Thus at this time improvement in management may be more likely to depend on efforts of researchers rather than educators.

In practice, clinicians must take a proactive role in providing up to date information about NVP as well as supporting women with symptoms, thus they should stay ahead in terms of information regarding NVP and treatments available (DiLorio et al, 1994). In addition, DiLorio et al, 1994 report that many women report gaining information from mothers, family members and friends, thus it is important that there is public awareness about treatments available so that the women will receive safe advice. Thus it is preferable if the researchers and educators work together to increase awareness about NVP, which affects so many women and may have a large emotional and economic impact. In the study carried out by Gadsby et al (1993), it was found that out of the 363 women taking part in the study, 206 were in paid employment. Seventy three of these women (35%) spent a mean of 62 hours away from their paid work because of their symptoms, showing the socio-economic significance of this condition.
4.1.7 Methods used to alleviate symptoms

In this study it was found that the most common relief measure was eating little and often, followed by eating carbohydrate rich foods, ginger and rest. These relief measures have been observed in other studies.

Lacroix et al (2000) found that the most effective dietary methods used by women to alleviate symptoms were modification of diet to dry foods and carbonated drinks and increasing the time spent outdoors and reduction of mobility.

O’Brien et al (1997) reported that although most women reported that no intervention or relief measures completely relieved symptoms, almost all women reported to have altered their normal activities in some way, with rest being an important relief measure, especially lying down. Other effective measures were being outdoors or in water, and nutritional factors such as hydration and consumption of carbohydrates especially breads and crackers. Most women also found fruit such as bananas and oranges to be helpful. Meat was consumed less, with the main protein source being dairy products. This was also seen in our study where when questioned about foods which helped reduce symptoms of NVP, the majority of women reported carbohydrates. Some women also mentioned fruit, sweets, non-alcoholic beverages and dairy products; Meat was not mentioned by anyone.

In a prospective study carried out by O’Brien and Naber (1992) on 147 women, using open-ended questions, 120 women reported at least one technique to relieve symptoms. The most common was eating (52.8%), recumbent rest (25%), nothing (9.7%), vomiting (5.6%), time (4.2%), medication (2.1%) and distraction (0.7%).
In a study on 92 pregnant teenagers, DiIorio (1985) found that the teenagers had tried a variety of measures to control NVP, the most common measure was lying down during an episode of NVP, with 46% of those who tried it reporting it to be effective in reducing symptoms. Twenty-three women tried eating crackers, but only 26% found this to be the most effective measure in relieving symptoms. Other measures mentioned were going out for air, sitting quietly, fizzy drink and anti-sickness medication.

It can be seen that rest has been mentioned very frequently as an effective relief measure for NVP. DiIorio (1985) speculates that NVP may be due to orthostatic hypotension, ie low blood pressure found in some patients when they stand up, as NVP tends to occur on getting out of bed in the morning. Lying down is thus a common sense approach to counteract orthostatic hypotension. O’Brien at al (1997) reports that by lying down, women may be trying to reduce the amount of fatigue that they were experiencing as many women reported being continuously tired, or they may have been trying to stabilise their position since some women reported that they often felt dizzy. More research is needed to find out whether rest or position has the greatest impact on symptom relief.

Some factors are known to exacerbate symptoms. In this study, when the women were asked about foods, which made symptoms worse, the most commonly avoided foods and drinks were “ethnic” and spicy foods, followed by stimulating drink such as tea and coffee. Similar findings have been reported in other studies. O’Brien et al (1997)
found that the foods that made the symptoms worse were probably related to individual taste and food tolerance. Some women reported spicy foods, and others reported not being able to tolerate prenatal supplements or coffee. Other factors, which exacerbated symptoms, included olfactory stimulation such as smells, and some activities such as loud noises and talking on the phone.

In their study on 147 women, O’Brien and Naber (1992) found that 117 women reported at least one thing that exacerbated symptoms, mainly particular foods or beverages, not eating, physical position and olfactory stimulation. Some other mentioned factors were auditory stimulation, visual stimulation, heat, time of day and brushing teeth.

In practice, this information can help symptomatic women and their providers develop strategies for reducing symptoms of NVP. The results cannot be generalised to the entire population of symptomatic women, as each woman is different; by knowing what other women found effective, advice can be given to each woman to try the different methods mentioned to see which method will suit that individual.

Lacroix et al (2000) found that among their sample, 20% had not tried any relief measure, suggesting that measures should be reviewed with women as some women may not know what can be done, this might prove to be beneficial in reducing symptoms amongst the women.
### 4.1.8 Effect of NVP on outcome of pregnancy

In this retrospective questionnaire study, no relationship was observed between NVP and outcome of pregnancy. This is supported by other studies. Jarnfelt-Samsioe et al (1983) found no effect of NVP on birth weight and length of gestation. Lacroix et al (2000) also did not find an effect of NVP on birth weight and Wiegel and Wiegel (1989) did not find an effect on birth weight, length, head circumference and length of gestation. Wiegel and Wiegel (1989) found that the only outcome associated with NVP was a decreased risk of miscarriage, and it was those women who vomited who had the decreased risk, women with nausea only had similar miscarriage rates as those women without NVP.

However, other authors have reported a protective effect of NVP on outcome of pregnancy. Klebanoff et al (1985) did not find an effect of NVP on birth weight, but they did find that those women who had vomited had a longer gestation (1.5 days) compared to those women who did not vomit. Brandes (1967) found that women without NVP had lower birth weight babies and shorter gestations than those with NVP. Tierson et al (1986) also found that asymptomatic women delivered a higher proportion of LBW babies (20%) compared to those with nausea (6%) and vomiting (10%), partly as a result of lower gestational age in asymptomatic women.

It was originally speculated by Little and Hook (1979) that NVP may be protective, as NVP was more common among non-smokers and drinkers. However, in a later study, Little (1980) found that NVP was related to a higher birth weight, even after
adjustment for maternal smoking and alcohol use. Smoking and drinking during pregnancy were found to be independent risk factors for LBW.

Wiegel and Wiegel (1989) suggested that the lack of agreement in findings could be due to the fact that confounding variables which have been shown to affect birth weight may not have been taken into consideration in some studies. The large size of their study, 903 women and the fact that other studies have shown similar findings increases the confidence of these findings.

Flaxman and Sherman (2000) who conducted a comprehensive review of the literature found that women who experienced NVP were significantly less likely to miscarry than women who did not. The authors report that in contrast to the strong and consistent negative associations between NVP and miscarriage, NVP was not associated with birth weight and rate of birth defects. In addition, Flaxman and Sherman (2000) investigated whether alleviating the symptoms artificially would reduce the positive effects of NVP. However in their review of the studies conducted on anti-emetic use and NVP, Flaxman and Sherman (2000) did not see an increase in risk of birth defects in women who took antiemetics. The authors report however that eliminating vomiting could create a better metabolic environment for fetal development, or that those women with symptoms severe enough to require medication are bearing the healthiest embryos, or that women with NVP may have developed aversions to potentially harmful foods, thus protecting the woman and her fetus. Thus we can see that for the time being, we can reassure women that NVP does have some protective effects and that alleviating symptoms does not stop this effect.
Although NVP seems to have a protective effect in terms of reducing risk of miscarriage, it does not seem to have an effect on other pregnancy outcomes. However, results remain controversial, and how NVP exerts its effect is still only at the hypothesis level, a lot of research is needed in this area before any definite conclusions can be drawn.

4.2 Dietary cravings and aversions in pregnancy

4.2.1 Incidence of cravings and aversions in pregnancy

It can be seen that dietary cravings and aversions are not limited to a few isolated individuals but affect a sizeable fraction of pregnant women. In this study 51.3% reported at least one craving and 41.4% reported at least one aversion. This incidence is similar to that reported by other authors. Cravings have been reported to occur in 47%-76% of pregnant women (Dickens and Trethowan, 1971, Schwab and Axelson, Finley et al, 1985, Tierson et al, 1985, Wijewardene et al, 1994, 1984, Knox, 1995, Bayley et al, 2002) while aversions have been reported to occur in 25.1%-85% of pregnant women (Dickens and Trethowan, 1971, Schwab and Axelson, 1984, Finley et al, 1985, Tierson et al, 1985, Wijewardene et al, 1994, Knox, 1995, Bayley et al, 2002).

4.2.2 Foods craved and avoided during pregnancy

We have found that the most commonly craved food category was sweets, fruit, grains and starches followed by dairy products. In this sample, there were three reportings of pica, one for coal, and two for ice-cubes. As for aversions, the most
commonly avoided foods were stimulating drinks, followed by vegetables, and ethnic, strong and spicy foods.

Similar findings were reported by Finley et al (1985). The foods most commonly craved were sweets, milk products and fruit. As for aversions, Finley et al (1985) reported that vegetables, greasy, strong tasting foods, tea, coffee and alcohol were most commonly avoided.

In another study carried out in the UK on 100 primiparous women by Dickens and Trethowan (1971), the most commonly craved foods were fruit and fruit drinks, sweets, chocolate and ice cream, and milk and dairy products. The most commonly avoided foods were tea, coffee, cocoa, vegetables, meat fish and eggs, followed by greasy foods.

In their review of the literature, Flaxman and Sherman (2000) found that the most commonly craved foods were fruit and juices, sweets, and dairy products and ice cream. The most commonly avoided foods were meats, fish and poultry and eggs followed by non-alcoholic beverages then vegetables. They reported that the pattern of cravings and aversions were mirror images of each other.

Bayley et al (2002) also found that the most commonly craved foods were fruit and fruit juices and sweet foods, and the most commonly avoided foods were tea, coffee, spicy foods and meat or high protein foods.
Our study as well as those studies carried out by other authors have shown that fruit and fruit juices are commonly craved foods during pregnancy, whereas, tea and coffee are commonly avoided. Dickens and Trethowan (1971) speculate that it would appear that women crave strong-tasting foods, whereas aversions are for those items which have a unique or powerful odour. They put forward the idea that pregnant women crave sweet, sour, savoury or strong-tasting substances in order to try and stimulate and impaired sense of taste and smell brought about by pregnancy. Brown and Toma (1986) carried out a taste test on twenty-three pregnant women and twenty-three non-pregnant women. They found that pregnant women were less able to discriminate among differing concentrations of salt solutions compared to non-pregnant women and preferred stronger tasting salt solutions compared to non-pregnant women. As for sucrose solutions, no significant difference was seen, though the authors suggest that larger studies are needed to test this effect.

As for aversions, Dickens and Trethowan (1971) speculate that aversions could be due to heightened sense of smell, for example many women report an aversion to the smell of tobacco.

Aside from changes in olfactory and taste sensitivity in pregnancy, several other factors may be the cause of dietary cravings and aversions. The cravings for dairy items, sweets, chocolate and fruit could be due to the increased needs for calcium and calories (Hook, 1978). Although there is an increased need for protein too, there is no craving for meat products, instead meat is often reported as an aversion. This could be due to the fact that protein consumption today is high anyway. Finley et al (1985)
reported that while aversions to meat products and vegetables may reduce the quality of the diet, most women who reported an aversion to meat had a craving for dairy products.

Another cause which was originally put forward by Hook (1978), and has recently gained a lot of interest is that cravings and aversions are manifestations of an evolutionary process in which beneficial foods were chosen and craved, and aversions developed toward food harmful to the fetus. In accordance with this theory is that it has been seen that many women report an aversion to caffeinated drinks. Fumeaux et al (2001) state that there is some evidence to suggest that caffeine consumption may be associated with IUGR, spontaneous abortion and adverse effects on the neonate, though results remain controversial. Caffeine belongs to a family of drugs known as methylxanthines. Caffeine is completely absorbed from the digestive tract and reaches all tissues, and during pregnancy, caffeine passes through the placenta and can be measured in fetal tissues, cord blood and amniotic fluid and breast milk.

We have also seen a high aversion to vegetables. The chemicals that give many plants their distinctive aromas and flavours evolved to counter the plant's enemies such as herbivorous insects and vertebrates, fungi, pathogens and parasites. These chemicals are known as phytochemicals, and in large quantities they can be mutagens, teratogens, abortifacients and allergens. For example, crude juice extracts from vegetables such as cabbage or brussel sprouts contain isothiocyanates and other breakdown products of glucosinolates that can induce chromosomal aberrations in mammalian cells (Flaxman and Sherman, 2000).
Flaxman and Sherman (2000) considered three possible explanations for the association between animal products, food aversions and NVP. First, the digestive breakdown of animal products may create or release teratogenic or abortifacient substances. Categories of compounds released include dipeptides, tripeptides, phospholipids, sterols, amino acids, uric acid and fat soluble vitamins, of which only vitamin A is known to cause birth defects if consumed in pharmacological doses over several months of gestation, thus it is unlikely that the constituents of meats in the normal diet will endanger a developing embryo. The second idea put forward by Flaxman and Sherman (2000) is that certain culinary practices like frying and smoking create mutagens and introduce phytochemicals such as those in spices. Before the widespread availability of refrigeration, the use of spices or heavy salting were primary means of preserving animal products, so by avoidance of roasted, burned or smoked or heavily spiced foods, pregnant women could minimize exposure of their embryo to toxic chemicals. We have seen in this study that ethnic, spicy or strong tasting foods were commonly avoided during pregnancy. Although spices may be beneficial in the tiny quantities used in cooking, in large doses, many phytochemicals have deleterious effects as allergens, mutagens, carcinogens, teratogens and abortifacients (Flaxman and Sherman, 2000). Flaxman and Sherman (2000) report that the third and most likely reason for avoidance of meat products is to minimize exposure to foodborne illnesses and food poisoning. It has been shown that raw meats and meat dishes that are prepared in advance and stored at ambient temperatures for more than a few hours, show a high increase in bacterial and fungal growth. Since the pregnant women’s immune system is suppressed in order to prevent rejection of her own offspring, it seems that aversions are nature’s way of protecting the mother as well as the fetus. In view of this, Flaxman and Sherman (2000)
expanded the term “embryo protection hypothesis” to be the “fetal and maternal protection hypothesis”.

We found a 3% incidence of pica in the women with cravings, with ice being reported in two out of the three cases. In other studies, the incidence of pica has been reported to be between 12-20%, with the majority of women consuming ice (Knox et al, 1995, Pope et al, 1992, Scwab and Axelson, 1984). In the study carried out by Knox et al (1995) most women attributed the craving of ice to thirst, whereas Schwab and Axelson (1984) state that craving for ice (pagophagia) might be a clinical sign of iron deficiency. In a retrospective study by Rainville (1998) on 281 women who were eligible for the Special Supplemental Nutrition program for women, infants and children (WIC), it was found that women who had ice pica, had the lowest haemoglobin levels. However, Rainville (1998) stated that it is not known whether anaemia is the cause or effect of pica, as it could be that the ice could be replacing iron-rich foods in the diet. However, being a retrospective study, this could have led to recall bias. In addition, the results of the study by Rainville (1998) only apply to those women eligible for the WIC program, also those women may have problems such as alcohol use or lifestyle factors which could have played a role in these results.

4.2.3 Reasons cited for cravings and aversions

Of the women reporting cravings and aversions in pregnancy, only thirty-nine women gave reasons for craving or avoiding certain foods. Only endogenous reasons were considered in this study, as exogenous factors such as the doctor telling the women to avoid a certain food is not the same as a definite dislike of the food. Tierson et al (1985) reported that most women reported endogenous factors for cravings and
aversions such as NVP or that the food item tasted better. In a study carried out in Scotland, Taggart (1961) found that fruit were craved because they were readily available, and they satisfied thirst. In a retrospective study on 250 women, Hook (1978) found an increase in consumption of milk, which was not totally attributable to concern for infant and maternal health. Nearly one third of women reported endogenous factors such as a greater desire for the item and better taste. Endogenous reasons such as nausea and loss of taste for the drinks were also cited as causes for aversions to stimulating drinks.

In this retrospective study, the main reasons cited for cravings were to ease NVP (mainly by carbohydrates and fruit) because the foods were bland (such as carbohydrates, dairy products and fruit), and to make up for reduced tea intake (increasing consumption of non-alcoholic beverages, fruit juices and dairy products).

The main reasons cited for aversions in this study was mainly due to NVP (mainly ethnic, strong, spicy foods, vegetables and stimulating drinks such as tea and coffee), this was followed by the smell of the food (mainly stimulating drinks) and heartburn (mainly ethnic, strong, spicy foods).

4.2.4 Factors related to cravings and aversions in pregnancy

The finding that cravings and aversions were more likely to occur together than alone has been reported by other researchers (Dickens and Trethowan, 1971 and Knox, 1995). Knox et al (1995) reported that this tendency for cravings and aversions to co-exist may well point to some common causal link.
In this study it was observed that cravings and aversions were more likely to occur in women with NVP. Although many authors report that the cause of some cravings and aversions could be NVP, to the best of the researcher’s knowledge, statistically significant relationships have only been seen by three authors. Vellacott et al (1988) reported that those women with cravings were more likely to have NVP. Crystal et al (1999) in a study on one hundred and twenty nine women, found that severity of symptoms of vomiting affected aversions, whereas severity of nausea did not. As for cravings, although there was an increase in cravings in women who had more severe vomiting, this relationship did not reach statistical significance, and again severity of nausea did not have an effect. In a recent retrospective study by Bayley et al (2002), on 99 pregnant women, it was found that there was a significant relationship between nausea and aversions. No significant relationship was seen between nausea and cravings. Bayley et al (2002) put forward the idea that the relationship between aversions and nausea was due to a taste aversion learning mechanism where foods paired with illness are subsequently avoided. Bayley et al (2002) reported that this is supported by the fact that food aversions and nausea tended to start during the same week, and also that no relationship was seen between nausea and cravings. In addition, in most cases, cravings were found to start two weeks after nausea, and so Bayley et al (2002) speculated that the cravings could have developed for foods which would help ease the nausea, and as seen earlier, the main reason cited for the cravings in the current study was that the food eased NVP.

In this study it was found that aversions were more likely to occur in women with higher education, other authors have not reported this relationship. Seeing the strong relationship between aversions and NVP, and as NVP was seen to occur more often in
women with NVP, this could explain why aversions were more likely to occur in women with higher levels of education.

4.3 Factors related to pregnancy outcomes

We have found that maternal birth weight was significantly related to infant birth weight, length and head circumference. We did not find a relationship between maternal birth weight and PI or head circumference to length ratio. In a study carried out by Godfrey et al (1997) on 538 infants in Southampton, it was found that women who themselves had a low birth weight had infants who were lighter and thinner, they also had lower ponderal indices. Maternal birth weight was an independent risk factor for ponderal index even after taking into account of gestational age, gender, parity and maternal diet. This association was also independent of SEC, maternal height and smoking. Godfrey et al (1997) stated that the fact that maternal but not paternal birth weight is related to infant ponderal index is evidence against the hypothesis that thinness at birth and later insulin resistance are due to genetic abnormalities. Since low maternal birth weight was found to affect placental weight, the authors speculated that low growth rates in utero among female fetuses may lead to impaired placentation when they reproduce, probably as a result of alterations in the uterine vasculature, which may be determined during fetal life. This impaired placentation may result in failure of the fetus to achieve it full growth potential, or may lead to actual fetal wasting. Thus women whose own fetal growth was retarded tend to have thin infants, which could explain why some women have thin babies in successive pregnancies (Godfrey et al, 1997). Since thinness at birth has been shown to be associated with insulin resistance, NIDDM and CHD in adult life, it is important to
promote proper intrauterine growth in this generation, to protect the next generation (Godfrey et al, 1997).

In this study it was seen that maternal height was related only to infant length. Godfrey et al (1997) found that the infants of short women were shorter and lighter than infants born to tall women, however maternal height was unrelated to infant’s ponderal index. Mathews et al (1999) in their study on 693 pregnant women in Portsmouth also found that maternal height was related to birth weight. Using multiple regression, maternal height was an independent risk factor for birth weight. Thame et al (1997) also found that shorter women had lighter, shorter babies with smaller head circumferences. However maternal height was not related to infant ponderal index or head circumference to length ratio.

Another factor found to be related to birth outcome was maternal BMI. Thinner women had lighter babies. In addition there was a trend for thinner women to have infants with smaller head circumferences and lower PI. Thame et al (1997) in a retrospective study on 2394 records of pregnant women also found that maternal BMI was related to infant birth weight, length and head circumference, but it was not related to ponderal index or head circumference to length ratio.

We also found that maternal pre-pregnancy weight was related to infant birth weight, length and head circumference. In addition, there was a trend for maternal pre-pregnancy weight to be related to PI. Godfrey at al (1997) found that after taking into
account maternal height, smoking and parity, maternal weight in early pregnancy was only weakly related to infant birth weight and not related to ponderal index.

Mathews et al (1999) also found that maternal weight pre-pregnancy was related to birth weight, but it was not an independent factor. Thame et al (1997) found that mothers who were lighter had babies who were shorter, lighter with smaller head circumferences and higher head circumference to length ratio. Maternal weight was not found to be related to ponderal index.

Maternal weight gain in pregnancy was also a significant factor in terms of infant birth weight, length and head circumference. In their study on 510 women in America, Aaronson and Macnee (1989) also found a significant relationship between maternal weight gain and infant birth weight. Low maternal weight gain is known to be a risk factor for LBW and increased perinatal mortality (British Nutrition Foundation, 1994). In 1990, the National Academy of Sciences Food and Nutrition Board in the USA made recommendations where optimal target weight gains, based on optimal neonatal survival were established for groups of women with different pre-pregnancy BMI. Within these recommendations, women with lower pre-pregnancy BMI were recommended to gain more weight in pregnancy compared to those of higher BMI (British Nutrition Foundation, 1994). In a systematic review conducted recently by Abrams et al (2000), they found that studies have shown that pregnancy weight gain within the recommendations by the National Academy of Sciences, Food and Nutrition Board in the USA, is associated with the best outcomes in terms of fetal weight compared to those women gaining below or above these recommendations.
We have also shown that housewives had heavier and longer babies. Similar findings were found by Wiegel and Wiegel (1989). In his review of the literature, Pivarnik (1998) concluded that some studies have shown job related physical activity to be related to unfavourable birth outcomes including premature delivery and LBW. Pivarnik (1998) reports that most studies did not control for SEC nor was actual physical activity throughout gestation actually quantified. In addition, other unknown stresses related to the job may have confounded or modified the effects of physical activity.

We also showed that primiparous women had infants who were lighter, shorter and with smaller head circumference compared to infants born to multiparous women. Parity had no effect on either PI or head circumference to length ratio. Godfrey et al (1997) also found that primiparous women had infants with lower birth weights and shorter lengths than infants born to multiparous women, ponderal index was also lower.

In this study we found that father’s height was related to infant length. In addition there was a near association with birth weight. Father’s height was not found to be related to either PI or head circumference to length ratio. Godfrey et al (1997) also found that infants of short fathers were lighter and shorter, with a proportionately greater decrease in length than birth weight, thus making the ponderal index of those infants higher. Godfrey et al (1997) report that since father’s height was not found to be related to placental weight, the association between father’s height and ponderal index does not seem to be mediated by impaired placental development. They speculate that this association could be due to genetic influences, where paternal
height promotes higher rates of skeletal growth in the offspring, which outstrip the supply of nutrients for soft tissue deposition. The authors found that father's height was an independent risk factor for ponderal index even after taking into account of gestational age, gender, parity and maternal diet. This association was also independent of SEC, maternal height and smoking.

Father's who themselves had low birth weight were found to have infants who were lighter, shorter and with smaller head circumferences. Father's birth weight was not found to be related to either PI or head circumference to length ratio. Godfrey et al (1997) also found that infants of fathers who themselves had a low birth weight were lighter and shorter, however paternal birth weight was unrelated to infant's ponderal index. Godfrey et al (1997) found that maternal birth weight and paternal height were independently associated with ponderal index at birth.

As these variations in size at birth may be early markers of CHD in later life, possible ways of reducing these variations should be aimed at.

It is always important to remember that these measurements were provided by the women in the study and were not actually measured in the study, thus inaccuracies may have occurred. However, the fact that other authors have reported similar results tends to increase the confidence in these findings. In addition, Godfrey et al (1997) found a high level of agreement when recalled weights from the sample were validated against a sample of those recorded in their study.
4.4 Dietary advice during pregnancy

It was seen that most women received information about nutrition in pregnancy from their midwife. Anderson (2001) stated that ante-natal care is one situation that is unique in providing the opportunity to reach large numbers of healthy women with the potential to influence the health of the next generation. For many women, antenatal staff may be the first trained staff to inform, advise and re-enforce health messages about nutrition and other lifestyle considerations. Thus it is very important that the midwives have a sound knowledge of nutrition, as wrong information during pregnancy leading to poor nutritional intake may be risking a lot of health problems in the future generations, as we have seen from the work of Barker and his colleagues. Thus in order to optimize the women’s reproductive health, nutrition screening and education should be an integral part of health care, and midwives are in an excellent position to deliver nutritional care as primary care providers for women of reproductive age (Hally, 1998). Midwives should be able to screen pregnant women for nutritional risk factors, and in specific cases with suspected nutritional inadequacy, refer the women to a dietitian.

Anderson (2001) reported that dietary alterations aimed at enhancing the well-being of the mother and baby may arise from a number of stimuli including advice given during pregnancy by health professionals, from lay individuals and information gathered from books, magazines and the media. In our study, we have observed similar findings. Other than the midwives, some women reported receiving their information from book, magazines, their doctor and leaflets about pregnancy. Other sources of information mentioned were friends, relatives and only in 3.3% of cases a
dietitian. Since it has been observed that dietary information is sought from different sources, it is the responsibility of nutritionists to make sure that the information being written or presented in the media is accurate and will not harm the woman or her baby. In addition, the midwives should just reiterate the general guidelines of diet in pregnancy to make sure that each woman has the proper information.

However, it is important to remember that in those women with symptoms of NVP, their physical symptoms are controlling their intake, and in such cases, the dietary changes might not be nutritionally beneficial, but may actually make the women feel a lot better in the short term. Specifically for NVP, since midwives are the main source of dietary information for pregnant women, it is important that they are aware of the different remedies available in order to advise the women about them. In addition, midwives should ask the women about symptoms of NVP, as it has been shown that many women do not report these to their carers.

### 4.5 Study Limitations

This study was based on women reporting about symptoms of NVP and cravings and aversions, which could have taken place one year previously. Thus it does not allow for a very clear recall of what actually happened. In addition, being a questionnaire study, the study was based on self-recall rather than actual observations of women's responses to foods or measured severity of NVP during pregnancy. Some women may have responded to what they should have written rather than what actually happened (Flaxman and Sherman, 2000). Self reporting may only provide approximate indications of what is actually consumed (Knox, 1995). Another limitation is that the women were not given actual definitions for NVP and cravings and aversions. Dietary
preferences may be interpreted as cravings or women might translate increased appetite in pregnancy as cravings (Knox, 1995). In addition, in terms of severity of symptoms, mild nausea to one woman might be very severe to another. Or nausea and vomiting which occurs only once or twice a day, may have less of an effect on the woman than continuous nausea which occurs throughout the day. Finally, the study was based on a biased community of high income, education and SEC, where only white women were included.

In the analysis conducted in this study, confounding variables such as gestational age and infant gender were not considered, these could have affected the relationships seen with pregnancy outcomes.

In the light of these limitations, it was decided to undertake a prospective clinical trial to examine the effect of NVP on dietary intake and outcome of pregnancy, and the following chapters describe the trial and the outcomes.
5. SUBJECTS AND METHODS (PROSPECTIVE STUDY)

5.1 Study Design

A prospective study was conducted to test whether NVP had an effect on pregnancy outcome. Two subject groups of women, one with NVP and one without NVP were followed up for the duration of pregnancy, in order to assess whether their experience of NVP was related to their initial status such as pre-pregnancy weight, BMI, smoking status, and whether the outcome of pregnancy was related to their initial status or to factors occurring during pregnancy such as change in diet.

The achievable outcomes the study would observe were mean differences in pregnancy outcome between women with NVP and women without NVP.

5.2 Subjects and Recruitment

5.2.1. Subject Numbers

Sample size calculations were calculated by Dr. Ioannis Vlachonikolis, Reader in Medical Statistics, University of Surrey. These were based on mean pregnancy outcome and standard deviation and the expected degree of change in outcome. In this study these were:

1) Mean birth weight of 3500g (SD 500g) with an effect of 150g (Mathews and Neil, 1998)

2) Mean placental weight of 600g (SD 120g) and an effect of 50g (Williams et al, 1997, Godfrey et al, 1996)

3) Percentage of women suffering from NVP (70%) (Broussard and Richter, 1998).
In order that the tests of the effect of NVP on pregnancy outcome compared with the effect of no NVP had 80% power at the 5% significance level, 45 women per group were required. However, the study was restricted by the time frame rather than the statistical power.

5.2.2. Subject Characteristics

Women with and without NVP who consented to take part were recruited from the Guildford area. Due to the timetable, associated with the constraints of the preparation of the thesis, recruitment was curtailed after eighteen months. Women were recruited early on in pregnancy when NVP was likely to occur. All the women had healthy pregnancies, with no gestational diabetes, high blood pressure or anaemia. The women were not given any incentives for taking part in the study. All the women taking part in the study were under the care of the Royal Surrey County Hospital, which covers the South West Surrey area.

5.2.3. Exclusions

The exclusion criteria for this study were that the women should not be less than 18 years of age, should not have pre-existing diabetes, there should not be a language barrier, and the women should not suffer from mental or psychological problems. The midwife recommended those women who would not be suitable for the study to the investigator.

5.2.4. Recruitment Method

Five different methods of recruitment were used in this study. These were:

1. Antenatal clinics, a service offered at three GP surgeries (Fairlands Medical Centre, Dapdune House Surgery and St. Luke’s Medical Centre). Women with
and without NVP were recruited from booking in antenatal clinics (6-10 weeks gestation). They were approached in the waiting rooms, and the study was explained to them, they were given an information sheet (See Appendix VIII), which the women took home to think about and discuss with her partner. If the women consented, she was asked to sign a consent form (See Appendix IX). If consent was gained, an appointment for a home visit was arranged. Forty-nine of the fifty-seven women taking part in this study were recruited by this method.

2. Guildford National Childbirth Trust (NCT). Flyers were sent to a member of the Guildford NCT, who put them in the Guildford NCT magazine. If a woman was interested in taking part, she contacted the researcher, and a home visit was arranged. If the woman was not from the three surgeries in the study, her doctor and midwife were contacted either by phone or by mail to ask for approval. Five women were recruited by this method.

3. University of Surrey web page. A notice was placed on the University web page and in the University of Surrey newsletter. Two women were recruited by this method.

4. Radio. Three radio broadcasts about the study were also conducted on the local radio stations; County Sounds and Southern Counties, and a request for women to participate in the study was given out. The radio broadcast attracted no women.

5. Community midwives. Flyers were also sent out to community midwives in the Guildford area. The midwives were based at Hazlemere Hospital, Farnham
Hospital and the Royal Surrey County Hospital. The midwives distributed the flyers when seeing the woman at home for the booking-in appointment. One woman was recruited through the community midwives.

5.3 Assessment of nutritional status during pregnancy

According to Gibson (1990), if it is suspected that nutrition affects health in some way, the nutritional status of a group of people can be assessed using:

1. Dietary methods- In this study one week food records were used.

2. Laboratory methods- Functional tests are not suitable for field surveys as they are too invasive and require elaborate equipment (Gibson, 1990). In this study all the women did not have problems with anaemia, elevated blood pressure or gestational diabetes. These were considered as they have been shown to have an effect on outcome of pregnancy (Godfrey et al, 1991; Steer et al, 1997).

3. Anthropometric methods- In this study, weight and triceps skinfolds were measured. Anthropometric measurements have the advantage of providing information about past history, which cannot be obtained with equal confidence using other methods (Gibson, 1990).

5.3.1 Dietary Assessment

5.3.1.1 Method of Assessment

The total daily intake of all foods was measured using estimated food records over a seven-day period. Using this method, the participant is asked to record, at the time of consumption, all foods and beverages consumed, including detailed descriptions cooking methods, brand names and recipes (Gibson, 1990). Initially the aim was for
women to keep a one-week weighed intake diary, and digital scales (SOEHNLE digita) were provided. This method is the most precise method available for estimating usual food intake of individuals. However, the compliance to this method was very poor, as the women found it very tedious to weigh out their entire intake for a whole week. The researcher was recruiting for two months, only two women were recruited, four consented and then dropped out due to the weighed intake. Thus a decision was made with advice from the study supervisors to use estimated food records instead. Although precision is greater with weighed intakes (Gibson, 1990), the compliance rate with the estimated records proved to be better. Seven days were used as it has been reported that this is sufficient to calculate energy and energy yielding nutrients (Margetts and Nelson, 1997). Longer periods are probably needed for items such as alcohol, some vitamins and minerals and cholesterol (Margetts and Nelson, 1997), however, this would have been too tedious for the participants.

5. 3.1.2. Assessment Protocol

Women were asked to keep a seven-day record of their intake at the time of recruitment, ie weeks 6-12, when NVP was likely to be, and at weeks 25-32, when NVP was likely to have resolved, in order to compare the diets and to assess the effect of NVP on nutritional intake. The women were asked to record everything they ate and drank in household measures. These were then converted to weights using published food portion sizes. Diet 5 2000 (Robert Gordon University, Aberdeen) was used for the computed dietary analysis.
5. 3.1.3. Food diaries

A food diary was devised to assess the women’s mean daily energy and nutrient intake (Appendix X). The diaries had the woman’s code number only for confidentiality.

The diary contained an instruction sheet for diary completion, and an example of a typical day’s intake. In the main body of the diary, each page was divided into a section for the time, food or drink commodity and estimated weight. A final section was available for the researcher to input the actual weight in grams. Each page in the diary corresponded to a single day. Women with NVP were asked to record whether they had vomited at all during that time and to record the time that they had vomited. This was requested so that any meals consumed up to 2 hours before being sick (Mathews and Neil, 1998) could be discarded. The first and second diet diary were different colours; The first diet diary was blue and the second one was green, in order to differentiate between them.

The researcher went through the diaries with the women to explain how to fill them in, clarify any points and remove anomalies.

5. 3.2 Laboratory Assessment

A non-fasting blood sample and blood pressure measurement were taken by the midwife at booking-in clinic at Fairlands, and at 16 weeks at St.Luke’s, then again at 26 weeks at both surgeries. However, it was hard to get actual results as they were not usually given to the women, in most cases the women were only told if they had a problem.
5. 3.3 Anthropometry

5. 3.3.1 Weight
Portable electronic scales were used by the researcher to weigh the women at both home visits. The women were weighed in light clothing.

5. 3.3.2 Height
Recalled height was used in this study.

5. 3.3.3 Skinfold Thickness
Triceps skinfold measurements were measured twice, once at the first home visit and again at the second visit. The skinfold measures were taken using Holtain calipers. This was measured on the non-dominant arm, half way between the acromion and the olecranon process, as described by Gibson (1990). Three measurements were taken and the mean was calculated. Measurements from all four sites were not taken, as some women were not comfortable about this. Skinfold measurements at a single site are sometimes used to assess the total body fat or the percentage body fat. Studies carried out by Viegas et al (1987) and Clark et al (1998) on pregnant women, both used triceps skinfold thickness measurements to assess nutritional status in pregnant women. There is no agreement as to the best single skinfold site, however Gibson (1990) recommended that triceps skinfold thickness has been the site most frequently selected site for a single, indirect measure of body fat in women. Clark et al (1998) reported that skinfolds change very little in early pregnancy, therefore values taken at 18 weeks or before may be a good indicator of poor pre-pregnancy or early pregnancy nutritional status. Viegas et al (1987) suggested that changes in skinfold measurements in the second trimester probably reflects the balance of energy intake minus energy expenditure during the trimester when the mother would be normally be
laying down extra fat in anticipation of later fetal demands. The second measurement of skinfold thickness in our study was thus taken at the end of the second trimester by the same researcher.

The measurement techniques of the researcher were checked by experienced colleagues (Dr. Jane Morgan) before commencement of the study.

5.4 Assessment of NVP symptoms During Pregnancy

5.4.1. Method of Assessment

The duration and severity of symptoms of NVP during pregnancy was determined by recording symptoms on a daily basis from the time of entry into the study until the symptoms resolved.

5.4.2. Assessment Protocol

The women were asked to keep a diary of their symptoms from the start of the study until the cessation of the symptoms. The women were asked to record their symptoms on a half-hourly basis and to describe whether they were nauseous or were actually sick. The data arising from the symptom diary was used to assess severity and duration of symptoms by calculating the number of weeks suffered and the total number of hours of NVP.

5.4.3 Symptom Diary

A symptom diary was devised to assess the women’s symptoms (See appendix XI). The diary had the woman’s code number only. This diary was based on the symptom diary devised by Gadsby et al (1993). The diary contained an instruction sheet, and an
example of a typical day’s symptoms. In the main body of the diary, each page was
divided into 21 columns and corresponded to 3 weeks. Methods used to alleviate NVP
were entered on the final page.

The researcher explained how to fill in the diary and obtained the date of onset of
symptoms. Up to two weeks retrospective symptoms were accepted if they could be
remembered accurately. The women completed the diaries until symptoms had
ceased.

5. 5 Protocol for data collection during pregnancy

5. 5.1 Number and timing of visits to each women

The researcher visited each woman at home twice over the course of her pregnancy,
once early in pregnancy and once towards the end of the pregnancy. One of the
purposes of the visit was to measure the mother. At the first visit, the diet diaries and
symptom diaries were distributed and explained. Additionally, the women’s
background details were collected, and some details were collected about the partner.
At the second visit, the record card for the delivery was distributed and explained.

5. 5.2 First home visit

The following protocol was followed for the first home visit.
The researcher carried out an interview with the women regarding the women’s
background information. Questions were also asked about the partner’s background.
These questions were based on those used from in the questionnaire survey as no
problems were encountered in the retrospective study (See Appendix XII). The
women were also asked about their gestational age and expected date of delivery. This
was based on last menstrual period. This was confirmed and corrected by an ultra
sound scan. If the due date was different to that given to the researcher at the first home visit, the women notified the researcher at the second home visit.

Each woman was given the food diary and the researcher explained the method of completion. Symptom diaries were distributed and explained to those women with NVP. Each woman was given pre-paid envelopes to return the diaries. The woman was weighed and triceps skinfold measurements were carried out.

5. 5.2. Second home visit

The second visit was made after the women returned the completed second diet diary, this was usually at around 30-32 weeks gestation. Women were not seen later in pregnancy due to the risk of a missed appointment because of premature labour. The women were weighed and triceps skinfold measurements carried out.

The women were given an A5 sized card to give to the midwife at delivery. The card asked the midwife to record the endpoints of the pregnancy that the study required. Attached to the card was the blood bottle for the collection of the cord blood sample. Women were also given a card for them to record the baby’s length and head circumference once the health visitor had measured them after ten days. A pre-paid envelope was provided to send the card back to the researcher.

At the end of the visit, each woman was thanked for participating in the study. No incentive was offered to the women.
5.6 Assessment of outcome of pregnancy

5.6.1 Anthropometry

5.6.1.1 Birth weight
At birth the babies were weighed to the nearest gram by the midwives using electronic scales (Weylux Scales).

5.6.1.2 Length
The health visitor measured the length of the babies at ten days of age, as length is not routinely measured at birth. The length was measured with the baby supine, using a measuring mat provided to the health visitors by the Child Growth Foundation.

5.6.1.3 Head circumference
The health visitor measured the head circumference of the babies at ten days of age, as head circumference is not routinely measured at birth. Head circumference was measured midway between the eyebrows and the hairline at the front of the head and the occipital prominence at the back using a tape measure provided to the health visitors by the Child Growth Foundation.

5.6.2. Biochemical Analysis

5.6.2.1 Blood Sampling Method
The midwife took cord blood samples after the cord had been clamped. Once this had been done, the researcher was contacted, and collected the sample as soon as possible to prevent haemolysis of the IGF-1. The blood was collected in a plain tube, containing no additives. Each tube had the women’s code number marked on it. The sample was taken to the School of Biomedical and Life Sciences, University of
Surrey. The sample was allowed to clot then centrifuged at 3000 rpm for 10 minutes. The serum was removed and frozen at -20°C, until the end of the study. Dr. Derek Teale, Royal Surrey County Hospital was responsible for the biochemical analysis of the cord blood.

5. 6.2.2. IGF-1 Assay

The serum was transported to the Royal Surrey County Hospital at the end of the study. IGF-1 was analysed using the Nichols Advantage IGF-1 Assay, which is a two-site chemiluminescence immunoassay used for the measurement of IGF-1 in human serum. The antibody to the C-terminal with the amino acid sequence of 62-70 was biotinylated for capture and the antibody to the amino acid sequences of 1-23 and 42-61 was labelled with acridinium ester for detection. The sample was acidified to separate IGF-1 from IGFBPs. Then, excess IGF-II was added in the assay to block the IGFBP binding sites from recombining with the released IGF-1. The acidified sample was incubated simultaneously with the biotinylated capture antibody, excess IGF-II and the acridinium ester labelled tag antibody. During the first incubation period, streptavidin coated magnetic particles were added to the reaction mixture and a second incubation followed. The streptavidin coated magnetic particles allow for a highly specific and efficient means of binding the sandwich complex to the solid phase via the high affinity interaction between biotin and the streptavidin. Free labelled antibody was separated from the labelled antibody bound to the magnetic particles by aspiration of the reaction mixture and the subsequent washing. The wells containing the washed magnetic particles were transported into the system luminometer, which automatically injects Trigger 1 and Trigger 2, initiating the chemiluminescence reaction. Acridinium esters emit light upon treatment with hydrogen peroxide and an alkaline solution. The trigger 1 solution contains hydrogen
peroxide in dilute acid and Trigger 2 solution contains dilute sodium hydroxide.

Trigger 1 and Trigger 2 oxidise the acridinium ester, which becomes in an excited state. The subsequent return to ground state results in the emission of light, which was quantified in 2 seconds and was expressed in relative light units (RLU) by the integrated system luminometer. The amount of bound-labelled antibody is directly proportional to the concentration of IGF-1 in the sample.

5.6.3 Associated data collection

5.6.3.1 Placental weight

The placenta was weighed to the nearest gram by the midwives using digital scales (Soehnle digita) provided by the researcher. Placental weights were recorded wet, without trimming the membranes or cord. Trimmed placental weight was not used as it was apparent that this would be too troublesome for the midwives.

5.6.3.2 Gestational age

Gestational age was recorded by the midwife, based on routine clinical obstetric data; the last menstrual period (LMP) and ultrasound scan.

5.6.3.2 APGAR scores

The midwife recorded the APGAR scores of the infant, on the card provided by the participant. APGAR scores assess the infant heart rate, respiratory effort, muscle tone, reflex irritability and colour, and are a score out of ten.
5. 7 Data Analysis

The strictest rules of confidentiality and anonymity were observed in all data handling. All subjects were assigned a code number upon joining the study. All information relating to the subjects was stored, by number only, in a secured personal computer, which was accessed by the researcher only. Hard copies of data were similarly denoted, and stored in a locked cabinet.

SPSS version 10.0 was used for data storage and statistical analysis. The data from the two groups was analysed using appropriate observational and comparative statistics. In this study, the severity of NVP was categorised using three different methods. Firstly, type of NVP (none, nausea only or both nausea and vomiting), hours of NVP and duration of NVP. When looking at factors related to NVP, Spearman Rank correlations were used to correlate between the continuous factors such as maternal age and hours and duration of NVP. As for the categorical variables, the Mann Whitney test was used. ANOVA was used to find the relationship between the continuous variables and type of NVP. For the categorical variables, the Chi square test was used.

The pearson product moment correlation was used to find the relationship between the continuous maternal factors and pregnancy outcomes. As for the categorical variables with two variables, such as smoking status, either the independent t-test or the Mann whitney tests were used. For categorical variables with more than two variables, such as socio-economic status, ANOVA or the Kruskall Wallis test was used.
As for the effect of NVP on outcome of pregnancy, the relationship between the duration and hours of NVP and pregnancy outcome was assessed using Spearman correlations. As for the type of NVP, ANOVA or the Kruskall Wallis test was used.

For cravings and aversions, their effect on pregnancy outcome was assessed using the independent t-test or the Mann-whitney test.

For the effect of NVP, cravings and aversions on nutritional intake, the independent t-test was used. As for the effect of maternal factors, the effect of the continuous factors on nutritional intake was tested using the Pearson correlation, whereas ANOVA was used for the categorical variables.

The effect of nutritional intake on pregnancy outcome was tested using either the Pearson or Spearman correlations.

The results of the statistical tests were considered significant at p<0.05.

For the open questions, such as types of foods craved and avoided, only descriptive statistics could be carried out. Frequency tables were generated and graphs produced.
5.8 Ethical Approval

5.8.1 Main Study

The study protocol, together with the information letter for the women, the consent form, a copy of the diet diary and symptom diary, the project's time frame, permission letters from the head of midwifery, head of obstetrics and gynaecology and Dr. John Nichols (Fairlands Medical Centre), and the questions to be asked at the home visit were all submitted along with the application form to the South West Surrey Local Research Ethics Committee on 28.03.00. Permission was granted on 16.05.00. See Appendix XIII. The reference number of this study was EC51/00

5.8.2 Amendment

An application for an amendment to the study was made on 04.07.00 to the South West Surrey Local Research Committee. The amendment requested permission to recruit women from another two surgeries in Guildford, Dapdine House Surgery and St.Luke's Surgery. This amendment was requested in order to increase the sample size of the study. The Chairman of the Ethics Committee approved the amendment subject to ratification by the full committee. This was granted on 12.08.00. See Appendix XIV.

A further amendment was requested on 07.08.00. The amendment requested permission to recruit women via the local radio stations, local papers and via the Guildford branch of the National Childbirth Trust. Permission was granted on 23.09.00.
5. 8.3 University of Surrey

An application for an endorsement of the approval for the prospective study was made to the advisory committee on ethics of the University of Surrey in May 2000. The committee made some comments. Once the appropriate changes were made, the advisory committee approved the study on 05.07.00 (See Appendix XV). The reference number of the study was ACE/2000/52/EIIHMS.
6. RESULTS OF PROSPECTIVE STUDY

6.1 Study Population, including a comparison with the non-responders

A total of one hundred and fifty women were seen in clinics between May 2000 and August 2001. Eighty-two women agreed to take part in the prospective study, however, of those thirty women dropped out, leaving a study population of fifty-two women.

Of the 30 women who did not take part in the study, five women dropped out even before the first home visit as they stated that they were too busy to take part. Three women who had consented to take part and arranged a time for the first home visit missed the visit and did not answer the researcher’s calls to rearrange the meeting. One woman miscarried before the first home visit.

Twenty one women of the thirty were visited by the researcher, of those sixteen then did not send the diaries back to the researcher, and when the researcher called them to remind them, they asked to be dropped from the study. Two of the women visited by the researcher moved away from the research area. Three women visited then had miscarriages and were withdrawn from the study.

Of the thirty women who dropped out, information was only available about twenty-one of them, whom the researcher actually visited, and the demographic information for these women is compared with the study population.
The mean age of the women who did not take part in the study was 31.14 years (SD 5.30), the youngest women being eighteen and the oldest thirty-eight. Independent t-tests were carried out to test whether there was a statistical difference between the mean age of the women in the study population compared to the non-responders. No significant difference was found ($p = 0.195$). The mean pre-pregnancy weight of the women in the non-response group was 61.99kg (SD 9.22), the minimum weight being 44.5 kg and the maximum weight 90.7 kg. There was no significant difference in the mean weight of the non-responders compared to the women in the study population.

More than half of the women who did not take part in the study had a household income of more than £40,000. The Chi-Square test to compare the study population with the non-responders could not be carried out as more than 20% of the cells had an expected count less than 5.

In addition in this group, more than half the women had obtained a degree or a post degree. There were no significant differences between the proportion of women at each level of education between both groups ($p=0.795$).

Seventy five percent of the non-responders were of social classes I and II. Chi square tests could not be carried out as more than 20% of cells had an expected frequency less than 5.
The majority of the women who dropped out did not smoke either pre-pregnancy (81%) or during pregnancy (85.7%). Again, Chi square tests could not be carried out for smoking status.

As for alcohol intake, 61.9% of the non-response group did not drink alcohol pre-pregnancy. Figure 6.1.a below shows how the study group compares with those who dropped out of the study.

Figure 6.1.a Alcohol intake in the study group compared to the non-responders

There was a significant difference between the proportion of women who drank alcohol pre-pregnancy in the study group compared to the non-responders, where women in the study group were more likely to consume alcohol pre-pregnancy compared to those in the non-response group (Chi Squared $p=0.04$).
As for alcohol intake during pregnancy, the majority of women (95.2%) in the non-response group did not drink during pregnancy. Chi square tests could not be carried out in this case due to the small numbers involved.

When asked about nutritional supplement use pre-pregnancy, more than half (52.4%) of the women who dropped out did not consume any nutritional supplements, whereas, in the study population, only 28.8% of the women did not consume nutritional supplements pre-pregnancy. Chi square tests showed that this difference was not significant (p = 0.066).

As for supplement use during pregnancy, a minority of women (9.5%) did not take nutritional supplements during pregnancy. Again, Chi square tests could not be carried out due to the small numbers involved.

More than half of the non-responders (57.1%) were either in full-time or part-time occupation. There was no significant difference in the proportion of women in each type of occupation between the two groups (p = 0.37).

As for the number of children, 28.6% of the women were first time mothers. Equally, 28.6% were second time mothers, and another 28.6% were third time mothers. 9.5% of the women had three children already and 4.8% had four children. There were no significant differences between the number of children the women had in the non-response group compared to the study population (p=0.21).
6.1.1. Descriptive Characteristics of the study population

The mean age of the women at the time of delivery was 32 years (SD 4.19), the youngest women being 20 years and the oldest forty-two years. One hundred percent of the women were married or living with their partners. Twenty-five women (48.1%) were first time mothers.

Four women (7.7%) reported smoking pre-pregnancy and one woman (1.9%) reported smoking during pregnancy. As for alcohol intake, thirty-four women (65.4%) reported drinking pre-pregnancy and six women (11.5%) reported drinking during pregnancy. Nutritional supplements were consumed pre-pregnancy by thirty-seven women (71.2%), and during pregnancy by forty-one women (78.8%).

Thirty-two women (61.5%) were degree or postgraduate degree holders. Thirty-eight women (73%) were in full-time or part-time occupation. Similarly to the previous study, reported in chapter 3, the majority of women (82.9%), were in social classes I and II. In addition, the majority of women (67.5%) had a reported annual household income of 40,000 pounds or higher. See Tables 6.1.a and 6.1.b for the descriptive characteristics of the study population.
Table 6.1.a Categorical characteristics of study population

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<td>(2.5)</td>
</tr>
<tr>
<td>10,000-19,999</td>
<td>1</td>
<td>(2.5)</td>
</tr>
<tr>
<td>20,000-29,999</td>
<td>3</td>
<td>(7.5)</td>
</tr>
<tr>
<td>30,000-39,999</td>
<td>8</td>
<td>(20)</td>
</tr>
<tr>
<td>&gt;40,000</td>
<td>27</td>
<td>(67.5)</td>
</tr>
<tr>
<td>Education</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>1</td>
<td>(1.9)</td>
</tr>
<tr>
<td>GSCE</td>
<td>12</td>
<td>(23.1)</td>
</tr>
<tr>
<td>A-Level</td>
<td>7</td>
<td>(13.5)</td>
</tr>
<tr>
<td>Degree</td>
<td>19</td>
<td>(36.5)</td>
</tr>
<tr>
<td>Post degree</td>
<td>13</td>
<td>(25)</td>
</tr>
<tr>
<td>Socioeconomic status</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>IIM</td>
<td>2</td>
<td>(4.3)</td>
</tr>
<tr>
<td>IIIN</td>
<td>6</td>
<td>(12.8)</td>
</tr>
<tr>
<td>II</td>
<td>23</td>
<td>(48.9)</td>
</tr>
</tbody>
</table>
Table 6.1.c Continuous characteristics of study population

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-pregnancy weight (kg)</td>
<td>49</td>
<td>47.0</td>
<td>90.7</td>
<td>62.3 (9.4)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>52</td>
<td>20.0</td>
<td>42</td>
<td>32.7 (4.2)</td>
</tr>
<tr>
<td>Women’s birth weight (kg)</td>
<td>43</td>
<td>1.8</td>
<td>4.4</td>
<td>3.3 (0.5)</td>
</tr>
<tr>
<td>Height (m)</td>
<td>51</td>
<td>1.6</td>
<td>1.9</td>
<td>1.7 (0.1)</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>48</td>
<td>17.7</td>
<td>32.1</td>
<td>22.7 (3.2)</td>
</tr>
</tbody>
</table>

6.1.2. Anthropometric Assessment

The mean pre-pregnancy weight of the women was 62.3 kg, and a mean BMI of 22.7 kg/m². At the first meeting, when the women were between six and ten weeks gestation, the mean weight was 65.2 kg, and the mean triceps skinfold thickness was 26 mm. At the second meeting, when the women were between 26-30 weeks gestation, the mean weight was 75.9 kg, and the mean triceps skinfold thickness was 28 mm.

6.2 NVP

6.2.1 Symptoms of NVP

Of the fifty-two women in this sample, forty-one (78.8%), reported having experienced NVP. Of those, twenty-four women had nausea only and the remaining seventeen women had both nausea and vomiting. In four women (9.8%), the NVP was
severe enough to cause weight loss in the women. In all the women in this study, symptoms of NVP had started before the initial interview at 6 to 10 weeks gestation.

6.2.2 Onset and cessation of NVP

In all the women, episodes of nausea occurred before the initial interview. The mean week for NVP to start was 5.2 (SD 1.9, median 6 weeks, range 1 to 9 weeks), in all the women with symptoms, episodes of NVP had started by 9 weeks gestation. See Figure 6.2.a.

Figure 6.2.a Distribution of week of onset of NVP

The mean week for cessation of symptoms was 14.3 (SD 5.12, median 13 weeks, range 6 to 33 weeks). 87.2% of women with symptoms ceased having symptoms by week 20. In one woman, symptoms persisted until week 33. See Figure 6.2.b.
6.2.3 Symptom severity

Two measures of symptom severity were used in this study- the total number of hours of nausea during pregnancy and the duration of symptoms in weeks from the start of symptoms. The median total number of hours of symptoms was 80 hours (range 24 to 1177 hours). These symptoms lasted for a median of 8 weeks (range 2 to 25 weeks).

6.2.4 Episodic Nature of Symptoms

The total number of episodes of NVP recorded was 1130. The times throughout the day when episodes of nausea occurred are shown in table 6.2.a. The most common three hour period for symptoms of nausea was between 06:00-09:00. The three hour periods between 09:00-12:00, 12:00-15:00 p.m, 15:00-18:00 and 18:00-21:00 each had a similar percentage of symptoms of nausea. The least time for symptoms to occur were between 21:00-00:00, 00:00-03:00 and 03:00-06:00.
Of the seventeen women reporting vomiting, recorded episodes were available for only 13 of them, with the number of episodes ranging from 1-130. 266 episodes were recorded, with the most common time of occurrence being either 06:00-09:00a.m or 18:00-21:00. 09:00-12:00 and 12:00-15:00 were also common times for the episodes of vomiting. This was followed by 15:00-18:00 and 21:00-00:00 and 03:00-06:00. Vomiting did not occur between 12:00-15:00.

Table 6.2.a Distribution of timing of episodes of nausea and vomiting

<table>
<thead>
<tr>
<th>Time</th>
<th>Nausea (n=1130) (% episodes)</th>
<th>Vomiting (n=266) (% episodes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>06.00-08.59</td>
<td>32</td>
<td>26</td>
</tr>
<tr>
<td>09.00-11.59</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td>12.00-14.59</td>
<td>10</td>
<td>19</td>
</tr>
<tr>
<td>15.00-17.59</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>18.00-20.59</td>
<td>12</td>
<td>27</td>
</tr>
<tr>
<td>21.00-23.59</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>00.00-02.59</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>03.00-05.59</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

6.2.5 Number and length of episodes per day

Of the women with NVP, a total of 19 women (90.5%) experienced days with only one episode of nausea, and 18 women (85.7%) experienced days with two episodes of nausea. 17 women (81%) experienced episodes, which lasted three or more hours at some time during their pregnancy. Of the 1396 episodes in which length of NVP was stated, 72% lasted between half an hour to two hours. 17.9% lasted more than two hours with 3.8% of episodes lasting more than 10 hours at some time during the pregnancy.
6.2.6 Factors that alleviate and worsen symptoms

At the initial interview and in the symptom diary women were asked about measures used to alleviate symptoms of NVP. It was observed as shown in Figure 6.2.c that eating little and often, carbohydrate rich meals, ginger and rest were reported to be the most effective methods for reducing symptoms of NVP.

Figure 6.2.c Methods used by women to alleviate symptoms of NVP

(Numbers by the pie chart denote number of women who reported effectiveness of method)

When asked about factors that made symptoms of NVP worse, it was found that both smells and tiredness were equally reported by the majority of women complaining of symptoms of NVP. See Figure 6.2.d.
(Numbers by the pie chart denote number of women who reported factor to worsen symptoms of NVP)

6.2.7 Factors related to NVP

In this study, three different methods were used to assess factors related to NVP. The first was type of NVP; none, nausea only or both nausea and vomiting. Second was hours of NVP during pregnancy and third was duration of NVP.

For the continuous variables and hours and duration, Spearman correlations were used, as the hours and duration of NVP were not normally distributed. For the continuous variables and type of NVP, ANOVA was used as all the continuous variables were normally distributed. The results of the tests are shown in Table 6.2.b. Women’s age has an effect on both duration of NVP and type of NVP. Tukey post hoc analysis showed that there was a significant difference in age between those women without NVP and those with both nausea and vomiting. See Figure 6.2.e. The mean age of
women without NVP was 35.2(3.5) whereas women with both nausea and vomiting were 31.8(4.0) years old.

Table 6.2.b Effect of continuos maternal factors on duration, number of hours and type of NVP

<table>
<thead>
<tr>
<th>Factor</th>
<th>Duration</th>
<th>Hours</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight 1</td>
<td>$P=0.774$</td>
<td>$P=0.747$</td>
<td>$P=0.855$</td>
</tr>
<tr>
<td>Skinfold 1</td>
<td>$P=0.731$</td>
<td>$P=0.737$</td>
<td>$P=0.241$</td>
</tr>
<tr>
<td>Weight 2</td>
<td>$P=0.666$</td>
<td>$P=0.717$</td>
<td>$P=0.647$</td>
</tr>
<tr>
<td>Skinfold 2</td>
<td>$P=0.726$</td>
<td>$P=0.333$</td>
<td>$P=0.545$</td>
</tr>
<tr>
<td>Pre-pregnancy weight</td>
<td>$P=0.789$</td>
<td>$P=0.736$</td>
<td>$P=0.917$</td>
</tr>
<tr>
<td>Women's birth weight</td>
<td>$P=0.674$</td>
<td>$P=0.446$</td>
<td>$P=0.234$</td>
</tr>
<tr>
<td>Women's height</td>
<td>$P=0.100$</td>
<td>$P=0.543$</td>
<td>$P=0.310$</td>
</tr>
<tr>
<td>Women's age</td>
<td>$P=0.023^*$</td>
<td>$P=0.536$</td>
<td>$P=0.076$</td>
</tr>
<tr>
<td>Women's BMI</td>
<td>$P=0.936$</td>
<td>$P=0.964$</td>
<td>$P=0.984$</td>
</tr>
<tr>
<td>Weight gain</td>
<td>$P=0.133$</td>
<td>$P=0.390$</td>
<td>$P=0.391$</td>
</tr>
<tr>
<td>Change in skinfolds</td>
<td>$P=0.909$</td>
<td>$P=0.773$</td>
<td>$P=0.761$</td>
</tr>
</tbody>
</table>

(In the table, weight 1 and skinfold 1 refer to measurements made at the first home visit. Weight 2 and skinfold 2 refer to measurements made at the second home visit. Skinfold measures were only taken at the triceps. * denotes significant value)

Figure 6.2.e Effect of women's' age on type of NVP

As for the results of the categorical variables, these were statistically explored using the Mann Whitney test for duration and hours of NVP and using Chi square test for
Type of NVP. However in the case of type of NVP, many of the tests could not be carried out as the sample size was too small. See Table 6.2.c.

Table 6.2.c Effect of categorical maternal factors on duration, number of hours and type of NVP

<table>
<thead>
<tr>
<th>Factor</th>
<th>Duration</th>
<th>Hours of NVP</th>
<th>Type of NVP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking pre-pregnancy</td>
<td>P=0.140</td>
<td>P=0.190</td>
<td>-</td>
</tr>
<tr>
<td>Smoking during pregnancy</td>
<td>P=0.154</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Alcohol pre-pregnancy</td>
<td>P=0.352</td>
<td>P=0.223</td>
<td>P=0.126</td>
</tr>
<tr>
<td>Alcohol during pregnancy</td>
<td>P=0.464</td>
<td>P=0.114</td>
<td>-</td>
</tr>
<tr>
<td>Dietary restrictions</td>
<td>P=0.105</td>
<td>P=0.062</td>
<td>-</td>
</tr>
<tr>
<td>Supplements pre-pregnancy</td>
<td>P=0.180</td>
<td>P=0.517</td>
<td>-</td>
</tr>
<tr>
<td>Supplements during pregnancy</td>
<td>P=0.256</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Exercise pre-pregnancy</td>
<td>P=0.780</td>
<td>P=0.519</td>
<td>-</td>
</tr>
<tr>
<td>Exercise during pregnancy</td>
<td>P=0.530</td>
<td>P=0.972</td>
<td>P=0.264</td>
</tr>
<tr>
<td>Cravings</td>
<td>P=0.387</td>
<td>P=0.423</td>
<td>P=0.905</td>
</tr>
<tr>
<td>Aversions</td>
<td>P=0.989</td>
<td>P=0.590</td>
<td>-</td>
</tr>
<tr>
<td>Education</td>
<td>P=0.396</td>
<td>P=0.159</td>
<td>-</td>
</tr>
<tr>
<td>Income</td>
<td>P=0.151</td>
<td>P=0.435</td>
<td>-</td>
</tr>
<tr>
<td>Occupation</td>
<td>P=0.832</td>
<td>P=0.644</td>
<td>-</td>
</tr>
<tr>
<td>SEC</td>
<td>P=0.546</td>
<td>P=0.791</td>
<td>-</td>
</tr>
<tr>
<td>Husband smoking</td>
<td>P=0.407</td>
<td>P=0.467</td>
<td>-</td>
</tr>
</tbody>
</table>

(- denotes statistical analysis could not be carried out)

Type of NVP was significantly related to both duration of NVP ($P=0.009$) and number of hours of NVP ($P=0.003$), where women who had both nausea and vomiting had more hours of NVP, and the symptoms lasted for longer. See Figures 6.2.f and g.
6.2.8 Cravings and aversions in pregnancy

During the initial interview, the women were asked whether they had any cravings and /or aversions during pregnancy. In addition, some women mentioned further cravings and aversions in their food diaries. It can be seen that the most commonly craved foods were fruit, grains and starches, sweets and dairy products. See Figure 6.2.h.
Food category abbreviations: “Sweets” is sweets, desserts and chocolate, “Fruit” is fruits and fruit juices, “G&S” is grains and starches, “Dairy” is dairy products and ice-cream, “Meat” is meats, fish, poultry, eggs and meat alternatives, “Veg” is vegetables, “Other” is for foods that do not fit into the categories, “N-A” is nonalcoholic beverages, “Fried” is fried foods and junk foods, “Stim” is stimulating drink such as tea, coffee, “Alcohol” is alcoholic beverages, “ESS” is ethnic, strong and spicy foods.

As for the aversions, the most commonly avoided foods were stimulating drinks such as tea, coffee, meats, sweets, vegetables, ethnic and spicy foods. See Figure 6.2.i.
Food category abbreviations: “Sweets” is sweets, desserts and chocolate, “Fruit” is fruits and fruit juices, “G&S” is grains and starches, “Dairy” is dairy products and ice-cream, “Meat” is meats, fish, poultry, eggs and meat alternatives, “Veg” is vegetables, “Other” is for foods that do not fit into the categories, “N-A” is nonalcoholic beverages, “Fried” is fried foods and junk foods, “Stim” is stimulating drink such as tea, coffee, “Alcohol” is alcoholic beverages, “ESS” is ethnic, strong and spicy foods.

6.3 Pregnancy outcomes

Of the fifty-two infants born, twenty-two (42.3%) were male and thirty were female (57.5%). Male infants had a mean birth weight of 3.5kg (SD 0.6), a mean length of 53.3cm (SD 2.6), a mean head circumference of 36.3cm (SD 1.7), a mean gestational age of 38.82 weeks (SD 2.44) and a mean placental weight of 0.7kg (SD 0.1). Male infants had a mean APGAR score of 9 and a mean cord blood IGF-1 concentration of
Female infants had a mean birth weight of 3.6 kg (SD 0.5), a mean length of 51.7 cm (SD 2.8), a mean head circumference of 35.8 cm (SD 1.2), a mean gestational age of 39.8 weeks (SD 1.2) and a mean placental weight of 0.7 kg (SD 0.5). Mean APGAR scores in female infants was 9 and the mean cord blood concentration of IGF-1 was 10 nmol/l (SD 4.5). There were no significant differences between the males and females in any of the measurements except with ponderal index (PI) (p=0.006) where male infants (n=16) had PI of 23.6 kg/m\(^2\) (SD 2.59) and female infants (n=28) had a PI of 25.7 (2.1). For pregnancy outcomes see Table 6.3.a.

**Table 6.3.a Pregnancy outcomes**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>Range</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth weight (kg)</td>
<td>52</td>
<td>1.7-4.6</td>
<td>3.5(0.5)</td>
</tr>
<tr>
<td>Placental weight (kg)</td>
<td>29</td>
<td>0.5-1.0</td>
<td>0.7(0.2)</td>
</tr>
<tr>
<td>Head circumference (cm)</td>
<td>44</td>
<td>32.0-39.5</td>
<td>36.0(1.4)</td>
</tr>
<tr>
<td>Length (cm)</td>
<td>44</td>
<td>44-58</td>
<td>52.3(2.8)</td>
</tr>
<tr>
<td>PI (kg/m(^2))</td>
<td>44</td>
<td>17.9-29.4</td>
<td>24.9(2.5)</td>
</tr>
<tr>
<td>Hc:l</td>
<td>42</td>
<td>0.6-0.8</td>
<td>0.7(0.0)</td>
</tr>
<tr>
<td>APGAR</td>
<td>34</td>
<td>1-10</td>
<td>8.9(1.7)</td>
</tr>
<tr>
<td>IGF-1</td>
<td>16</td>
<td>4.5-15</td>
<td>9.8(1.7)</td>
</tr>
<tr>
<td>Gestational age (weeks)</td>
<td>50</td>
<td>31-42</td>
<td>39.4 (1.9)</td>
</tr>
</tbody>
</table>

The relationship between birth weight, length, head circumference, placental weight, IGF-1 and gestational age was investigated for both sexes combined, using Pearson Product moment correlation coefficient. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity. There was a strong positive correlation between birth weight and length (r = 0.765, \(p < 0.001\)) (Figure 6.3.a), head circumference (r = 0.657, \(p < 0.001\)) (Figure 6.3.b) and placental weight (r = 0.626, \(p < 0.001\)) (Figure 6.3.c) and gestational age. There was
no correlation between birth weight and both IGF-1 (r = -0.068, p = 0.802) and PI (r=0.192, p=0.212). As for head circumference to length ratio (hc:l), (r =-0.488, p = 0.001), although there was a significant negative correlation, the strength of the correlation was not very high (Figure 6.3.e).

Figure 6.3.a Relationship between infant birth weight (kg) and length (cm)

![Graph showing relationship between infant birth weight and length with male and female categories]

Figure 6.3.b Relationship between infant birth weight (kg) and head circumference (cm)

![Graph showing relationship between infant birth weight and head circumference with male and female categories]
Figure 6.3.c Relationship between infant birth weight (kg) and placental weight (kg)

Figure 6.3.d Relationship between infant birth weight (kg) and gestational age (weeks)
Figure 6.3.e Relationship between infant birth weight (kg) and head circumference:length ratio

Length and head circumference also showed a strong positive correlation ($r = 0.589$, $p < 0.001$). Length was also positively correlated with gestational age ($r = 0.424$, $p = 0.005$). There was no correlation between length and IGF-1 ($r = -0.765$, $p = 0.250$) or between length and placental weight ($r = 0.346$, $p = 0.091$). However, length was also strongly related to ponderal index and head circumference to length ratio ($r = -0.477$, $p = 0.001$) and ($r = -0.770$, $p < 0.001$) respectively.

As for head circumference, there was a strong positive correlation with placental weight ($r = 0.575$, $p < 0.001$), and with gestational age ($r = 0.568$, $p < 0.001$). There was no correlation between head circumference and IGF-1 ($r = -0.344$, $p = 0.330$). Head circumference was not related to either PI or hc:l ($r = -0.148$, $p = 0.348$) and ($r = 0.059$, $p = 0.709$).

There was no correlation between placental weight and gestational age ($r = 0.343$, $p = 0.074$). In addition, placental weight was not related to either PI or hc:l ($r = 0.227$, $p = 0.274$) and ($r = 0.108$, $p = 0.615$).
There was no correlation between placental weight and gestational age ($r = 0.343, p = 0.074$). In addition, placental weight was not related to either PI or HC:1 ($r = 0.227, p = 0.274$) and ($r = 0.108, p = 0.615$).

As for APGAR scores, they were not correlated with any of the other pregnancy outcomes, including head circumference ($r = -0.088, p = 0.643$), length ($r = -0.008, p = 0.967$), IGF-1 ($r = 0.462, p = 0.130$), weight ($r = -0.048, p = 0.787$), placental weight ($r = -0.075, p = 0.768$) and gestational age ($r = -0.072, p = 0.696$). In addition, APGAR scores were not related to either PI or HC:1 ($r = 0.000, p = 0.998$) and ($r = -0.097, p = 0.610$).

IGF-1 was not related to either PI or HC:1 ($r = -0.256, p = 0.447$) and ($r = -0.71, p = 0.848$). In addition, gestational age was not related to either PI or HC:1 ($r = -0.005, p = 0.975$) and ($r = -0.153, p = 0.345$). In this study, the majority of women had normal deliveries, thus the effect of mode of delivery on IGF-1 concentrations could not be assessed. Both HC:1 and PI were strongly related to one another ($r = 0.470, p = 0.002$).

### 6.3.1 Effect of maternal factors on pregnancy outcomes

Independent sample T-tests were used to test whether smoking and alcohol intake, had any significant relationships with the baby’s weight, placental size, length, head circumference, cord IGF-1, ponderal index or head circumference to length ratio. As for gestational age and APGAR scores, the Mann Whitney test was used. For level of education, occupation, level of income and socio-economic status, ANOVA and the Kruskall Wallis tests were used. The $p$ values of the tests are shown in Table 6.3.b.
Table 6.3.b Results of statistical analysis of the relationship between categorical maternal factors and pregnancy outcomes

<table>
<thead>
<tr>
<th></th>
<th>PI</th>
<th>HC:L</th>
<th>WT</th>
<th>PWT</th>
<th>HC</th>
<th>LENG</th>
<th>APG</th>
<th>IGF-1</th>
<th>GEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoke pre-preg</td>
<td>0.655</td>
<td>0.006*</td>
<td>0.378</td>
<td>0.611</td>
<td>0.159</td>
<td>0.045*</td>
<td>0.857</td>
<td>0.924</td>
<td>0.105</td>
</tr>
<tr>
<td>Smoke during</td>
<td>0.357</td>
<td>0.494</td>
<td>0.533</td>
<td>-</td>
<td>0.489</td>
<td>0.242</td>
<td>0.857</td>
<td>-</td>
<td>0.760</td>
</tr>
<tr>
<td>Etoh pre-preg</td>
<td>0.183</td>
<td>0.177</td>
<td>0.718</td>
<td>0.794</td>
<td>0.303</td>
<td>0.084*</td>
<td>0.905</td>
<td>0.741</td>
<td>0.556</td>
</tr>
<tr>
<td>Etoh during</td>
<td>0.425</td>
<td>0.612</td>
<td>0.934</td>
<td>0.576</td>
<td>0.220</td>
<td>0.874</td>
<td>0.264</td>
<td>0.723</td>
<td>0.850</td>
</tr>
<tr>
<td>Occup</td>
<td>0.518</td>
<td>0.033</td>
<td>0.188</td>
<td>0.106</td>
<td>0.339</td>
<td>0.097</td>
<td>0.937</td>
<td>0.651</td>
<td>0.934</td>
</tr>
<tr>
<td>SEC</td>
<td>0.960</td>
<td>0.970</td>
<td>0.662</td>
<td>0.872</td>
<td>0.115</td>
<td>0.160</td>
<td>0.104</td>
<td>0.368</td>
<td>0.180</td>
</tr>
<tr>
<td>Educat</td>
<td>0.482</td>
<td>0.828</td>
<td>0.340</td>
<td>0.941</td>
<td>0.948</td>
<td>0.841</td>
<td>0.501</td>
<td>0.790</td>
<td>0.982</td>
</tr>
<tr>
<td>incom</td>
<td>0.369</td>
<td>0.185</td>
<td>0.283</td>
<td>0.376</td>
<td>0.487</td>
<td>0.213</td>
<td>0.276</td>
<td>1.000</td>
<td>0.354</td>
</tr>
</tbody>
</table>

( Abbreviations: PI is ponderal index, HC:L is head circumference to length ratio, WT is birth weight, PWT is placental weight, HC is head circumference, LENG is length, APG id APGAR, IGF-1 is cord blood IGF-1 levels and GEST is gestational age. ETOH is alcohol, OCCUPAT is maternal occupation, SEC is family socio-economic status, educat is maternal level of education and incom is level of family income)

It can be seen that there was a relationship between smoking pre-pregnancy on length at birth ($p=0.045$) where babies born to women who were non-smokers pre-pregnancy were longer than babies born to women who smoked pre-pregnancy (Figure 6.3.f). Smoking pre-pregnancy was also related to the ratio between head circumference and length ($p=0.006$), where women who smoked pre-pregnancy had babies with higher hc:l compared to those who did not smoke pre-pregnancy (Figure 6.3.g).
Figure 6.3.f Relationship between maternal smoking pre-pregnancy and baby's length

![Image](image.png)

Figure 6.3.g Relationship between maternal smoking pre-pregnancy and head circumference to length ratio

![Image](image.png)

As for the continuous maternal characteristics, these were examined for any significant relationships with the pregnancy outcomes using either Pearson correlations for birth weight, placental weight, head circumference, length, IGF-1, h/c:l and PI, and
weight, placental weight, head circumference, length, IGF-1, HC:L and PI, and Spearman correlations for gestational age and APGAR scores. The results of the correlations are shown in Table 6.3.c. The table also included two paternal factors: father’s height and birth weight.

Table 6.3.c Results of statistical analysis to assess relationship between continuous maternal and paternal characteristics and pregnancy outcomes

<table>
<thead>
<tr>
<th>Bwt</th>
<th>Pwt</th>
<th>Hc</th>
<th>Leng</th>
<th>Gest</th>
<th>IGF-1</th>
<th>APG</th>
<th>Hc:L</th>
<th>PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>R=.246</td>
<td>R=.200</td>
<td>R=.037</td>
<td>R=.082</td>
<td>R=.197</td>
<td>R=.316</td>
<td>R=.313</td>
<td>R=.046</td>
<td>R=.199</td>
</tr>
<tr>
<td>P=.082</td>
<td>P=.307</td>
<td>P=.815</td>
<td>P=.600</td>
<td>P=.174</td>
<td>P=.233</td>
<td>P=.068</td>
<td>P=.774</td>
<td>P=.200</td>
</tr>
<tr>
<td>R=.051</td>
<td>R=.179</td>
<td>R=.081</td>
<td>R=.075</td>
<td>R=.052</td>
<td>R=.443</td>
<td>R=.281</td>
<td>R=.002</td>
<td>R=.190</td>
</tr>
<tr>
<td>P=.728</td>
<td>P=.393</td>
<td>P=.615</td>
<td>P=.643</td>
<td>P=.733</td>
<td>P=.129</td>
<td>P=.119</td>
<td>P=.990</td>
<td>P=.235</td>
</tr>
<tr>
<td>R=.239</td>
<td>R=.311</td>
<td>R=.122</td>
<td>R=.047</td>
<td>R=.265</td>
<td>R=.135</td>
<td>R=.256</td>
<td>R=.059</td>
<td>R=.388</td>
</tr>
<tr>
<td>P=.098</td>
<td>P=.442</td>
<td>P=.767</td>
<td>P=.072</td>
<td>P=.619</td>
<td>P=.150</td>
<td>P=.716</td>
<td>P=.010</td>
<td>*</td>
</tr>
<tr>
<td>R=-.017</td>
<td>R=.234</td>
<td>R=.049</td>
<td>R=.271</td>
<td>R=.112</td>
<td>R=.250</td>
<td>R=.087</td>
<td>R=.335</td>
<td>R=.414</td>
</tr>
<tr>
<td>P=.914</td>
<td>P=.261</td>
<td>P=.777</td>
<td>P=.105</td>
<td>P=.497</td>
<td>P=.458</td>
<td>P=.668</td>
<td>P=.049</td>
<td>P=.011</td>
</tr>
<tr>
<td>R=.102</td>
<td>R=.273</td>
<td>R=.105</td>
<td>R=.094</td>
<td>R=.338</td>
<td>R=.364</td>
<td>R=.018</td>
<td>R=.072</td>
<td>R=.271</td>
</tr>
<tr>
<td>P=.989</td>
<td>P=.161</td>
<td>P=.513</td>
<td>P=.552</td>
<td>P=.022</td>
<td>P=.166</td>
<td>P=.919</td>
<td>P=.661</td>
<td>P=.083</td>
</tr>
<tr>
<td>R=-.096</td>
<td>R=.076</td>
<td>R=.144</td>
<td>R=.073</td>
<td>R=.043</td>
<td>R=.230</td>
<td>R=.072</td>
<td>R=.143</td>
<td>R=.001</td>
</tr>
<tr>
<td>P=.562</td>
<td>P=.731</td>
<td>P=.416</td>
<td>P=.678</td>
<td>P=.800</td>
<td>P=.524</td>
<td>P=.725</td>
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<tr>
<td>R=.243</td>
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<td>P=.869</td>
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<td>P=.497</td>
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<td>P=.950</td>
<td>P=.017</td>
</tr>
<tr>
<td>Bwtm</td>
<td>R=.317</td>
<td>R=.467</td>
<td>R=.077</td>
<td>R=.229</td>
<td>R=.271</td>
<td>R=.147</td>
<td>R=.131</td>
<td>R=.194</td>
</tr>
<tr>
<td>P=.039</td>
<td>P=.018</td>
<td>P=.650</td>
<td>P=.179</td>
<td>P=.083</td>
<td>P=.616</td>
<td>P=.489</td>
<td>P=.264</td>
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</tr>
<tr>
<td>R=.222</td>
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<td>R=.131</td>
<td>R=.207</td>
<td>R=.150</td>
<td>R=.177</td>
<td>R=.304</td>
<td>R=.528</td>
<td>R=.054</td>
</tr>
<tr>
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<td>P=.121</td>
<td>P=.398</td>
<td>P=.177</td>
<td>P=.756</td>
<td>P=.528</td>
<td>P=.370</td>
<td>P=.573</td>
<td>R=.087</td>
</tr>
<tr>
<td>R=.006</td>
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<td>R=.082</td>
<td>R=.067</td>
<td>R=.022</td>
<td>R=.017</td>
<td>R=.159</td>
<td>R=.036</td>
<td>R=.066</td>
</tr>
<tr>
<td>P=.964</td>
<td>P=.377</td>
<td>P=.596</td>
<td>P=.668</td>
<td>P=.878</td>
<td>P=.949</td>
<td>P=.560</td>
<td>P=.819</td>
<td>P=.672</td>
</tr>
<tr>
<td>BM1</td>
<td>R=.127</td>
<td>R=.097</td>
<td>R=.175</td>
<td>R=.136</td>
<td>R=.131</td>
<td>R=.450</td>
<td>R=.200</td>
<td>R=.086</td>
</tr>
<tr>
<td>P=.389</td>
<td>P=.638</td>
<td>P=.274</td>
<td>P=.395</td>
<td>P=.385</td>
<td>P=.106</td>
<td>P=.274</td>
<td>P=.604</td>
<td>P=.422</td>
</tr>
<tr>
<td>Bwtf</td>
<td>R=.039</td>
<td>R=.050</td>
<td>R=.137</td>
<td>R=.127</td>
<td>R=.225</td>
<td>R=.272</td>
<td>R=.399</td>
<td>R=.286</td>
</tr>
<tr>
<td>P=.870</td>
<td>P=.877</td>
<td>P=.628</td>
<td>P=.652</td>
<td>P=.341</td>
<td>P=.602</td>
<td>P=.141</td>
<td>P=.322</td>
<td>P=.063</td>
</tr>
<tr>
<td>R=.048</td>
<td>R=.308</td>
<td>R=.076</td>
<td>R=.103</td>
<td>R=.245</td>
<td>R=.283</td>
<td>R=.097</td>
<td>R=.029</td>
<td></td>
</tr>
<tr>
<td>P=.738</td>
<td>P=.111</td>
<td>P=.622</td>
<td>P=.749</td>
<td>P=.379</td>
<td>P=.100</td>
<td>P=.540</td>
<td>P=.850</td>
<td>*</td>
</tr>
</tbody>
</table>

(Abbreviations: Wt 1 is maternal weight at the first home visit, skin 1 is triceps skinfold thickness at the first home visit, wt 2 is maternal weight at the second home visit, skin 2 is triceps skinfold thickness at the second home visit, wtchan is difference in weight between the first and second home visit, skincha is the difference

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in triceps skinfold thickness between the first and second home visit, pre-preg is maternal pre-pregnancy weight, bwtm is maternal birth weight, htm is maternal height, age is maternal age, BMI is maternal body mass index, bwtf is paternal birth weight, htf is paternal height, bwt is infant's birth weight, pwt is placental weight, hc is infant's head circumference, leng is infant's length, gest is gestational age, IGF-1 is cord blood IGF-1 concentrations, APG is infant's APGAR scores, hc:l is infant's head circumference to length ratio and PI is infant's ponderal index (* denotes statistical significance)

It was found that maternal weight (wt2) at the second meeting (ie in the third trimester) was significantly positively correlated with the infant’s PI (p=0.01). Maternal skinfold thickness at the second meeting (skin2) was also positively correlated with both PI and hc:l (p=0.01) and (p=0.05) respectively.

It was also found that maternal weight gain between the first visit and the second had a significant positive correlation with the length of gestation (p=0.02), ie the greater the weight gain, the longer the pregnancy.

Maternal pre-pregnancy weight was significantly positively correlated with the infant’s PI (P=0.02).

Maternal birth weight was also positively correlated with both the infant’s birth weight and placental weight, (p=0.039) and (p=0.018) respectively. However, when partial correlations were carried out between placental weight and maternal birth weight, controlling for the baby’s birth weight, the relationship ceased to be
significant ($p=0.080$, r=0.364). Thus the effect the relationship between maternal birth weight and placental weight is probably due to the effect of the baby’s birth weight. Finally, maternal BMI was significantly positively correlated with PI ($p=0.006$).

However, in all these correlations, the strength of the relationship was not strong, as the r-value in all of the correlation was less than 0.5 (Pallant, 2001).

Neither of the paternal factors tested were found to have an effect on any of the factors examined.

### 6.3.2 Effect of NVP on pregnancy outcome

The differences in pregnancy outcomes between babies born to women with NVP and women who did not experience NVP are shown in Table 6.3.d.

#### Table 6.3.d Pregnancy outcomes in women with and without NVP

<table>
<thead>
<tr>
<th>Outcome</th>
<th>NVP</th>
<th>No NVP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestational age (weeks)</td>
<td>39.48 (1.52) (n=40)</td>
<td>38.90 (3.07) (n=10)</td>
</tr>
<tr>
<td>Birth weight (kg)</td>
<td>3.55 (0.49)  (n=41)</td>
<td>3.48 (0.70)  (n=11)</td>
</tr>
<tr>
<td>Placental weight (kg)</td>
<td>0.72 (0.14)  (n=21)</td>
<td>0.75 (0.19)  (n=8)</td>
</tr>
<tr>
<td>Length (cm)</td>
<td>52.14 (2.94) (n=35)</td>
<td>52.83 (2.28) (n=9)</td>
</tr>
<tr>
<td>Head circumference (cm)</td>
<td>35.88 (1.14) (n=35)</td>
<td>36.33 (2.20) (n=9)</td>
</tr>
<tr>
<td>APGAR</td>
<td>8.78 (1.85)  (n=27)</td>
<td>9.13 (0.35)  (n=8)</td>
</tr>
<tr>
<td>IGF-1 (nmol/l)</td>
<td>9.68 (3.2)   (n=10)</td>
<td>10.05 (3.74) (n=6)</td>
</tr>
</tbody>
</table>

To assess the effect of NVP on the outcome of pregnancy, three different methods were used, first type of NVP, second duration and third number of hours of NVP. For type of NVP and the continuous variables, ANOVA was used or the Kruskall Wallis test.
test in the case of APGAR scores and gestational age as they were not normally distributed. As for the categorical variables, Chi square was used. With duration of NVP and hours of NVP, Spearman correlations were used. The results of the analysis are shown Table 6.3.e.

Table 6.3.e Relationship between NVP and pregnancy outcomes using three different measures of symptom severity

<table>
<thead>
<tr>
<th>Outcome measure</th>
<th>Type of NVP</th>
<th>Duration</th>
<th>Hours of NVP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestational age (weeks)</td>
<td>0.911</td>
<td>0.789</td>
<td>0.791</td>
</tr>
<tr>
<td>Baby’s weight (kg)</td>
<td>0.725</td>
<td>0.273</td>
<td>0.760</td>
</tr>
<tr>
<td>Placental weight (kg)</td>
<td>0.810</td>
<td>0.147</td>
<td>0.238</td>
</tr>
<tr>
<td>Head circumference (cm)</td>
<td>0.259</td>
<td>0.807</td>
<td>0.654</td>
</tr>
<tr>
<td>Length (cm)</td>
<td>0.636</td>
<td>0.962</td>
<td>0.561</td>
</tr>
<tr>
<td>APGAR</td>
<td>0.459</td>
<td>0.180</td>
<td>0.075</td>
</tr>
<tr>
<td>PI</td>
<td>0.992</td>
<td>0.500</td>
<td>0.504</td>
</tr>
<tr>
<td>Hc:l</td>
<td>0.669</td>
<td>0.505</td>
<td>0.590</td>
</tr>
<tr>
<td>Gender</td>
<td>0.972</td>
<td>0.601</td>
<td>0.268</td>
</tr>
<tr>
<td>Placental ratio</td>
<td>0.949</td>
<td>0.011*</td>
<td>0.502</td>
</tr>
<tr>
<td>IGF-1 (nmol/l)</td>
<td>0.044*</td>
<td>0.940</td>
<td>0.103</td>
</tr>
</tbody>
</table>

(Abbreviations: PI is ponderal index, Hc:l is infant head circumference to length ratio, type of delivery is either normal or casearian, and IGF-1 is cord blood IGF-1 concentrations) (* denotes statistical significance)

It was found that there was a negative relationship between placental ratio and duration of NVP, where women with longer duration of NVP having the lowest placental ratios (See figure 6.3h)
There was also a significant difference between the cord blood IGF-1 concentrations in babies born to women with varying degrees of NVP. Tukey tests established that there was a significant difference between women with no NVP and those with both nausea and vomiting 10.05 nmol/l (SD 3.74) compared to 12.72 nmol/l (SD 1.52) (Figure 6.3.j)
6.3.3 Effect of cravings and aversions on pregnancy outcomes

Independent t-tests were used to test whether cravings and aversions had an effect on birth weight, placental weight, IGF-1, length, head circumference, ponderal index and head circumference to length ratio. The equivalent non-parametric test, the Mann Whitney U test was used to test the effect on gestational age and APGAR scores as these were not normally distributed.

To test the effect on gender, chi square tests were used. The p values of the statistical tests are shown in Table 6.3.f.

Table 6.3.f Relationship between both aversions and cravings and pregnancy outcomes

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Aversions</th>
<th>Cravings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth weight (kg)</td>
<td>(P=0.681)</td>
<td>(P=0.192)</td>
</tr>
<tr>
<td>Placental weight (kg)</td>
<td>(P=0.161)</td>
<td>(P=0.424)</td>
</tr>
<tr>
<td>Head circumference (cm)</td>
<td>(P=0.770)</td>
<td>(P=0.399)</td>
</tr>
<tr>
<td>IGF-1 (nmol/l)</td>
<td>(P=0.238)</td>
<td>(P=0.231)</td>
</tr>
<tr>
<td>Length (cm)</td>
<td>(P=0.916)</td>
<td>(P=0.772)</td>
</tr>
<tr>
<td>HCL</td>
<td>(P=0.238)</td>
<td>(P=0.283)</td>
</tr>
<tr>
<td>PI</td>
<td>(P=0.729)</td>
<td>(P=0.157)</td>
</tr>
<tr>
<td>Gender</td>
<td>(P=0.195)</td>
<td>(P=0.982)</td>
</tr>
<tr>
<td>Gestation (weeks)</td>
<td>(P=0.973)</td>
<td>(P=0.100)</td>
</tr>
<tr>
<td>APGAR</td>
<td>(P=0.803)</td>
<td>(P=0.987)</td>
</tr>
</tbody>
</table>

As can be seen, neither the occurrence of cravings nor aversions showed any significant relationships with the pregnancy outcomes.
6.4 Nutritional intake in early pregnancy

6.4.1 Effect of NVP on nutritional intake in early pregnancy

The effect of NVP on nutritional intake in early pregnancy was tested using independent sample t-tests. The intakes of both women with NVP and without NVP are shown Table 6.4.a. These intakes are not inclusive of nutritional supplements.
Table 6.4.a Effect of NVP on nutritional intake in early pregnancy

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>DRV</th>
<th>NVP (n=33)</th>
<th>No NVP (n=10)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (kj)</td>
<td>8100</td>
<td>7094 (1682.23)</td>
<td>7936 (1479.60)</td>
<td>0.163</td>
</tr>
<tr>
<td>Energy (kcals)</td>
<td>1940</td>
<td>1687 (401.04)</td>
<td>1887 (353.19)</td>
<td>0.163</td>
</tr>
<tr>
<td>Fat (g)</td>
<td>77</td>
<td>65.94 (21.65)</td>
<td>77.78 (19.38)</td>
<td>0.129</td>
</tr>
<tr>
<td>CHO (g)</td>
<td>50% E</td>
<td>224.53 (55.26)</td>
<td>241.44 (49.10)</td>
<td>0.930</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>51</td>
<td>61.55 (13.17)</td>
<td>68.03 (11.32)</td>
<td>0.168</td>
</tr>
<tr>
<td>Thiamin (mg)</td>
<td>0.8</td>
<td>1.58 (1.12)</td>
<td>1.88 (0.50)</td>
<td>0.457</td>
</tr>
<tr>
<td>Riboflavin (mg)</td>
<td>1.4</td>
<td>1.25 (0.37)</td>
<td>1.53 (0.44)</td>
<td>0.050*</td>
</tr>
<tr>
<td>Niacin (mg)</td>
<td>13</td>
<td>30.10 (7.31)</td>
<td>32.04 (7.59)</td>
<td>0.469</td>
</tr>
<tr>
<td>Vitamin B6 (mg)</td>
<td>1.2</td>
<td>1.74 (0.46)</td>
<td>2.04 (0.46)</td>
<td>0.075</td>
</tr>
<tr>
<td>Vitamin B12 (ug)</td>
<td>1.5</td>
<td>2.42 (1.33)</td>
<td>2.96 (0.97)</td>
<td>0.246</td>
</tr>
<tr>
<td>Folate (ug)</td>
<td>300</td>
<td>231.09 (80.02)</td>
<td>270.00 (57.97)</td>
<td>0.162</td>
</tr>
<tr>
<td>Vitamin C (mg)</td>
<td>40</td>
<td>107.14 (72.69)</td>
<td>122.02 (28.13)</td>
<td>0.342</td>
</tr>
<tr>
<td>Vitamin D (ug)</td>
<td>10</td>
<td>2.33 (1.55)</td>
<td>2.59 (1.07)</td>
<td>0.631</td>
</tr>
<tr>
<td>Vitamin A (ug)</td>
<td>700</td>
<td>650.64 (409.00)</td>
<td>734.50 (278.55)</td>
<td>0.549</td>
</tr>
<tr>
<td>Calcium (g)</td>
<td>700</td>
<td>678.76 (222.40)</td>
<td>858.100 (112.72)</td>
<td>0.002*</td>
</tr>
<tr>
<td>Iron (g)</td>
<td>14.8</td>
<td>11.67 (4.92)</td>
<td>11.40 (1.99)</td>
<td>0.803</td>
</tr>
<tr>
<td>Phosphorus (mg)</td>
<td>550</td>
<td>1024.45 (228.36)</td>
<td>1203.00 (154.97)</td>
<td>0.022*</td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>270</td>
<td>211.06 (54.19)</td>
<td>262.50 (41.83)</td>
<td>0.009*</td>
</tr>
<tr>
<td>Sodium (mg)</td>
<td>1600</td>
<td>2622.58 (740.68)</td>
<td>2564.10 (505.38)</td>
<td>0.817</td>
</tr>
<tr>
<td>Potassium (mg)</td>
<td>3500</td>
<td>2310.11 (581.72)</td>
<td>2794.40 (337.78)</td>
<td>0.017*</td>
</tr>
<tr>
<td>Chloride (mg)</td>
<td>2500</td>
<td>3890.55 (1011.48)</td>
<td>3896.80 (733.07)</td>
<td>0.986</td>
</tr>
<tr>
<td>Zinc (mg)</td>
<td>7</td>
<td>6.27 (1.52)</td>
<td>7.37 (1.13)</td>
<td>0.042*</td>
</tr>
<tr>
<td>Copper (mg)</td>
<td>1.2</td>
<td>0.90 (0.21)</td>
<td>1.10 (0.22)</td>
<td>0.014*</td>
</tr>
<tr>
<td>Selenium (ug)</td>
<td>60</td>
<td>48.91 (16.99)</td>
<td>51.00 (24.38)</td>
<td>0.760</td>
</tr>
</tbody>
</table>

(* denotes statistical significance)
As can be seen, women with NVP consumed less riboflavin \((p=0.005)\) (Figure 6.4.f), calcium \((p=0.002)\) (Figure 6.4.a), magnesium \((p=0.009)\) (Figure 6.4.b), potassium \((p=0.017)\) (Figure 6.4.c), zinc \((p=0.042)\) (Figure 6.4.d) and copper \((p=0.014)\) (Figure 6.4.e) compared to women without NVP.

**Figure 6.4.a Relationship between NVP and riboflavin intake**

![Bar chart showing riboflavin intake comparison between women with and without NVP.]

**Figure 6.4.b Relationship between NVP and calcium intake**

![Bar chart showing calcium intake comparison between women with and without NVP.]

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Figure 6.4.c Relationship between NVP and magnesium intake

Figure 6.4.d Relationship between NVP and potassium intake

Figure 6.4.e Relationship between NVP and zinc intake
As for the effect of the severity of NVP on nutritional intake in early pregnancy, three methods of measuring severity were used in the analysis; total hours of nausea, duration of NVP and type of NVP. The results of the analysis are shown in Table 6.4.b.
Table 6.4.b Effect of NVP on nutritional intake using three different measures of severity

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Hours of NVP</th>
<th>Duration</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (kcals)</td>
<td>R=-0.014, p=0.952</td>
<td>R=-0.131, p=0.473</td>
<td>P=0.337</td>
</tr>
<tr>
<td>Fat (g)</td>
<td>R=-0.128, p=0.591</td>
<td>R=-0.142, p=0.439</td>
<td>P=0.214</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>R=-0.216, p=0.359</td>
<td>R=-0.211, p=0.246</td>
<td>P=0.237</td>
</tr>
<tr>
<td>CHO</td>
<td>R=0.105, p=0.661</td>
<td>R=0.003, p=0.987</td>
<td>P=0.686</td>
</tr>
<tr>
<td>Thiamin (mg)</td>
<td>R=0.196, p=0.407</td>
<td>R=0.015, p=0.936</td>
<td>P=0.328</td>
</tr>
<tr>
<td>Riboflavin (mg)</td>
<td>R=0.024, p=0.917</td>
<td>R=-0.182, p=0.318</td>
<td>P=0.151</td>
</tr>
<tr>
<td>Niacin (mg)</td>
<td>R=-0.209, p=0.377</td>
<td>R=-0.191, p=0.295</td>
<td>P=0.531</td>
</tr>
<tr>
<td>Vitamin B6 (mg)</td>
<td>R=-0.062, p=0.796</td>
<td>R=-0.229, p=0.207</td>
<td>P=0.194</td>
</tr>
<tr>
<td>Vitamin B12 (ug)</td>
<td>R=-0.060, p=0.801</td>
<td>R=-0.083, p=0.653</td>
<td>P=0.473</td>
</tr>
<tr>
<td>Folate (ug)</td>
<td>R=0.053, p=0.824</td>
<td>R=-0.166, p=0.363</td>
<td>P=0.308</td>
</tr>
<tr>
<td>Vitamin C (mg)</td>
<td>R=-0.135, p=0.571</td>
<td>R=0.034, p=0.853</td>
<td>P=0.825</td>
</tr>
<tr>
<td>Vitamin A (ug)</td>
<td>R=0.062, p=0.796</td>
<td>R=0.157, p=0.390</td>
<td>P=0.750</td>
</tr>
<tr>
<td>Calcium (g)</td>
<td>R=0.015, p=0.950</td>
<td>R=0.020, p=0.913</td>
<td>P=0.066</td>
</tr>
<tr>
<td>Iron (g)</td>
<td>R=0.280, p=0.231</td>
<td>R=0.015, p=0.935</td>
<td>P=0.986</td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>R=0.031, p=0.897</td>
<td>R=-0.101, p=0.582</td>
<td>P=0.033*</td>
</tr>
<tr>
<td>Sodium (mg)</td>
<td>R=-0.016, p=0.947</td>
<td>R=-0.107, p=0.559</td>
<td>P=0.824</td>
</tr>
<tr>
<td>Potassium (mg)</td>
<td>R=-0.118, p=0.620</td>
<td>R=-0.147, p=0.423</td>
<td>P=0.057</td>
</tr>
<tr>
<td>Zinc (mg)</td>
<td>R=-0.036, p=0.881</td>
<td>R=-0.245, p=0.176</td>
<td>P=0.045*</td>
</tr>
<tr>
<td>Copper (mg)</td>
<td>R=0.379, p=0.099</td>
<td>R=0.018, p=0.920</td>
<td>P=0.046*</td>
</tr>
<tr>
<td>Selenium (ug)</td>
<td>R=0.094, p=0.693</td>
<td>R=0.019, p=0.919</td>
<td>P=0.913</td>
</tr>
</tbody>
</table>

(* denotes statistical significance)
For total number of hours and duration of NVP, no significant relationships were seen. As for type of NVP, significant differences were seen for magnesium ($p=0.033$), zinc ($p=0.045$) and copper ($p=0.046$) intake between women in the three different severity groups.

Post-hoc Tukey tests were carried out to identify the groups between which significant differences were detected. The results of the tests are shown Table 6.4.c.

**Table 6.4.c Results of Post-hoc Tukey tests for relationship between NVP and intake of magnesium, zinc and copper**

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>No nausea and nausea</th>
<th>No nausea and NVP</th>
<th>Nausea and NVP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnesium</td>
<td>0.050*</td>
<td>0.045*</td>
<td>0.973</td>
</tr>
<tr>
<td>Zinc</td>
<td>0.345</td>
<td>0.036*</td>
<td>0.320</td>
</tr>
<tr>
<td>Copper</td>
<td>0.042*</td>
<td>0.117</td>
<td>0.920</td>
</tr>
</tbody>
</table>

(* denotes statistical significance)

Both women with nausea and those with nausea and vomiting consumed significantly less magnesium compared to women without NVP (Figure 6.4.g). For zinc, women with both nausea and vomiting had significantly lower values compared to women without (Figure 6.4.h). As for copper, women with nausea had significantly lower values compared to women with out NVP (Figure 6.4.i).
Figure 6.4.g Relationship between type of NVP and magnesium intake

Figure 6.4.h Relationship between type of NVP and zinc intake
6.4.3 Effect of cravings and aversions on nutritional intake in early pregnancy

The relationship between both cravings and aversions were tested against markers of nutritional intake using independent sample t-tests. The results of the tests are shown in Table 6.4.d.
Table 6.4.d Relationship between both cravings and aversions and nutritional intake in early pregnancy

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Cravings</th>
<th>Aversions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (kcals)</td>
<td>0.382</td>
<td>0.168</td>
</tr>
<tr>
<td>Fat (g)</td>
<td>0.102</td>
<td>0.974</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>0.736</td>
<td>0.016*</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>0.304</td>
<td>0.080</td>
</tr>
<tr>
<td>Thiamin (mg)</td>
<td>0.583</td>
<td>0.965</td>
</tr>
<tr>
<td>Riboflavin (mg)</td>
<td>0.547</td>
<td>0.011*</td>
</tr>
<tr>
<td>Niacin (mg)</td>
<td>0.175</td>
<td>0.155</td>
</tr>
<tr>
<td>Vitamin B6 (mg)</td>
<td>0.274</td>
<td>0.070</td>
</tr>
<tr>
<td>Vitamin B12 (ug)</td>
<td>0.788</td>
<td>0.164</td>
</tr>
<tr>
<td>Folate (ug)</td>
<td>0.528</td>
<td>0.204</td>
</tr>
<tr>
<td>Vitamin C (mg)</td>
<td>0.905</td>
<td>0.822</td>
</tr>
<tr>
<td>Vitamin A (ug)</td>
<td>0.252</td>
<td>0.650</td>
</tr>
<tr>
<td>Calcium (g)</td>
<td>0.683</td>
<td>0.063</td>
</tr>
<tr>
<td>Iron (g)</td>
<td>0.870</td>
<td>0.003*</td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>0.446</td>
<td>0.121</td>
</tr>
<tr>
<td>Sodium (mg)</td>
<td>0.637</td>
<td>0.315</td>
</tr>
<tr>
<td>Potassium (mg)</td>
<td>0.861</td>
<td>0.192</td>
</tr>
<tr>
<td>Zinc (mg)</td>
<td>0.718</td>
<td>0.052</td>
</tr>
<tr>
<td>Copper (mg)</td>
<td>0.844</td>
<td>0.067</td>
</tr>
<tr>
<td>Selenium (ug)</td>
<td>0.076</td>
<td>0.928</td>
</tr>
</tbody>
</table>

(* denotes statistical significance)
intake ($p=0.016$) (Figure 6.4.j), riboflavin intake ($p=0.011$) (Figure 6.4.k) and iron intake ($p=0.003$) (Figure 6.4.l), where women with aversions consumed less of each of these nutrients compared to women who had no aversions.

**Figure 6.4.j Relationship between aversions and carbohydrate intake (g/d)**

![Bar chart showing carbohydrate intake comparison between aversions and no aversions.]

**Figure 6.4.k Relationship between aversions and riboflavin intake (mg/d)**

![Bar chart showing riboflavin intake comparison between aversions and no aversions.]

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6.4.4 Effect of nutritional intake in early pregnancy on pregnancy outcomes

Both Pearson correlations and Spearman correlations were used to assess any relationships between the intakes of various nutrients and the pregnancy outcomes. The results are shown in Table 6.4.e.
### Table 6.4.e Relationship between nutrient intake in early pregnancy and pregnancy outcomes

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Bwt</th>
<th>Pwt</th>
<th>Hc</th>
<th>Length</th>
<th>IGF-1</th>
<th>Gest</th>
<th>APG</th>
<th>Hc1</th>
<th>PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (kcal)</td>
<td>R=-.133</td>
<td>P=.395</td>
<td>R=.069</td>
<td>R=.016</td>
<td>R=.106</td>
<td>R=.247</td>
<td>R=.057</td>
<td>R=.015</td>
<td>R=.045</td>
</tr>
<tr>
<td>Fat (g)</td>
<td>R=-.106</td>
<td>P=.499</td>
<td>R=.070</td>
<td>R=.087</td>
<td>R=.198</td>
<td>R=.224</td>
<td>R=.086</td>
<td>R=.025</td>
<td>R=.051</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>R=-.178</td>
<td>P=.253</td>
<td>R=.098</td>
<td>R=.111</td>
<td>R=.092</td>
<td>R=.108</td>
<td>R=.244</td>
<td>R=.056</td>
<td>R=.239</td>
</tr>
<tr>
<td>CHO</td>
<td>R=-.089</td>
<td>P=.572</td>
<td>R=.048</td>
<td>R=.117</td>
<td>R=.013</td>
<td>R=.246</td>
<td>R=.096</td>
<td>R=.061</td>
<td>R=.075</td>
</tr>
<tr>
<td>Thiamin (mg)</td>
<td>R=-.032</td>
<td>P=.838</td>
<td>R=.473</td>
<td>R=.020</td>
<td>R=.122</td>
<td>R=.054</td>
<td>R=.040</td>
<td>R=.045</td>
<td>R=.194</td>
</tr>
<tr>
<td>Riboflavin (mg)</td>
<td>R=.153</td>
<td>R=.328</td>
<td>R=.316</td>
<td>R=.133</td>
<td>R=.179</td>
<td>R=.281</td>
<td>R=.300</td>
<td>R=.070</td>
<td>R=.116</td>
</tr>
<tr>
<td>Vitamin B6 (mg)</td>
<td>R=.054</td>
<td>P=.729</td>
<td>R=.373</td>
<td>P=.072</td>
<td>R=.272</td>
<td>R=.353</td>
<td>R=.427</td>
<td>R=.090</td>
<td>R=.027</td>
</tr>
<tr>
<td>Vitamin B12 (ug)</td>
<td>R=.043</td>
<td>P=.784</td>
<td>R=.008</td>
<td>P=.971</td>
<td>R=.022</td>
<td>R=.290</td>
<td>R=.089</td>
<td>R=.116</td>
<td>R=.078</td>
</tr>
<tr>
<td>Folate (ug)</td>
<td>R=.065</td>
<td>P=.681</td>
<td>R=.407</td>
<td>P=.048</td>
<td>R=.233</td>
<td>R=.228</td>
<td>R=.273</td>
<td>R=.026</td>
<td>R=.119</td>
</tr>
<tr>
<td>Vitamin C (mg)</td>
<td>R=-.126</td>
<td>P=.422</td>
<td>R=.032</td>
<td>P=.880</td>
<td>R=.117</td>
<td>R=.138</td>
<td>R=.011</td>
<td>R=.056</td>
<td>R=.208</td>
</tr>
<tr>
<td>Vitamin A (ug)</td>
<td>R=-.219</td>
<td>P=.157</td>
<td>R=.121</td>
<td>P=.572</td>
<td>R=.235</td>
<td>R=.045</td>
<td>R=.431</td>
<td>R=.033</td>
<td>R=.072</td>
</tr>
<tr>
<td>Calcium (g)</td>
<td>R=-.033</td>
<td>P=.834</td>
<td>R=.036</td>
<td>P=.868</td>
<td>R=.102</td>
<td>R=.010</td>
<td>R=.084</td>
<td>R=.173</td>
<td>R=.066</td>
</tr>
<tr>
<td>Iron (g)</td>
<td>R=.271</td>
<td>P=.079</td>
<td>R=.430</td>
<td>P=.036</td>
<td>R=.074</td>
<td>R=.377</td>
<td>R=.113</td>
<td>R=.161</td>
<td>R=.153</td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>R=.157</td>
<td>P=.314</td>
<td>R=.138</td>
<td>P=.519</td>
<td>R=.105</td>
<td>R=.067</td>
<td>R=.031</td>
<td>R=.010</td>
<td>R=.060</td>
</tr>
<tr>
<td>Sodium (mg)</td>
<td>R=.031</td>
<td>P=.842</td>
<td>R=.073</td>
<td>P=.735</td>
<td>R=.072</td>
<td>R=.068</td>
<td>R=.078</td>
<td>R=.031</td>
<td>R=.015</td>
</tr>
<tr>
<td>Potassium (mg)</td>
<td>R=.137</td>
<td>P=.380</td>
<td>R=.090</td>
<td>P=.676</td>
<td>R=.036</td>
<td>R=.239</td>
<td>R=.213</td>
<td>R=.041</td>
<td>R=.069</td>
</tr>
<tr>
<td>Zinc (mg)</td>
<td>R=.151</td>
<td>P=.333</td>
<td>R=.134</td>
<td>P=.534</td>
<td>R=.068</td>
<td>R=.047</td>
<td>R=.004</td>
<td>R=.198</td>
<td>R=.023</td>
</tr>
<tr>
<td>Copper (mg)</td>
<td>R=-.241</td>
<td>P=.120</td>
<td>R=.149</td>
<td>P=.887</td>
<td>R=.110</td>
<td>R=.002</td>
<td>R=.270</td>
<td>R=.001</td>
<td>R=.179</td>
</tr>
</tbody>
</table>

* P-values are significant at the 0.05 level.
It can be seen that thiamin and folate were significantly positively correlated with placental weight. Vitamin B₆ was significantly positively correlated with length. Vitamin B₁₂ was significantly negatively correlated with APGAR scores. Vitamin C and potassium were negatively correlated with ponderal index. As for iron, it was positively correlated with both placental weight and length at birth. Finally, selenium was found to be negatively correlated with both birth weight and gestational age.

However, it is important to note that in all these correlations the strength of the relationship was not high, as shown by an r value of less than 0.5 (Pallant, 2001).

The effect of nutritional intake in early pregnancy was then investigated, taking NVP into account. See Table 6.4.f.
Table 6.4.f Relationship between dietary intake in early pregnancy and pregnancy outcomes in women with NVP

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Bwt</th>
<th>Pwt</th>
<th>He</th>
<th>Length</th>
<th>IGF-1</th>
<th>Gest</th>
<th>APG</th>
<th>Hcl</th>
<th>PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (kcal)</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
</tr>
<tr>
<td>Fat (g)</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
</tr>
<tr>
<td>CHO</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
</tr>
<tr>
<td>Thiamine (mg)</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
</tr>
<tr>
<td>Riboflavin (mg)</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
</tr>
<tr>
<td>Niacin (mg)</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
</tr>
<tr>
<td>Vitamin B6 (mg)</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
</tr>
<tr>
<td>Vitamin B12 (ug)</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
</tr>
<tr>
<td>Folate (ug)</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
</tr>
<tr>
<td>Vitamin C (mg)</td>
<td>R=.90</td>
<td>R=.90</td>
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<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
</tr>
<tr>
<td>Vitamin A (ug)</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
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</tr>
<tr>
<td>Calcium (g)</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
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<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
</tr>
<tr>
<td>Iron (g)</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
</tr>
<tr>
<td>Sodium (mg)</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
</tr>
<tr>
<td>Potassium (mg)</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
</tr>
<tr>
<td>Zinc (mg)</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
</tr>
<tr>
<td>Copper (mg)</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
</tr>
<tr>
<td>Selenium (ug)</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
<td>R=.90</td>
</tr>
</tbody>
</table>
As can be seen, in women with NVP, vitamin B\textsubscript{12} was negatively correlated with HC:L. Iron was positively correlated with birth weight, placental weight and length. As for potassium, it was negatively correlated with ponderal index.

As for women without NVP, Table 6.4.g shows the relationship between intake and pregnancy outcomes in these women.
### Table 6.4.g Relationship between dietary intake in early pregnancy and pregnancy outcomes in women without NVP

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Bwt</th>
<th>Pwt</th>
<th>He</th>
<th>Length</th>
<th>IGF-I</th>
<th>Gest</th>
<th>APG</th>
<th>Hc:1</th>
<th>PI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy (kca)</strong></td>
<td>R=.068</td>
<td>R=.215</td>
<td>R=.176</td>
<td>R=.101</td>
<td>R=.947</td>
<td>R=.321</td>
<td>R=.204</td>
<td>R=.280</td>
<td>R=.132</td>
</tr>
<tr>
<td><strong>Fat (g)</strong></td>
<td>R=.219</td>
<td>R=.377</td>
<td>R=.145</td>
<td>R=.212</td>
<td>R=.788</td>
<td>R=.101</td>
<td>R=.408</td>
<td>R=.165</td>
<td>R=.307</td>
</tr>
<tr>
<td><strong>Protein (g)</strong></td>
<td>R=.224</td>
<td>R=.301</td>
<td>R=.333</td>
<td>R=.753</td>
<td>R=.831</td>
<td>R=.413</td>
<td>R=.206</td>
<td>R=.777</td>
<td>R=.192</td>
</tr>
<tr>
<td><strong>CHO</strong></td>
<td>R=.023</td>
<td>R=.087</td>
<td>R=.189</td>
<td>R=.066</td>
<td>R=.951</td>
<td>R=.346</td>
<td>R=.000</td>
<td>R=.202</td>
<td>R=.028</td>
</tr>
<tr>
<td><strong>Thiamin (mg)</strong></td>
<td>R=.281</td>
<td>R=.745</td>
<td>R=.164</td>
<td>R=.454</td>
<td>R=.238</td>
<td>R=.250</td>
<td>R=.412</td>
<td>R=.110</td>
<td>R=.038</td>
</tr>
<tr>
<td><strong>Riboflavin (mg)</strong></td>
<td>R=.202</td>
<td>R=.260</td>
<td>R=.544</td>
<td>R=.345</td>
<td>R=.759</td>
<td>R=.236</td>
<td>R=.408</td>
<td>R=.278</td>
<td>R=.115</td>
</tr>
<tr>
<td><strong>Niacin (mg)</strong></td>
<td>R=.046</td>
<td>R=.103</td>
<td>R=.374</td>
<td>R=.341</td>
<td>R=.785</td>
<td>R=.127</td>
<td>R=.412</td>
<td>R=.699</td>
<td>R=.260</td>
</tr>
<tr>
<td><strong>Vitamin B6 (mg)</strong></td>
<td>R=.304</td>
<td>R=.446</td>
<td>R=.531</td>
<td>R=.512</td>
<td>R=.599</td>
<td>R=.329</td>
<td>R=.204</td>
<td>R=.254</td>
<td>R=.023</td>
</tr>
<tr>
<td><strong>Vitamin B12 (ug)</strong></td>
<td>R=.222</td>
<td>R=.142</td>
<td>R=.021</td>
<td>R=.013</td>
<td>R=.587</td>
<td>R=.177</td>
<td>R=.408</td>
<td>R=.356</td>
<td>R=.206</td>
</tr>
<tr>
<td><strong>Folate (ug)</strong></td>
<td>R=.214</td>
<td>R=.632</td>
<td>R=.407</td>
<td>R=.352</td>
<td>R=.421</td>
<td>R=.363</td>
<td>R=.204</td>
<td>R=.101</td>
<td>R=.133</td>
</tr>
<tr>
<td><strong>Vitamin C (mg)</strong></td>
<td>R=.294</td>
<td>R=.252</td>
<td>R=.199</td>
<td>R=.440</td>
<td>R=.289</td>
<td>R=.194</td>
<td>R=.612</td>
<td>R=.342</td>
<td>R=.555</td>
</tr>
<tr>
<td><strong>Vitamin A (ug)</strong></td>
<td>R=.149</td>
<td>R=.588</td>
<td>R=.165</td>
<td>R=.154</td>
<td>R=.662</td>
<td>R=.380</td>
<td>R=.612</td>
<td>R=.069</td>
<td>R=.167</td>
</tr>
<tr>
<td><strong>Calcium (mg)</strong></td>
<td>R=.081</td>
<td>R=.136</td>
<td>R=.205</td>
<td>R=.295</td>
<td>R=.786</td>
<td>R=.017</td>
<td>R=.204</td>
<td>R=.395</td>
<td>R=.435</td>
</tr>
<tr>
<td><strong>Iron (g)</strong></td>
<td>R=.164</td>
<td>R=.131</td>
<td>R=.080</td>
<td>R=.019</td>
<td>R=.884</td>
<td>R=.051</td>
<td>R=.408</td>
<td>R=.243</td>
<td>R=.182</td>
</tr>
<tr>
<td><strong>Magnesium (mg)</strong></td>
<td>R=.310</td>
<td>R=.281</td>
<td>R=.374</td>
<td>R=.007</td>
<td>R=.468</td>
<td>R=.380</td>
<td>R=.204</td>
<td>R=.409</td>
<td>R=.145</td>
</tr>
<tr>
<td><strong>Sodium (mg)</strong></td>
<td>R=.133</td>
<td>R=.053</td>
<td>R=.173</td>
<td>R=.314</td>
<td>R=.913</td>
<td>R=.017</td>
<td>R=.000</td>
<td>R=.407</td>
<td>R=.144</td>
</tr>
<tr>
<td><strong>Potassium (mg)</strong></td>
<td>R=.326</td>
<td>R=.016</td>
<td>R=.289</td>
<td>R=.060</td>
<td>R=.664</td>
<td>R=.498</td>
<td>R=0.00</td>
<td>R=.459</td>
<td>R=.095</td>
</tr>
<tr>
<td><strong>Zinc (mg)</strong></td>
<td>R=.218</td>
<td>R=.088</td>
<td>R=.208</td>
<td>R=.124</td>
<td>R=.859</td>
<td>R=.209</td>
<td>R=.104</td>
<td>R=.496</td>
<td>R=.033</td>
</tr>
<tr>
<td><strong>Copper (mg)</strong></td>
<td>R=.177</td>
<td>R=.248</td>
<td>R=.219</td>
<td>R=.115</td>
<td>R=.833</td>
<td>R=.565</td>
<td>R=.204</td>
<td>R=.406</td>
<td>R=.026</td>
</tr>
<tr>
<td><strong>Selenium (ug)</strong></td>
<td>R=.479</td>
<td>R=.244</td>
<td>R=.290</td>
<td>R=.196</td>
<td>R=.668</td>
<td>R=.633</td>
<td>R=.408</td>
<td>R=.690</td>
<td>R=.659</td>
</tr>
</tbody>
</table>
In women without NVP, energy, carbohydrate, iron and sodium intake were all positively correlated with IGF-1 levels. In addition, protein intake was negatively correlated with HC:L.

6.5 Nutritional Intake in late pregnancy

6.5.1 Effect of NVP on nutritional intake in late pregnancy

The intake of the women in the last trimester was assessed using the second food diary. The intakes of women both with and without NVP are shown in Table 6.5.a.
Table 6.5.a Intakes in the third trimester of women both with and without NVP

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>DRV</th>
<th>NVP (n=33)</th>
<th>No NVP (n=10)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (kj)</td>
<td>8900</td>
<td>6939.56 (1536.84)</td>
<td>7750.50 (977.55)</td>
<td>0.119</td>
</tr>
<tr>
<td>Energy (kcals)</td>
<td>1940 (+200)</td>
<td>1648.41 (366.44)</td>
<td>1842.00 (232.95)</td>
<td>0.119</td>
</tr>
<tr>
<td>Fat (g)</td>
<td>84</td>
<td>62.45 (19.01)</td>
<td>70.92 (16.25)</td>
<td>0.201</td>
</tr>
<tr>
<td>CHO (g)</td>
<td>51</td>
<td>63.69 (12.15)</td>
<td>68.25 (13.28)</td>
<td>0.301</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>51</td>
<td>63.69 (12.15)</td>
<td>68.25 (13.28)</td>
<td>0.301</td>
</tr>
<tr>
<td>Thiamin (mg)</td>
<td>0.9</td>
<td>1.58 (0.92)</td>
<td>1.66 (0.28)</td>
<td>0.801</td>
</tr>
<tr>
<td>Riboflavin (mg)</td>
<td>1.4</td>
<td>1.41 (0.45)</td>
<td>1.58 (0.46)</td>
<td>0.273</td>
</tr>
<tr>
<td>Niacin (mg)</td>
<td>13</td>
<td>31.41 (7.36)</td>
<td>32.50 (7.83)</td>
<td>0.681</td>
</tr>
<tr>
<td>Vitamin B6 (mg)</td>
<td>1.2</td>
<td>1.95 (0.50)</td>
<td>2.16 (0.66)</td>
<td>0.281</td>
</tr>
<tr>
<td>Vitamin B12 (ug)</td>
<td>1.5</td>
<td>3.17 (1.62)</td>
<td>3.05 (0.75)</td>
<td>0.830</td>
</tr>
<tr>
<td>Folate (ug)</td>
<td>300</td>
<td>234.17 (70.94)</td>
<td>264.70 (65.80)</td>
<td>0.222</td>
</tr>
<tr>
<td>Vitamin C (mg)</td>
<td>50</td>
<td>103.64 (44.36)</td>
<td>118.55 (54.87)</td>
<td>0.367</td>
</tr>
<tr>
<td>Vitamin A (ug)</td>
<td>700</td>
<td>559.85 (234.35)</td>
<td>585.60 (233.94)</td>
<td>0.757</td>
</tr>
<tr>
<td>Calcium (g)</td>
<td>700</td>
<td>745.10 (266.17)</td>
<td>807.40 (203.24)</td>
<td>0.493</td>
</tr>
<tr>
<td>Iron (g)</td>
<td>14.8</td>
<td>12.29 (6.66)</td>
<td>12.43 (5.58)</td>
<td>0.950</td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>270</td>
<td>214.10 (43.89)</td>
<td>250.80 (37.15)</td>
<td>0.019*</td>
</tr>
<tr>
<td>Sodium (mg)</td>
<td>1600</td>
<td>2497.90 (619.13)</td>
<td>2347.10 (596.37)</td>
<td>0.490</td>
</tr>
<tr>
<td>Potassium (mg)</td>
<td>3500</td>
<td>2368.17 (542.62)</td>
<td>2808.40 (423.59)</td>
<td>0.021*</td>
</tr>
<tr>
<td>Zinc (mg)</td>
<td>7</td>
<td>6.32 (1.24)</td>
<td>7.14 (1.73)</td>
<td>0.092</td>
</tr>
<tr>
<td>Copper (mg)</td>
<td>1.2</td>
<td>0.87 (0.19)</td>
<td>0.98 (0.12)</td>
<td>0.124</td>
</tr>
<tr>
<td>Selenium (ug)</td>
<td>60</td>
<td>53.20 (18.01)</td>
<td>52.00 (13.00)</td>
<td>0.845</td>
</tr>
</tbody>
</table>
In women without NVP, intake of magnesium and potassium were significantly higher than were shown for women who did experience NVP. See Figures 6.5.a and b.

Figure 6.5.a Magnesium intake (mg/d) in women with and without NVP

![Magnesium intake](image)

Figure 6.5.b Potassium intake (mg/d) in women with and without NVP

![Potassium intake](image)

A comparison between the macronutrient intake in the first and second trimester, in both women with and without NVP is shown in Table 6.5.b
Table 6.5.b Macronutrient intake in the first and second trimesters in both women with and without NVP

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>First trimester</th>
<th>Third trimester</th>
<th>R and p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NVP yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy (Kcal) (SD)</td>
<td>1690 (400)</td>
<td>1650 (370)</td>
<td>R=.507, p=.003*</td>
</tr>
<tr>
<td>Fat (g) (SD)</td>
<td>65.94 (21.65)</td>
<td>62.45 (19.01)</td>
<td>R=.371, p=.033*</td>
</tr>
<tr>
<td>Protein (g) (SD)</td>
<td>61.55 (13.17)</td>
<td>63.69 (12.15)</td>
<td>R=.383, p=.028*</td>
</tr>
<tr>
<td>Carbohydrates (g) (SD)</td>
<td>224.53 (55.26)</td>
<td>220.32 (49.42)</td>
<td>R=.557, p=.001*</td>
</tr>
<tr>
<td>NVP no</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy (kcal) (SD)</td>
<td>1890 (350)</td>
<td>1840 (230)</td>
<td>R=.631, p=.051</td>
</tr>
<tr>
<td>Fat (g) (SD)</td>
<td>77.78 (19.38)</td>
<td>70.92 (16.25)</td>
<td>R=.537, p=.110</td>
</tr>
<tr>
<td>Protein (g) (SD)</td>
<td>68.03 (11.32)</td>
<td>68.25 (13.28)</td>
<td>R=.522, p=.122</td>
</tr>
<tr>
<td>Carbohydrates (g) (SD)</td>
<td>241.44 (49.10)</td>
<td>243.56 (35.95)</td>
<td>R=.704, p=.023*</td>
</tr>
</tbody>
</table>

As can be seen, in women with NVP, energy, fat and carbohydrate intake in the first trimester was significantly higher than that in the last trimester. In women with NVP protein intake in the last trimester was significantly higher than the first trimester.

As for women without NVP, no significant differences were seen between the intakes of energy, fat and protein between the first and last trimester, however, in these women, carbohydrate intake was significantly higher in the last trimester.

6.5.2 Effect of nutritional intake in late pregnancy on pregnancy outcomes

The only significant relationships seen between intake in the last trimester and pregnancy outcomes were a negative correlation between energy intake and APGAR scores, a positive correlation between copper intake and gestational age and a positive correlation between sodium intake and ponderal index. See Table 6.5.c.
Table 6.5.c The relationships between nutritional intake in the last trimester and pregnancy outcome

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Bwt</th>
<th>Pwt</th>
<th>Hct</th>
<th>Length</th>
<th>IGF-1</th>
<th>Gest</th>
<th>APG</th>
<th>Hcl</th>
<th>PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (kals)</td>
<td>R=.059</td>
<td>R=.048</td>
<td>R=.179</td>
<td>R=.122</td>
<td>R=.050</td>
<td>R=.143</td>
<td>R=.340</td>
<td>R=.252</td>
<td>R=.236</td>
</tr>
<tr>
<td>Fat (g)</td>
<td>R=.036</td>
<td>R=.100</td>
<td>R=.069</td>
<td>R=.133</td>
<td>R=.047</td>
<td>R=.121</td>
<td>R=.261</td>
<td>R=.199</td>
<td>R=.250</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>R=.033</td>
<td>R=.135</td>
<td>R=.253</td>
<td>R=.048</td>
<td>R=.076</td>
<td>R=.135</td>
<td>R=.276</td>
<td>R=.021</td>
<td>R=.004</td>
</tr>
<tr>
<td>CHO</td>
<td>R=.104</td>
<td>R=.025</td>
<td>R=.214</td>
<td>R=.096</td>
<td>R=.204</td>
<td>R=.159</td>
<td>R=.301</td>
<td>R=.261</td>
<td>R=.238</td>
</tr>
<tr>
<td>Thiamin (mg)</td>
<td>R=.239</td>
<td>R=.061</td>
<td>R=.163</td>
<td>R=.161</td>
<td>R=.481</td>
<td>R=.100</td>
<td>R=.045</td>
<td>R=.094</td>
<td>R=.072</td>
</tr>
<tr>
<td>Riboflavin (mg)</td>
<td>R=.012</td>
<td>R=.134</td>
<td>R=.190</td>
<td>R=.052</td>
<td>R=.273</td>
<td>R=.062</td>
<td>R=.026</td>
<td>R=.247</td>
<td>R=.006</td>
</tr>
<tr>
<td>Niacin (mg)</td>
<td>R=.033</td>
<td>R=.056</td>
<td>R=.171</td>
<td>R=.094</td>
<td>R=.060</td>
<td>R=.041</td>
<td>R=.187</td>
<td>R=.053</td>
<td>R=.030</td>
</tr>
<tr>
<td>Vitamin B6</td>
<td>R=.129</td>
<td>R=.091</td>
<td>R=.179</td>
<td>R=.072</td>
<td>R=.259</td>
<td>R=.060</td>
<td>R=.115</td>
<td>R=.144</td>
<td>R=.047</td>
</tr>
<tr>
<td>Vitamin B12 (ug)</td>
<td>R=.077</td>
<td>R=.121</td>
<td>R=.191</td>
<td>R=.055</td>
<td>R=.238</td>
<td>R=.180</td>
<td>R=.261</td>
<td>R=.014</td>
<td>R=.072</td>
</tr>
<tr>
<td>Folate (ug)</td>
<td>R=.006</td>
<td>R=.093</td>
<td>R=.040</td>
<td>R=.035</td>
<td>R=.269</td>
<td>R=.076</td>
<td>R=.014</td>
<td>R=.188</td>
<td>R=.087</td>
</tr>
<tr>
<td>Vitamin C (mg)</td>
<td>R=.194</td>
<td>R=.087</td>
<td>R=.165</td>
<td>R=.084</td>
<td>R=.169</td>
<td>R=.046</td>
<td>R=.020</td>
<td>R=.002</td>
<td>R=.103</td>
</tr>
<tr>
<td>Vitamin A (ug)</td>
<td>R=.021</td>
<td>R=.038</td>
<td>R=.011</td>
<td>R=.078</td>
<td>R=.163</td>
<td>R=.032</td>
<td>R=.082</td>
<td>R=.217</td>
<td>R=.161</td>
</tr>
<tr>
<td>Calcium (g)</td>
<td>R=.025</td>
<td>R=.162</td>
<td>R=.229</td>
<td>R=.069</td>
<td>R=.160</td>
<td>R=.055</td>
<td>R=.305</td>
<td>R=.277</td>
<td>R=.138</td>
</tr>
<tr>
<td>Iron (g)</td>
<td>R=.042</td>
<td>R=.122</td>
<td>R=.256</td>
<td>R=.032</td>
<td>R=.016</td>
<td>R=.077</td>
<td>R=.203</td>
<td>R=.066</td>
<td>R=.011</td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>R=.008</td>
<td>R=.034</td>
<td>R=.103</td>
<td>R=.057</td>
<td>R=.141</td>
<td>R=.163</td>
<td>R=.317</td>
<td>R=.036</td>
<td>R=.038</td>
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<tr>
<td>Sodium (mg)</td>
<td>R=.099</td>
<td>R=.154</td>
<td>R=.058</td>
<td>R=.158</td>
<td>R=.029</td>
<td>R=.105</td>
<td>R=.070</td>
<td>R=.246</td>
<td>R=.382</td>
</tr>
<tr>
<td>Potassium (mg)</td>
<td>R=.055</td>
<td>R=.125</td>
<td>R=.094</td>
<td>R=.115</td>
<td>R=.386</td>
<td>R=.015</td>
<td>R=.183</td>
<td>R=.218</td>
<td>R=.047</td>
</tr>
<tr>
<td>Zinc (mg)</td>
<td>R=.040</td>
<td>R=.183</td>
<td>R=.027</td>
<td>R=.016</td>
<td>R=.229</td>
<td>R=.135</td>
<td>R=.075</td>
<td>R=.050</td>
<td>R=.001</td>
</tr>
<tr>
<td>Copper (mg)</td>
<td>R=.088</td>
<td>R=.266</td>
<td>R=.185</td>
<td>R=.037</td>
<td>R=.140</td>
<td>R=.290</td>
<td>R=.321</td>
<td>R=.113</td>
<td>R=.096</td>
</tr>
<tr>
<td>Selenium (ug)</td>
<td>R=.021</td>
<td>R=.243</td>
<td>R=.071</td>
<td>R=.265</td>
<td>R=.238</td>
<td>R=.068</td>
<td>R=.287</td>
<td>R=.022</td>
<td>R=.147</td>
</tr>
</tbody>
</table>
The relationships between intake and pregnancy outcome, were re-analyzed, taking NVP into consideration. In women with NVP, protein intake is negatively correlated with IGF-1 values. In addition, sodium was positively correlated with ponderal index. Copper intake was positively correlated with APGAR scores and selenium intake was negatively correlated with both IGF-1 and gestational age. See Table 6.5.d.
Table 6.5.d Relationships between nutrient intake in the last trimester and pregnancy outcome in women with NVP

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Bwt</th>
<th>Pwt</th>
<th>Hc</th>
<th>Length</th>
<th>IGF-1</th>
<th>Gest</th>
<th>APG</th>
<th>Hc:1</th>
<th>PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (kcals)</td>
<td>R=.102</td>
<td>R=.199</td>
<td>R=.199</td>
<td>R=.041</td>
<td>R=.455</td>
<td>R=.057</td>
<td>R=.194</td>
<td>R=.219</td>
<td>R=.165</td>
</tr>
<tr>
<td>Fat (g)</td>
<td>R=.134</td>
<td>R=.178</td>
<td>R=.178</td>
<td>R=.037</td>
<td>R=.469</td>
<td>R=.086</td>
<td>R=.277</td>
<td>R=.192</td>
<td>R=.188</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>R=.807</td>
<td>R=.273</td>
<td>R=.273</td>
<td>R=.189</td>
<td>R=.743</td>
<td>R=.244</td>
<td>R=.007</td>
<td>R=.061</td>
<td>R=.120</td>
</tr>
<tr>
<td>CHO</td>
<td>R=.094</td>
<td>R=.152</td>
<td>R=.152</td>
<td>R=.062</td>
<td>R=.257</td>
<td>R=.096</td>
<td>R=.153</td>
<td>R=.230</td>
<td>R=.195</td>
</tr>
<tr>
<td>Thiamin (mg)</td>
<td>R=.360</td>
<td>R=.052</td>
<td>R=.106</td>
<td>R=.195</td>
<td>R=.155</td>
<td>R=.044</td>
<td>R=.100</td>
<td>R=.066</td>
<td>R=.073</td>
</tr>
<tr>
<td>Riboflavin (mg)</td>
<td>R=-.047</td>
<td>R=-.133</td>
<td>R=.032</td>
<td>R=.073</td>
<td>R=.029</td>
<td>R=.070</td>
<td>R=.147</td>
<td>R=.233</td>
<td>R=.012</td>
</tr>
<tr>
<td>Niacin (mg)</td>
<td>R=.085</td>
<td>R=.043</td>
<td>R=.140</td>
<td>R=.175</td>
<td>R=.403</td>
<td>R=.190</td>
<td>R=.129</td>
<td>R=.122</td>
<td>R=.096</td>
</tr>
<tr>
<td>Vitamin B6 (mg)</td>
<td>R=-.126</td>
<td>R=.101</td>
<td>R=.043</td>
<td>R=.098</td>
<td>R=.236</td>
<td>R=.090</td>
<td>R=.149</td>
<td>R=.035</td>
<td>R=.025</td>
</tr>
<tr>
<td>Vitamin B12 (ug)</td>
<td>R=-.066</td>
<td>R=.235</td>
<td>R=.145</td>
<td>R=.077</td>
<td>R=.856</td>
<td>R=.110</td>
<td>R=.148</td>
<td>R=.023</td>
<td>R=.099</td>
</tr>
<tr>
<td>Folate (ug)</td>
<td>R=.013</td>
<td>R=.076</td>
<td>R=.134</td>
<td>R=.052</td>
<td>R=.314</td>
<td>R=.026</td>
<td>R=.157</td>
<td>R=.155</td>
<td>R=.024</td>
</tr>
<tr>
<td>Vitamin C (mg)</td>
<td>R=-.083</td>
<td>R=.018</td>
<td>R=.005</td>
<td>R=.005</td>
<td>R=.213</td>
<td>R=.056</td>
<td>R=.149</td>
<td>R=.011</td>
<td>R=.162</td>
</tr>
<tr>
<td>Vitamin A (ug)</td>
<td>R=.096</td>
<td>R=.047</td>
<td>R=.086</td>
<td>R=.023</td>
<td>R=.121</td>
<td>R=.033</td>
<td>R=.091</td>
<td>R=.199</td>
<td>R=.094</td>
</tr>
<tr>
<td>Calcium (g)</td>
<td>R=-.032</td>
<td>R=-.168</td>
<td>R=.261</td>
<td>R=.017</td>
<td>R=.284</td>
<td>R=.084</td>
<td>R=.098</td>
<td>R=.252</td>
<td>R=.083</td>
</tr>
<tr>
<td>Iron (g)</td>
<td>R=.027</td>
<td>R=-.236</td>
<td>R=.058</td>
<td>R=.049</td>
<td>R=.127</td>
<td>R=.107</td>
<td>R=.120</td>
<td>R=.063</td>
<td>R=.032</td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>R=.136</td>
<td>R=.123</td>
<td>R=.162</td>
<td>R=.186</td>
<td>R=.210</td>
<td>R=.061</td>
<td>R=.290</td>
<td>R=.055</td>
<td>R=.168</td>
</tr>
<tr>
<td>Sodium (mg)</td>
<td>R=.129</td>
<td>R=.062</td>
<td>R=.030</td>
<td>R=.080</td>
<td>R=.485</td>
<td>R=.031</td>
<td>R=.116</td>
<td>R=.216</td>
<td>R=.356</td>
</tr>
<tr>
<td>Potassium (mg)</td>
<td>R=.016</td>
<td>R=.024</td>
<td>R=.123</td>
<td>R=.037</td>
<td>R=.110</td>
<td>R=.041</td>
<td>R=.103</td>
<td>R=.205</td>
<td>R=.125</td>
</tr>
<tr>
<td>Zinc (mg)</td>
<td>R=.044</td>
<td>R=.082</td>
<td>R=.170</td>
<td>R=.099</td>
<td>R=.301</td>
<td>R=.198</td>
<td>R=.172</td>
<td>R=.020</td>
<td>R=.056</td>
</tr>
<tr>
<td>Copper (mg)</td>
<td>R=.356</td>
<td>R=.283</td>
<td>R=.138</td>
<td>R=.054</td>
<td>R=.384</td>
<td>R=.001</td>
<td>R=.344</td>
<td>R=.073</td>
<td>R=.021</td>
</tr>
<tr>
<td>Selenium (ug)</td>
<td>R=.005</td>
<td>R=.016</td>
<td>R=.297</td>
<td>R=.165</td>
<td>R=.727</td>
<td>R=.334</td>
<td>R=.000</td>
<td>R=.031</td>
<td>R=.211</td>
</tr>
</tbody>
</table>

200
(Abbreviations: PI is ponderal index, HC:L is head circumference to length ratio, WT is birth weight, PWT is placental weight, HC is head circumference, LENG is length, APG is APGAR, IGF-1 is cord blood IGF-1 levels and GEST is gestational age) (* denotes statistical significance)

In women without NVP, IGF-1 values were positively correlated with energy, carbohydrate, thiamin, calcium, iron, magnesium and potassium intakes. Birthweight was negatively associated with vitamin C intakes. In addition, it was found that there was a negative correlation between fat and sodium intake and infant length at birth. See Table 6.5.e.
Table 6.5.e Effect of dietary intake in the last trimester on pregnancy outcome in women without NVP

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Bwt</th>
<th>Pwt</th>
<th>Hc</th>
<th>Length</th>
<th>IGF-1</th>
<th>Gest</th>
<th>APG</th>
<th>Hecl</th>
<th>PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (kcal)</td>
<td>R=.017</td>
<td>P=9.59</td>
<td>R=-.254</td>
<td>P=.543</td>
<td>R=.077</td>
<td>P=.843</td>
<td>R=.590</td>
<td>P=.094</td>
<td>R=.815</td>
</tr>
<tr>
<td>Fat (g)</td>
<td>R=.172</td>
<td>P=.612</td>
<td>R=-.362</td>
<td>P=.378</td>
<td>R=.291</td>
<td>P=.448</td>
<td>R=.678</td>
<td>P=.045</td>
<td>R=.772</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>R=.064</td>
<td>P=.851</td>
<td>R=-.354</td>
<td>P=.390</td>
<td>R=.195</td>
<td>P=.615</td>
<td>R=.534</td>
<td>P=.139</td>
<td>R=.610</td>
</tr>
<tr>
<td>CHO</td>
<td>R=.150</td>
<td>P=.675</td>
<td>R=.057</td>
<td>P=.894</td>
<td>R=.375</td>
<td>P=.320</td>
<td>R=.336</td>
<td>P=.376</td>
<td>R=.857</td>
</tr>
<tr>
<td>Thiamin (mg)</td>
<td>R=.073</td>
<td>P=.832</td>
<td>R=.075</td>
<td>P=.860</td>
<td>R=.241</td>
<td>P=.532</td>
<td>R=.250</td>
<td>P=.517</td>
<td>R=.919</td>
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<tr>
<td>Riboflavin (mg)</td>
<td>R=.195</td>
<td>P=.565</td>
<td>R=.170</td>
<td>P=.688</td>
<td>R=.532</td>
<td>P=.141</td>
<td>R=.032</td>
<td>P=.934</td>
<td>R=.759</td>
</tr>
<tr>
<td>Niacin (mg)</td>
<td>R=.094</td>
<td>P=.783</td>
<td>R=.158</td>
<td>P=.708</td>
<td>R=.265</td>
<td>P=.491</td>
<td>R=.257</td>
<td>P=.504</td>
<td>R=.419</td>
</tr>
<tr>
<td>Vitamin B6</td>
<td>R=.143</td>
<td>P=.675</td>
<td>R=.087</td>
<td>P=.838</td>
<td>R=.415</td>
<td>P=.267</td>
<td>R=.060</td>
<td>P=.879</td>
<td>R=.406</td>
</tr>
<tr>
<td>Vitamin B12</td>
<td>R=.069</td>
<td>P=.860</td>
<td>R=.135</td>
<td>P=.799</td>
<td>R=.567</td>
<td>P=.143</td>
<td>R=.013</td>
<td>P=.977</td>
<td>R=.809</td>
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<tr>
<td>Folate (ug)</td>
<td>R=.052</td>
<td>P=.879</td>
<td>R=.109</td>
<td>P=.797</td>
<td>R=.148</td>
<td>P=.704</td>
<td>R=.042</td>
<td>P=.914</td>
<td>R=.267</td>
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<tr>
<td>Vitamin C</td>
<td>R=.609</td>
<td>P=.047</td>
<td>R=.333</td>
<td>P=.420</td>
<td>R=.603</td>
<td>P=.085</td>
<td>R=.581</td>
<td>P=.101</td>
<td>R=.055</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>R=.187</td>
<td>P=.582</td>
<td>R=.206</td>
<td>P=.625</td>
<td>R=.259</td>
<td>P=.501</td>
<td>R=.415</td>
<td>P=.267</td>
<td>R=.341</td>
</tr>
<tr>
<td>Calcium (g)</td>
<td>R=.022</td>
<td>P=.948</td>
<td>R=.189</td>
<td>P=.653</td>
<td>R=.161</td>
<td>P=.679</td>
<td>R=.441</td>
<td>P=.235</td>
<td>R=.870</td>
</tr>
<tr>
<td>Iron (g)</td>
<td>R=.095</td>
<td>P=.782</td>
<td>R=.297</td>
<td>P=.476</td>
<td>R=.266</td>
<td>P=.489</td>
<td>R=.217</td>
<td>P=.575</td>
<td>R=.855</td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>R=.264</td>
<td>P=.433</td>
<td>R=.340</td>
<td>P=.411</td>
<td>R=.162</td>
<td>P=.677</td>
<td>R=.504</td>
<td>P=.166</td>
<td>R=.878</td>
</tr>
<tr>
<td>Sodium (mg)</td>
<td>R=.031</td>
<td>P=.929</td>
<td>R=.374</td>
<td>P=.361</td>
<td>R=.118</td>
<td>P=.762</td>
<td>R=.763</td>
<td>P=.017</td>
<td>R=.606</td>
</tr>
<tr>
<td>Potassium (mg)</td>
<td>R=.171</td>
<td>P=.615</td>
<td>R=.417</td>
<td>P=.304</td>
<td>R=.137</td>
<td>P=.725</td>
<td>R=.659</td>
<td>P=.054</td>
<td>R=.903</td>
</tr>
<tr>
<td>Zinc (mg)</td>
<td>R=.040</td>
<td>P=.907</td>
<td>R=.480</td>
<td>P=.229</td>
<td>R=.161</td>
<td>P=.679</td>
<td>R=.229</td>
<td>P=.553</td>
<td>R=.546</td>
</tr>
<tr>
<td>Copper (mg)</td>
<td>R=.006</td>
<td>P=.987</td>
<td>R=.082</td>
<td>P=.846</td>
<td>R=.188</td>
<td>P=.628</td>
<td>R=.315</td>
<td>P=.409</td>
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<tr>
<td>Selenium (ug)</td>
<td>R=.377</td>
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<td>R=.136</td>
<td>P=.569</td>
<td>R=.221</td>
<td>P=.781</td>
<td>R=.109</td>
<td>P=.359</td>
<td>R=.459</td>
</tr>
</tbody>
</table>

Note: * indicates statistical significance.
(Abbreviations: PI is ponderal index, HC:L is head circumference to length ratio, WT is birth weight, PWT is placental weight, HC is head circumference, LENG is length, APG is APGAR, IGF-1 is cord blood IGF-1 levels and GEST is gestational age) (* denotes statistical significance)
7. DISCUSSION OF PROSPECTIVE STUDY

7.1 NVP

7.1.1 Symptoms of NVP

In this study, it was found that the prevalence of NVP was 79%, this compares well with other studies which found that NVP occurs in nearly 70% of the population (Broussard and Richter, 1998).

Within the sample of women with NVP, it was found that 23% had vomiting as well. In other studies on NVP, vomiting was reported in 38-62% of pregnant women (Vellacott et al, 1988, Klebanoff et al, 1985, Tierson et al, 1986, Gadsby et al, 1993, Lacroix et al, 2000). This is slightly lower than that reported by other studies, this could be due to the fact that in most women, symptoms of NVP had started by the time of the first interview, and thus the actual number of episodes prior to the initiation of the symptom diary were not accurately remembered.

7.1.2 Onset and cessation of symptoms

In this study it was found that the mean week for NVP to start was 5.2 (median 6 weeks) from LMP. In all women with symptoms, symptoms had started by 9 weeks gestation. The mean week for cessation of symptoms was 14.3 (median 13), with 87.2% of women ceasing to have symptoms by week 20.

In their prospective study, Gadsby et al (1993) found that the mean week for symptoms to start was 5.7 from the LMP. The mean week for cessation of symptoms
in the study by Gadsby et al (1993) was week 12 from LMP, with 90.8% of women ceasing to have symptoms by week 16 from LMP.

In another prospective study carried out by Lacroix et al (2000) on 180 women using both symptom diaries and McGill Nausea Questionnaire, it was found that nausea was reported as early as 3 weeks gestation, although the mean gestational age at onset was 5.7 weeks. Although 50% of individuals with nausea reported resolution of symptoms by 14 weeks, it was not until week 22 that symptoms had resolved in 90% of women.

Tierson et al (1986) in their prospective study found that the mean and median week of onset of nausea was week 6, with no difference in women who had nausea only compared to those with both. By the 4th week, only 20% had symptoms, increasing to 80% by week 8, and 98% of women by week 16. By week 15, 50% of women stopped having symptoms, and by week 20, 25% still had symptoms. Nausea persisted longer if accompanied by vomiting.

In a prospective study by Zhou et al (1999) on 103 women, the mean duration of symptoms was 15.2 weeks, with 73.2% reporting symptoms to have stopped by week 24, 4% by 28-32 weeks and 22.8% persisting throughout pregnancy.

Thus it can be seen that NVP seems to persist into the second trimester, and therefore it is important that caregivers are aware of this aspect of the natural history of NVP to avoid women becoming angry and disappointed when the symptoms persist (Lacroix et al, 2000).
7.1.3 Symptom severity

In our study the median total number of hours of symptoms was 80 hours, which lasted for a median of 8 weeks. Similarly, Gadsby et al (1993) also showed that the symptoms lasting for a median of 41 days (interquartile range 28-56 days), ie nearly 8 weeks. However, the median total number of hours of symptoms per pregnancy recorded by Gadsby et al (1993) was 56 hours (range 22-139), this was lower than that recorded in our study, again this could probably be due to the inaccuracy of the information given by the women for the two weeks preceding the interview, since like us, Gadsby et al (1993) used recall for two weeks if the women could remember her symptom pattern.

7.1.4 Episodic nature of symptoms

The most common three hour period for nausea to occur was between 06:00-09:00 followed by 09:00-12:00, 12:00-15:00, and 15:00-18:00. As for vomiting, the most common time was 06:00-09:00 and 18:00-21:00. 09:00-12:00 and 12:00-15:00 p.m also common times for vomiting to occur.

This confirms the finding of the study by Gadsby et al (1993), who also found that the most common 3 hour period for symptoms to occur was between 09:00-12:00 in the morning, this was followed by 06:00-09:00, then 12:00-15:00, 15:00-18:00, 18:00-21:00. The most common six hour period being 06:00-12:00. Only 3.8% of women only experienced symptoms between 06:00-12:00 a.m. The majority of women experienced symptoms both before and after midday. For the women reporting vomiting, the most common time being 06:00-09:00, followed by 09:00-12:00.
Lacroix et al (2000) also found that although 80.2% of women reported nausea in the morning, only 1.8% reported only morning sickness. NVP lasted until afternoon in 3.7%, until after suppertime in 4.7% and all day long in 80%.

Similarly, Diiorio et al (1992) using 7 day diaries, also found that nausea was equally likely to be distributed throughout the waking hours. Another study carried out by Vellacott et al (1988) found that only 19% of women had symptoms confined to the morning. These figures suggest that the term morning sickness is misleading and should be avoided when one is referring to nausea and vomiting in pregnancy.

7.1.5 Number and length of episodes per day

In this study, 90.5% of women experienced days with only one episode of nausea, 85.7% two episodes of nausea and 81% of women experienced three or more episodes. In 72% of episodes, the duration of each episode was half and hour to an hour, 17.9% lasted more than two hours and 3.8% more than 10 hours. Week 11.9 was the week within which there were the longest episodes of NVP.

Similarly Gadsby et al (1993) found that 84.6% of women experienced days with two episodes of nausea and 55.8% experienced days with three or more episodes at some time during their pregnancy. In 35.7% of episodes, the duration of each episode was between 1 and 2 hours, 35.3% lasted between 2 and 4 hours. Week 9 was the median week within which there were the longest episodes of NVP.

In this study, it was found that women with more severe symptoms had more hours and longer duration of symptoms compared to those with less severe nausea. This
finding confirmed the study by Gadsby et al (1993) who found that those women reporting more severe vomiting had longer hours of nausea.

7.1.6 Factors that alleviate and worsen symptoms

In this study it was shown that the most commonly used methods to alleviate symptoms were eating little and often, carbohydrate rich meals, consuming ginger containing foods and rest. These are the same measures reported by the women in the retrospective study mentioned in chapters 2-4. As for factors that made symptoms worse, this study found that both smells and tiredness were reported by most of the women with NVP.

The effect of olfactory stimulation on exacerbating symptoms of NVP have been mentioned by O'Brien et al (1997), where olfactory stimulation such as smells, were reported by women as making symptoms worse. De la Ronde and Thirsk (1995) in their review stated that increased oestrogen levels may increase olfactory sensitivity. Odours such as perfume and smoke, in addition to aromas of cooking foods may also initiate nausea. Women could be advised to avoid cooking, and for the partner to cook instead. Alternatively, the women could prepare cold foods such as salads and sandwiches that do not produce aromas.

In devising the best advice for women it is important to note that rest helps alleviate symptoms and tiredness makes symptoms worse. As mentioned in section 4.1.6, rest is not mentioned in medical textbooks as a method to alleviate symptoms. As fatigue seems to exacerbate symptoms, women should be encouraged to increase their rest while they are symptomatic and to seek assistance in such daily activities as child
cai'e. It would therefore seem appropriate for health care providers to adopt a liberal attitude towards providing letters for leaves of absence from work. Such a policy will ultimately shorten the time lost from outside employment.

7.1.7 Factors related to NVP

The only factor found to be related to symptoms of NVP in this study was the women’s age. The finding that NVP was more common in younger women has been reported by Klebanoff et al (1985), Kallen (1987), Depue et al (1987), Wiegel and Wiegel (1988) and Pettiti (1986). Some possible reasons for this include a greater cumulative experience in handling high oestrogen levels during the course of normal menstrual cycles (Depue et al, 1987), alterations in steroid synthesis (Wiegel and Wiegel, 1988), and poor placental function in the older women. Snell et al (1998) stated that the weight of evidence points to the trend of a reduced risk of NVP with increasing age. The authors speculated that because oestrogen levels decrease with age, if oestrogen level is an etiologic factor in the development of symptoms, this could be the physiological basis for a decreased prevalence of NVP in older women.


7.2 Cravings and aversions in pregnancy

7.2.1 Foods craved during pregnancy

In this study it was found that the foods most commonly craved during pregnancy were fruit, grains and starches, sweets and dairy products. These cravings are the
same as those seen in the retrospective study mentioned in chapters 2-4. These findings reciprocate the findings of Dickens and Trethowan (1971), Finley et al (1985), Flaxman and Sherman (2000) and Bayley et al (2002).

7.2.2 Foods avoided during pregnancy

The most commonly avoided foods mentioned by the women in this study were stimulating drinks such as tea and coffee, meats, sweets, vegetables and ethnic and strong, spicy foods, these are similar to the aversions mentioned by the women in the retrospective study (chapter 2-4). Our results are similar to those seen by Dickens and Trethowan (1971), Finley et al (1985), Flaxman and Sherman (2000) and Bayley et al (2002).

7.3 Pregnancy outcomes

7.3.1 Effect of maternal factors on pregnancy outcomes

7.3.1.1 Maternal birthweight

In this study, it was found that maternal birth weight was related to baby’s birth weight and placental weight. However the relationship between maternal birth weight and placental weight ceased to be significant when controlling for birth weight. This result is supported by the study carried out by Godfrey et al (1996) who also found a relationship between maternal birth weight and baby’s weight. In addition Godfrey et al (1996) reported that placental weight was also related to maternal birth weight. Godfrey et al (1996) reported that this strong relationship supports the hypothesis that maternal constraint of fetal growth may operate largely through constraint of placental
growth, perhaps as a consequence of impaired uterine or ovarian development during the mother's own fetal life. Like Godfrey et al (1996), this study was based on recalled maternal birth weights. In the study by Godfrey et al (1996), it was found that there was a high degree of agreement between actual and recalled birth weights.

7.3.1.2 Maternal weight gain

In this study, it was found that maternal weight gain during pregnancy was positively related to gestational age. This is in contrast with Thame et al (1997), who reported that maternal weight gain was not related to any pregnancy outcome. Low gestational weight gain is known to be one of the greatest predictors of low birth weight for both preterm and small for gestational age births (Scholl et al, 1991). In a prospective study of 510 women by Aaronson and Macnee (1989) it was found that maternal weight gain was related to length of gestation. Abrams et al (2000) cited a review by Carmichael and Abrams (1997) which found that 11 out of 13 studies published between 1980 and 1996 found an association between a low rate of weight gain and an increased risk of preterm birth. Abrams et al (2000) reported that the pattern of weight gain as well as the total amount gained should be considered as they might have an effect on preterm delivery.

7.3.1.3 Maternal pre-pregnancy weight

Maternal pre-pregnancy weight was related to the infants ponderal index (PI) in this study. Both Godfrey et al (1997) and Thame et al (1997) found no relationship between early pregnancy weight and PI. One possible reason for this difference is that in our study we used recalled pre-pregnancy weights, whereas Godfrey et al (1997) and Thame et al (1997) used early pregnancy weights. Ponderal index is associated with increased risk of insulin resistance in later life (Godfrey and Barker, 2001), thus
improving maternal nutritional status pre-pregnancy may protect her infant’s future health.

7.3.1.4 Smoking pre-pregnancy
Smoking pre-pregnancy was statistically significantly related to shorter babies with larger head circumference to length ratio. Godfrey et al (1997) also found that women who smoked during pregnancy had infants who were lighter and shorter than women who did not smoke. Williams and Poulton (1999) reported that smoking might have non-nutritional effects that exert a direct effect on the fetus and that may be mediated by an effect on the placental circulation. In addition, maternal smoking could exert its effects by affecting nutritional intake. In our study, it was found that women who smoked pre-pregnancy had lower intakes of potassium in early pregnancy and lower carotene in later pregnancy. We could not compare the effect of smoking on nutritional intake during pregnancy with the nutritional intake of non-smokers as there were only a small number of women who smoked during pregnancy. Mathews et al (2000) in their prospective study using 7 day estimated food diaries on 774 pregnant women found that women who smoked had lower intakes of most nutrients compared to women who didn’t smoke. However, after adjusting for height, age and education, only levels of vitamin C and carotenoids were lower. In addition, it was found that young women who smoked had the lowest intakes compared to the rest of the pregnant women.

In a study by Vatten et al (2002) it was found that cord blood levels of IGF-1 were lower in women who reported smoking in early pregnancy compared to non-smokers. They reported a strong increase in cord IGF-1 levels with increasing birth weight and
length. In this study, no association was found between smoking and IGF-1 levels probably due to the small sample size of our study compared to the sample of 585 women used by Vatten et al (2002).

7.3.1.5 Maternal BMI

In this prospective study, it was found that maternal BMI was statistically significantly related to the infants ponderal index. In their retrospective study on 2394 birth records, Thame et al (1997) reported that maternal BMI was not linearly related to ponderal index, although those women with the lowest BMI had infants with lowest PI.

7.3.2 Effect of NVP on pregnancy outcome

1. Effect on cord blood IGF-1 concentrations

This study found that cord blood IGF-1 values were affected by severity of NVP, where they were significantly higher in women with both nausea and vomiting compared to women without symptoms. It was also found that in women with NVP, IGF-1 was not related to energy intake, whereas in women without NVP, IGF-1 was directly related to energy intake.

The dominant influence on fetal IGF-1 levels at least in the second half of gestation seems to be nutrient status and in particular glucose availability to the fetus and subsequent changes in fetal insulin release. Little is known of the factors that might regulate nutrient transfer across the placenta (Gluckman, 1995). There is mounting evidence that the IGFs can determine this partitioning. Elevations in fetal IGF-1 seem to partition nutrients between the placenta and fetus in favour of the fetus (Gluckman,
1995). Gluckman and Harding (1997) stated that fetal IGF-1 has an effect on placental metabolism by reducing placental lactate production and placental demands for amino acids, which allows an increased substrate supply to the fetus. However, how NVP is related to IGF-1 can be explained by one or all of the following three ways.

Firstly, the hormones, which have been associated with NVP, might have a role to play in improved placental function, and thus improved substrate availability, leading to elevated fetal IGF-1 levels. Worthington-Roberts and Williams (1993) stated that from the earliest days of pregnancy, the cells of the trophoblast and those differentiated from them in the placenta manufacture a variety of hormones; the first hormone to be synthesised is human chorionic gonadotrophin hormone (hCG). Early in the differentiation of the trophoblast, this hormone is found coating the trophoblast’s outer cell surface where it is thought to act as an immunologically protective layer preventing the rejection of the blastocyst and thereby facilitating implantation. hCG has been implicated in the aetiology of NVP as its levels peak in the first trimester when the frequency of NVP peaks (Masson et al, 1985). hCG production plays an important part in rescuing the corpus luteum and in maintaining progesterone production of the corpus luteum. During the first six weeks of gestation, the corpus luteum is believed to be the prime source of progesterone production and thereafter the placenta becomes the main source (Maruo et al, 1992). Progesterone production is important for placental and fetal growth. Kleeman et al (1994) found that administration of exogenous progesterone to pregnant rats increased fetal and placental growth. hCG has also been shown to activate the thyroid, stimulating the release of thyroxine, which is a potent stimulator of placental growth (Mori et al, 1988). Thyroid hormones can stimulate the production of a number of placental
hormones, including placental lactogen, progesterone, and oestradiol-17β in placental tissue (Symonds, 1995). This in vitro placental response is confined to the early part of gestation and is not seen near to term (Symonds, 1995). Taken together, these findings indicate that thyroid hormones play a primary role in maintaining function of the differentiated trophoblast, over a period in which growth and metabolic requirements are maximal (Symonds, 1995). The ability to alter maternal thyroid hormone production during early pregnancy could serve a dual purpose in promoting placental growth, as well as supplying serum thyroxine (T₄) to the fetus before development of fetal thyroid (Symonds, 1995).

Other hormones known to affect placental metabolism include maternal IGF-1, placental GH and placental lactogen. Elevation of maternal IGF-1 may enhance nutrient transfer from mother to placenta and so alter placental metabolism. Maternal IGF-1 in the second half of pregnancy is associated with an increase in mRNA for the glucose transporters 1 and 3 (Bauer et al, 1998). Bauer et al (1998) reported that ontogenic studies in sheep have found that levels of mRNA for GLUT 1 increase with placental size in early gestation and GLUT 3 increases with placental function in late gestation. Bauer et al (1998) speculated that GLUT 1 might be responsible for transfer between the mother and placenta, and GLUT 3 between the placenta and the fetus.

Alsat et al (1998) reported that up to 15-20 weeks gestation, pituitary GH is the main form present in the maternal circulation after which placental GH is produced and suppresses pituitary GH. Placental GH is only secreted into the maternal circulation and its levels increase with increasing placental size (Alsat et al, 1998). Placental growth hormone may have a role in placental development and syncytiotrophoblast
differentiation and function via an autocrine or paracrine mechanism as seen by specific receptors on this tissue (Alsat et al, 1998). Placental GH seems to regulate maternal IGF-1 production, and thus indirectly affects fetal growth (Alsat et al, 1998). Hull and Harvey (2001) suggested that placental growth hormone may enhance fetal growth by increasing placental size rather than by acting directly on the fetus, since placental growth hormone is not detected in the fetal circulation. Placental GH also stimulates placental IGF-1 production and enhances endometrial growth (Hull and Harvey, 2001). Placental GH may also alter endocrine activity of the placenta since it stimulates the production of placental lactogens, oestradiol and progesterone in vitro (Hull and Harvey, 2001). It also increases DNA synthesis and the growth of fetal tissues in rat and sheep fetuses during the latter part of pregnancy (Hull and Harvey, 2001).

The role of placental lactogen in maternal and fetal circulations remain unclear (Gluckman, 1995). There is some speculation that placental lactogen might be a regulator of maternal metabolism to partition nutrients in favour of the fetus (Gluckman, 1995) Thus placental lactogen could have a role in fetal growth and in the regulation of maternal and fetal IGF-1.

Jansson and Powell (2000) reported that the study of placental nutrient transport is still in its infancy and that much more research is needed in the area of fetal growth and placental function, using a wide variety of methods such as molecular biology to whole animal physiology. Also studies in pregnant women using newly developed stable isotope techniques will be valuable to obtain an understanding of the metabolism and transport of nutrients in vivo.
Secondly, it could be the maternal environment prior to pregnancy, which induces better placental growth and function. Wheeler et al (1999) reported that during the first trimester, the trophoblast environment is usually hypoxaemic, because perfusion of the trophoblastic villi by maternal blood is established only between 10 and 12 weeks gestation. Wheeler et al (1999) found higher levels of hCG and placental lactogen in women with low haemoglobin levels. They found that the expression of mRNA for one of the vascular endothelial growth factors was increased in hypoxia suggesting that an increase in placental angiogenesis may be one of the mechanisms through which this is achieved as VEGF plays a role in angiogenesis. Circulating VEGF can be detected in maternal plasma at 6 weeks gestation and rises to a peak at the end of the first trimester in parallel with hCG. Villous trophoblast VEGF expression appears to decline as pregnancy advances (Kingdom et al, 2000). Wheeler et al (1999) found that VEGF concentrations were positively correlated with placental volume at mid pregnancy and with fetal and placental weight at delivery. Wheeler et al (1999) speculated that placental growth is in part determined by maternal factors that prevail before conception, one possibility was that these factors modify angiogenesis within the trophoblastic cells. Wheeler et al (1999) reported that the production of VEGF by vascular smooth muscle cells is increased by oestrogen. Thus it could be that in women with elevated oestrogen levels such as in younger women, non-smokers who are more susceptible to NVP, there are higher VEGF levels, and thus better placental growth and function and therefore higher placental hormones such as hCG, which then trigger NVP.
Thirdly, it has been proposed that NVP is a result of a genetic conflict between the mother and fetus (Flaxman and Sherman, 2000). The preimplantation embryo bathes in a fluid that is rich in IGFs (van Kleffens et al, 1998). IGF-11 is produced in abundance by the trophoblast cells of the placenta (van Kleffens et al, 1998). Successful implantation, placental development and fetal growth depend on migration of the IGF-2 producing trophoblast into the maternal decidua (Minniti et al, 1992). IGF-11 knockout mice have significant growth retardation especially in the early stages of gestation and IGF-11 gene disruption is associated with severe placental growth retardation (DeChiara et al, 1990). Gardner et al (1999) reported that IGF-11 appears to have an effect on body composition in the mouse. It controls fluid uptake by direct action on the maternal capillaries by increasing VEGF. This increases capillary permeability and promotes angiogenesis.

The effects of the IGFs are mediated via 2 specific receptors, type-1 and type-2, which are expressed in high density on most fetal and placental cells. The type-1 and type-2 receptors co-localise with IGF-II, which suggests the receptors compete for IGF-II (Zhou and Bondy, 1992). IGF-II interacts with type-1 and type-2 IGF receptors (IGF2R); the type-2 receptor binds IGF-II with high affinity and IGF-I with an affinity about 100-fold lower (Han and Carter, 2000). Whereas the type-1 receptor promotes growth, the competitive non-signalling type-2 receptor limits growth (Czech, 1989); it is also implicated in IGF-II degradation (O’Dell and Day, 1998). A soluble circulating form of the type-2 receptor (IGFR2) inhibits IGF-II mediated DNA synthesis and therefore probably constrains fetal growth (Ong et al, 2000). Size at birth correlates with the ratio of circulating IGF-II and soluble IGF2R levels (Ong et al, 2000).
It has been suggested by Haig (Haig and Graham, 1991) that as the gene for the type-2 receptor is maternally imprinted and IGF-II is paternally imprinted (DeChiara et al., 1991), this presents an example of genetic conflict. Paternal genome expression promotes growth via the expression of IGF-II but the maternally expressed type-2 receptor can act to mop up IGF-II preventing it from binding to the growth promoting type-1 receptor. Thus an excess of type-2 receptor expression will limit growth of the placenta and, therefore, constrain fetal growth so limiting the metabolic demands placed on the mother.

Thus the size and function of the placenta could be determined by genetic conflict. IGF-11 then stimulates VEGF production, which leads to better placental function, elevated hCG levels and thus NVP. IGF-11, which causes placental growth and development, leads to an increase in placental hormones and thus nutrient partitioning, this leads to increased fetal IGF-1. A summary of these effects is shown in diagrammatic form in figure 7.3.a.
Figure 7.3.a Diagramatic presentation of possible hormonal pathways leading to elevated IGF-1 levels in infants born to women with more severe symptoms of NVP compared to those with less severe symptoms.

Although no significant effect of NVP on placental size was observed in this study, Gadsby et al (1997) did find larger placentas in women with NVP. Furthermore placental size does not necessarily reflect function, thus the effect of NVP could be to improve placental function without necessarily increasing placental size.
2. Effect on placental ratio

The duration of NVP had an effect on placental ratio, with women with longer duration of NVP having a lower placental ratio compared to women with short duration of symptoms. The effect of NVP on placental ratio may be beneficial in the long run as Barker and colleagues have reported that the risk of hypertension decreases with increasing birth weight, and increases with increased placental weight and placental ratio (Perry et al., 1995). Care should be taken when interpreting effects on placental ratio as it is not known whether the effect is on the birthweight or the placental weight.

No other effect of NVP on outcome was observed. This is supported by other studies, where no effect of NVP on outcome was observed, except on reducing risk of miscarriage (Flaxman and Sherman, 2000). However, due to the fact that the numbers required to achieve 80% power based on birth outcomes was not achieved, the relationship between NVP and pregnancy outcomes such as birth and placental weight cannot be considered.

7.4 Nutritional intake in early pregnancy

In general, the energy and nutritional intake of the women in this study compared well with the DRV for pregnant women. The energy intake was slightly lower than DRV, but this could be due to underreporting by the women. Folate levels were slightly lower, but this does not take into consideration folate supplements, which most women were taking. Vitamin D levels were also lower than DRV values but dietary vitamin D is not a main source of this nutrient. Iron levels were also lower, but none of the women reported that they were anaemic, or that they had been advised to take
iron supplements. Finally selenium levels were lower than the DRV values. This is similar to the findings of Mathews and Neil (1998), who carried out a study on 774 pregnant women in the second trimester of pregnancy, using 7 day semi-quantitative food diaries.

Mathews and Neil (1998) reported that vitamin D intakes in their cohort were far below the RNI of 10ug/day, and are unlikely to be achieved without supplementation. However the main evidence on which the RNI is set comes from a non randomised trial of Vitamin D supplementation in Scottish women, which made no assessment of intake from food, and suggested that supplementation reduced the incidence of infant hypocalcaemia and defects of dental enamel. Mathews and Neil (1998) suggested that vitamin D synthesis may be somewhat higher in women from the south of England, such as the cohort they describe in Portsmouth and our study in Guildford. The authors suggest that it may be appropriate to reassess the recommendation that all pregnant women should have vitamin D intakes of 10ug/day as further research becomes available.

Mathews and Neil (1998) also reported that intakes of iron in their cohort were low in comparison with the DRVs. However given that women found to be anaemic by routine antenatal haematology are normally prescribed iron supplements, severe iron deficiency in pregnancy seems unlikely with current practices of care.

The findings of low selenium intakes in this study as well as the study by Mathews and Neil (1998) is consistent with the report by Rayman et al (1996) which reported low serum concentrations of selenium in pregnant British women compared with
studies world-wide. Mathews and Neil (1998) suggested that some care should be taken into consideration in interpreting these findings because the selenium content of individual foods is known to vary widely, and thus it is unclear how adequately food diaries used in conjunction with the Nutrient Databank can assess intake of this nutrient. Moreover, many foods in the databank have missing values for this nutrient. True intakes of selenium may therefore be considerably higher than those calculated.

Mathews and Neil (1998) stated that in addition to the difficulties of measurement error, there is also uncertainty about the functional significance of low selenium intakes and circulating concentrations in pregnancy, compared to the well-documented adverse effects of high intakes. Mathews and Neil (1998) specified that more research is needed before advice about supplementation with selenium can be given with confidence to pregnant British women.

7.4.1 Effect of NVP on nutritional intake in early pregnancy

Women with NVP consume less riboflavin, biotin, calcium, magnesium, potassium, phosphorus, zinc and copper compared to women without NVP (it is important to remember that this does not include nutritional supplements). This could be due to the reduced intakes in women with NVP compared to women without NVP. Alternatively, the reduced intake resembled that of women with aversions, these women had lower intakes of carbohydrate, iron and riboflavin, and a trend for lower intakes of calcium, zinc, copper and vitamin B₆. However due to the small sample size, we could not test whether women with NVP were at greater risk of aversions, but it was found that the majority of women with aversions had NVP. On examination of the foods avoided by women in pregnancy, which were meat, vegetables and chocolates, it was observed that these are good sources of calcium, vitamin B₆.
magnesium, potassium, copper and zinc. In our retrospective study (see chapters 2-4), it was also found that NVP was highly related to aversions in pregnancy.

There are only a few studies, which have looked at the effect on NVP on nutritional intake in pregnancy.

The earliest study was carried out by Beal et al (1971) and was a prospective study of 95 pregnancies in 54 women in America. The study found no effect of NVP on energy intake; some women increased their intake and others decreased. They found that a greater percentage of women with nausea changed their caloric intake compared to women without nausea, but the magnitude of change was similar in the two groups. Women with minimal or moderate nausea were equally likely to increase or to decrease intake in the first trimester, but women with severe nausea were more likely to decrease their intake.

In another prospective study carried out by Teirson et al (1986) on 414 women in America, using both 24 hour recall and 7 day diet histories, it was found that there was a significant positive association between the total days of nausea experienced and an increased intake of sodium during week 12. A significant negative association was found between the total days of nausea and the intake of niacin during week 12. Also the total number of days of vomiting was negatively associated with intakes of both potassium and vitamin A.
In a more recent study in Southampton, Robinson et al (2001) using a food frequency questionnaire at 15 weeks gestation with the exception of women with severe NVP, energy intake was not reduced in early pregnancy as a result of NVP.

7.4.2 Effect of nutrition in early pregnancy on pregnancy outcome

In our study, there were positive associations found between vitamin B₆ and iron and birth length. Vitamin B₁₂ was negatively associated with APGAR scores. The three nutrients; thiamin, iron and folate were also positively associated with placental weight. Negative associations were found between potassium and vitamin C and PI, selenium and birth weight, and between selenium and gestational age.

These relationships seen in this study will be discussed below, however not all the relationships have been reported in the literature, thus only the associations found in the literature will be reported here.

- Selenium

The negative relationship seen between selenium intakes and birth weight and gestation age is similar to findings of Langley-Evans and Langley-Evans (2002), who also found that selenium intakes were negatively related to birth weight. However, as mentioned in section 7.4, care should be taken in the interpretation of the findings of selenium due its variation in foods and missing data in the nutrient data banks.

- Iron

Iron deficiency can result not only in reduced oxygen carrying capacity due to lower haemoglobin levels but also can affect immunity and growth and development. A vast body of literature suggests that iron deficiency has adverse effects on birth outcomes,
such as LBW, prematurity and perinatal mortality, but evidence that iron supplementation has an effect on improving fetal outcome is not conclusive (Ramakrishnan et al, 1999). In this study, there was a positive relationship between iron intakes and infant length and placental weight. There is evidence that there is a U shape relationship between maternal haemoglobin status and birth outcomes. For example a study by Godfrey et al (1991) on 8684 women studied retrospectively, found that large placentas were associated with low maternal haemoglobin levels and also a higher placental ratio in women with most severe anaemia and most fall in mean cell volume. This is probably due to placental hypertrophy that is disproportionate to fetal growth. It is important to remember that only haemoglobin levels were examined and that other measures were not considered such as serum ferritin, transferrin saturation, also anaemia may be due to other nutritional factors such as folate and B12 (Ramakrishnan et al, 1999). However, in our study, the relationship observed between iron intakes and pregnancy outcomes was based on dietary methods rather than biochemical markers of iron status.

- Thiamin

The finding that thiamin was positively related to placental weight has been seen in animals. Ramakrishnan et al (1999) reported that thiamine deficiency in rats has been shown to cause severe IUGR in the progeny as indicated by reduced body weight, placental weight and liver weight. As for humans, Ramakrishnan et al (1999) cited a study by Heinze and Weber (1990) which found that blood cell thiamin between the 28th to the 39th week was lower in women with IUGR compared to normal pregnancies. Doyle et al (1990) found that thiamin and niacin intakes were related to birth weight and head circumference. However the authors reported that these two
nutrients cannot be separated from each other or from other B vitamins such as riboflavin and pyridoxine because they are clustered together in the same foods and the maternal intakes were highly correlated with one another.

• Vitamin B₆

The positive association between vitamin B6 and infant length has not been reported in other studies. Ramakrishnan et al (1999) reported that in animal studies it has been shown that maternal B6 deficiency can have harmful effects on the fetus, however, this is not well studied in humans. Ramakrishnan et al (1999) cited a double blind randomly controlled trial by Schuster et al (1981) which found that infants of mothers taking 7.5mg or more of supplemental pyridoxine had a significantly higher one minute APGAR score compared to infants of mothers who received less than 5 mg. No difference was seen in 5 minute APGAR scores. No differences were seen in birth weight, length or placental weight, although the authors concluded that this could be due to the small sample size of 50 women.

• Folate

A positive association was seen between folate intakes and placental weight. Similarly, Mathews et al (1999) conducted a prospective study on 693 women in Portsmouth and found that placental weight was positively associated with intakes of vitamin C, vitamin E and total folate, the associations remained even after adjustment for maternal height. However, after adjustment for vitamin C intake, no other nutrient independently affected placental weight. Scholl and Johnson (2000) in their literature review found that folate deficiency was associated with both birth weight and gestation age. The authors also reported that folate deficiency also interferes with
growth of the conceptus, maternal erythropoiesis, growth of the uterus and mammary
gland and growth of the placenta. Ramakrishnan et al (1999) in their review reported
that there is some evidence that folate deficiency may be related to LBW and
prematurity, as in rapidly dividing cells, folate deficiency may lead to alterations in
DNA synthesis and chromosomal aberrations. However, the data are still conflicting
and there is an absence of good experimental studies to examine the benefits of folic
acid in reducing the LBW, prematurity and other complications. However, there was
no mention of any effect on placental weight.

The differences seen between the findings of our study and those reported in the
literature could be due to different population sizes and different techniques used. In
addition, in some studies, biochemical markers were used as opposed to nutritional
intake.

It is interesting to note that the effect of nutrients on outcome differ in women with
NVP compared to those without NVP. In women with NVP positive relationships
were seen between placental weight and iron intake and birthweight and iron intake.
Negative relationships were seen between head circumference to length ratio and
vitamin B_{12} intakes and between potassium intakes and ponderal index.

In women without NVP, positive relationships were seen between IGF-1 and energy,
carbohydrates, iron and sodium intakes. Negative relationships were seen between
head circumference to length ratio and protein intakes.
These variations in relationships between nutrition and outcome in women with NVP and those without NVP could be that the factors that might be contributing factors of NVP, such as elevated hormonal levels, lead to this variation in effects of nutrients on outcome. Alternatively, owing to the small sample size and inaccuracies in food records and food tables, care must be taken in interpreting these findings. In addition there was a difference in the number of women in the no NVP group compared to the NVP group which could have affected the analysis.

It is interesting to see that although women with NVP were found to have significantly higher cord blood IGF-1 concentrations, there was no relationship between IGF-1 concentrations and energy intakes in women with NVP. Thus the effect of NVP on IGF-1 could be due to some factors such as hormones which are causing the NVP. These hormones could lead to better nutritional partitioning in the women with NVP, thus a higher cord blood IGF-1. Thus NVP has an effect on intake, and intake has an effect on outcome, however, the effect of NVP on IGF-1 is probably not through the effect of diet, but other factors such as hormones.

7.5 Nutritional intake in late pregnancy

In this study, it was found that energy and nutrient intake in the third trimester was statistically significantly lower than that in the first trimester. This is supported by a number of studies. Beal et al (1971) also found a decrease in energy intake in the third trimester mainly due to decreased fat and carbohydrate intake. Beal et al (1971) hypothesised that the decrease in intake could be due to efforts to control weight gain or a decreased appetite due to reduced physical activity. In addition the decreased intake could be due to the increase in fetal size leading to discomfort upon eating.
Godfrey et al. (1996) reported an intake in early pregnancy of 2329 kcal and later of 2314 kcal, however they did not report whether these were significantly different. On the other hand, Mathews et al. (1999) found an increase in intake. This could be due to a variation in the methods used where Mathews et al. (1999) used a 7 day diet diary followed by a food frequency questionnaire. Food frequency questionnaires usually lead to higher level of nutrients (Robinson et al., 1996).

7.5.4 Effect of NVP on intake in late pregnancy

Magnesium and potassium intakes in the third trimester were found to be higher in women without NVP.

7.5.5 Effect of nutritional intake in late pregnancy on pregnancy outcomes

To summarise the findings of this study, positive relationships were seen between ponderal index and sodium intake and between gestational age and copper intake. Negative associations were found between APGAR scores and energy intakes. Similar to nutritional intakes in early pregnancy, the effect of nutritional intake on pregnancy outcome differed in women with NVP compared to women without NVP. As in section 7.4.2, only relationships seen in the literature will be discussed below.

- Copper

The finding of a positive association between copper intake and gestational age is supported by the study by Doyle et al. (1990) which found that length of gestation was correlated to the intake of copper, phosphorus, calcium, iron, chloride, sodium and magnesium in women who delivered pre-term infants.
It is important to remember that many nutrients are interrelated and thus the effects on outcome may not be due to a specific nutrient, but rather due to a group of nutrients. This data is consistent with the findings of Mathews et al. (1999) in that birth weight was not strongly related to maternal nutritional status either in early or late pregnancy, however like us, Langley-Evans and Langley-Evans (2002) reported relationships between nutrient intakes and infant body proportions. These observations that micronutrient intakes may be associated with body proportions at birth are consistent with the assertions of Barker and in general support the hypothesis that nutritional programming effects upon fetal development may manifest as readily measurable markers at birth such as fetal size and thinness at birth, which may have implications for later life.

Thus a healthy well-balanced diet is important for pregnant women as well as all of women of child-bearing age. Maternal nutritional status at the time of conception is an important determinant of embryonic and fetal growth (Doyle et al, 1990). The embryo is vulnerable to the effects of poor maternal diet during the first few weeks of development, often before pregnancy had been confirmed. Cell differentiation is most rapid at this time and any abnormalities in cell division cannot be corrected at a later stage. Improving nutritional status in women prior to pregnancy has a beneficial effect on birth outcome. If all pregnant women were to eat a balanced varied and adequate diet, this would help to correct nutritional imbalances and would help to ensure that the fetus has the best nutritional environment in which to develop.
7.6 Study limitations

Apart from the date nausea started, which was always retrospective, detailed prospective data were obtained. It has therefore been possible to describe in detail the condition and some features of the natural history of NVP. Drawing women’s attention to nausea and vomiting by using a daily diary may result in greater accuracy of reported symptoms. While vomiting is a clear end point, the reporting of which is unlikely to be affected, nausea must be a personal judgement, but there is no reason why this should influence the overall episodic pattern of symptoms. Gadsby et al (1993) cited Morell and Wale (1976) who stated that they found that patients who keep health diaries give more accurate information than those recalling symptoms.

Seven day semi-quantitative food diaries are considered to give a good estimate of nutrient intake compared with other techniques (Bingham and Nelson, 1991), and are likely to achieve better response rate than weighed methods. The usual concerns about the adequacy of nutritional databases, the validity and repeatability of dietary records, and the natural variability in the nutrient composition of food, should nevertheless be considered when interpreting the results of this study (Mathews and Neil, 1998). In addition, estimated food records do not give accurate estimates of the intakes of most of the micronutrients, thus care should be taken in interpreting the relationships with micronutrient intakes, especially as the sample size in this study was small.

Our fairly homogenous sample of highly educated, white women of high socio-economic status limits the generalizability of the findings. In addition, the small sample size of this study also limits the generalizability of our findings.
This study had taken the cut off limit for statistical significance to be 5%. Cut off limits of 1% can be used in order to be more confident of the associations seen.

In this study we only measured cord blood IGF-1 levels. However, the effect of NVP on cord blood IGF-1 could be mediated by several factors which need to be measured before it can be understood how NVP affects fetal IGF-1.
8. CONCLUSION

The incidence of NVP in the Guildford area was found to be around 70%, similar to the findings of other studies (Broussard and Richter, 1998).

NVP was found to occur more often in non-smokers, women of higher education, higher parity in the retrospective study. In the prospective study NVP was found to occur more often in women of younger age.

Although NVP has been associated with increased birth weight and gestational age, no such association was seen in this study. However, the factors which may lead to a beneficial effect were investigated. Women with NVP were not found to consume either a smaller or larger intake, however, it was found that NVP had an effect on quality of the diet. This study found a very strong association between NVP and cravings and aversions in pregnancy, with the most commonly avoided foods being tea, coffee, vegetables, strong tasting and spicy foods. This data provides sound evidence to support the maternal fetal protection hypothesis, which states that NVP protects the mother from the ingestion of potentially harmful foods.

A new finding was the relationship between NVP and cord blood IGF-1 concentrations, with IGF-1 concentrations increasing with increased severity of NVP. This effect seems to be regardless of nutritional intake, unlike in women without NVP. Some possible causes of this elevated IGF-1 concentrations could be due to the hormones which cause NVP, genetic conflict or maternal environment pre-pregnancy.
Another novel finding is the effect of duration of NVP on reducing placental ratio. This is important as Barker and his colleagues have shown relationships between increased placental ratio and hypertension in later life.

NVP does not guarantee a healthy pregnancy, nor does lack of it mean pregnancy failure, but it seems that that NVP has served an evolutionary protective function and should be considered as an adaptive rather than a pathological condition (Flaxman and Sherman, 2000; Forbes, 2002).

Flaxman and Sherman (2000) reported that there is no reason to believe that alleviating symptoms of NVP will improve the outcome of pregnancy. Indeed it could have an opposite effect if it does not prevent the expulsion of potentially harmful foods. Also discouraging women from avoiding foods to which they develop aversions could be detrimental if it means eating potentially harmful foods. However, more thorough testing of the maternal fetal protection hypothesis is needed before dietary practices based on this hypothesis are adopted.

8.1 Future Work

More thorough testing of the maternal and fetal protection hypothesis could be conducted first in animals such as rats to assess whether foods that carry teratogens are avoided during pregnancy and whether such diet choice reduce the incidence of birth defects or spontaneous abortion (Forbes, 2002). As for humans, further observational work using larger sample sizes are needed.
Further work is also needed to understand how nutrients influence normal fetal development and the extent to which deficits or excesses in select nutrients can trigger specific aberrant pathways. An understanding of how nutrients act to regulate embryonic development requires an appreciation of a variety of diverse processes including maternal nutrient metabolism, yolk and placental nutrient metabolism and transport, embryonic and fetal nutrient metabolism and ontogenic changes in gene nutrient interactions. Models of whole animals to cells culture need to be used to study the influence of essential nutrients on developmentally important processes at discrete stages of development (Hirshi and Keen, 2000).

The study of placental nutrient transport is still in its infancy (Jansson and Powell, 2000) and much more research is needed in the area of fetal growth and placental function, using a variety of methods such as molecular biology to whole animal physiology. Also studies in pregnant women using doubly labelled stable isotope techniques will be valuable to obtain an understanding of the metabolism and transport of nutrients in vivo.

In conclusion, further studies, with larger numbers using measurements of other hormones, biochemical markers of nutritional status and on a wider population will be needed before any definite statements can be made about the effect of NVP on nutrition and outcome. In this study multiple testing was used to find relationships between factors related to NVP and factors related to outcome. Further studies could be conducted to look at specific nutrients or factors of interest. This would make the statistical analysis stronger. Recently there has been much interest and research in the
area of NVP, which should offer further explanations on how this condition arises and how it has its effects.
9. REFERENCES


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INSTRUCTIONS

• Please tick or fill in all the appropriate boxes.

• Some questions may have more than one answer, please tick all the boxes that apply to you.

• Some questions ask you to explain or describe your answer, please write it on the provided line.

• In section B, it is preferable if the father completes his section. However, if this is not possible, please tick the box at the top of this section and try and answer as much of the section as you can.

• Not all the questions may apply to you.

• When you have finished, please post the questionnaire and one consent form to us in the pre-paid envelopes provided, even if you were not able to answer all of the questionnaire. We would be grateful if you could send the questionnaire back to us as soon as possible and preferably within 1 months time.

WE SHALL BE VERY GRATEFUL FOR YOUR HELP AND TIME.
SECTION A - INFORMATION ABOUT MOTHER

1. Date of birth
   Day  Month  Year

2. Marital status

   □ Single  □ Living with husband/partner

3. Pre-pregnancy weight (in kilograms or stones and pounds)

4. What was your weight gain by the end of your pregnancy? (kilograms or stones and pounds)

5. Your birth weight (if known)

6. Your height (in meters or feet and inches)

7. a) Occupation.

   □ Paid employment  □ Full time mother

   Current or previous job title description
8. a) Did you smoke prior to your pregnancy?
   □  □
   Yes  No
   
   If yes, how many cigarettes per day did you smoke?
   □  □  □
   1-9  10-20 >20

   b) Did you smoke during your pregnancy?
   □  □
   Yes  No
   
   If yes, how many cigarettes per day did you smoke?
   □  □  □
   1-9  10-20 >20

9. a) Did you drink alcohol prior to your pregnancy?
   □  □
   Yes  No
   
   If yes, how many units per day did you drink? (1 unit = half a pint of beer, 1 glass of wine, 1 measure of spirit such as gin or vodka)
   □  □  □
   1-2  3-4 >4

   b) Did you drink alcohol during your pregnancy?
   □  □
   Yes  No
   
   If yes, how many units per day did you drink? (1 unit = half a pint of beer, 1 glass of wine, 1 measure of spirit such as gin or vodka)
   □  □  □
   1-2  3-4 >4
10. Is this baby your first child?

☐ Yes ☐ No

If no, please write the number of children that you have, and their dates of birth (d.o.b) (excluding this baby)

11. a) Did you take any nutritional/dietary supplements pre-pregnancy?

☐ Yes ☐ No

If yes, please specify

______________________________________________________________________________________________

______________________________________________________________________________________________

b) Did you take any nutritional/dietary supplements throughout the pregnancy?

☐ Yes ☐ No

If yes, please explain eg Iron, Vitamin C, Multi Vitamins, and when did you start taking them.

______________________________________________________________________________________________

______________________________________________________________________________________________

12. Did you suffer from nausea and/or vomiting during this pregnancy?

☐ Yes ☐ No

If no, please go to question 20.

If yes, was it

☐ Mild (nausea) ☐ Moderate (nausea and vomiting) ☐ Severe (hyperemesis gravidarum)
13. At what time of day did the nausea and/or vomiting tend to occur?

- [ ] Only mornings
- [ ] Only nights
- [ ] A few hours/day
- [ ] The whole day (24hrs)

14. a) At what stage in your pregnancy did the nausea and vomiting start?

b) How long did the period of nausea and/or vomiting last (days, weeks, months)?

15. Were you hospitalised due to the nausea and/or vomiting?

- [ ] Yes
- [ ] No

16. Did the nausea and vomiting cause you to eat

- [ ] More
- [ ] Less
- [ ] The same

17. a) Did the nausea and/or vomiting cause you to avoid certain foods?

- [ ] Yes
- [ ] No

If yes, please explain which foods you avoided.

b) Were there any foods that you ate more of as they helped reduce the nausea and/or vomiting?

- [ ] Yes
- [ ] No

If yes, please explain which food you ate more of.
18.a) Did you seek help for the nausea and/or vomiting?
   □  □  
   Yes  no

b) Was this (please tick one or more)
   □  □  □
   Anti sickness Tablets  alternative therapy (please specify)  other (please specify)

19. Did any foods, medication, alternative remedies, help to alleviate the symptoms? Please explain.
   __________________________________________
   __________________________________________
   __________________________________________

20.a) Did you suffer from dietary aversions during pregnancy?
   □  □
   Yes  no

   Please explain (ie the foods you avoided and why)
   __________________________________________
   __________________________________________
   __________________________________________

b) Did you crave any foods during your pregnancy?
   □  □
   Yes  no

   Please explain (ie the foods you craved and why)
   __________________________________________
   __________________________________________
   __________________________________________
21. Did you receive any dietary advice during pregnancy?
  □ Yes  □ no
  If yes, who was this from, (please tick one or more)
  - Doctor
  - Midwife
  - Dietitian
  - Magazine
  - Book
  - Relative
  - Friend
  - Leaflets eg. From supermarkets
  - Other (please specify) __________________________

22. Ethnic origin
  □ White  □ Indian
  □ Black Caribbean  □ Pakistani
  □ Black African  □ Bangladeshi
  □ Black other
    please specify____________________
  □ Chinese
  □ Other
    Please specify____________________

23. Which of the following qualifications have you obtained?
  □ GCSEs or equivalent
  □ A levels or equivalent
  □ degree/post A level education
  □ other (please specify)

24. Approximate household income/year before tax is deducted is in the range
  □ Upto £9,999
  □ £10,000-£19,000
  □ £20,000-£29,000
  □ £30,000-£39,000
  □ over £40,000
SECTION B – ABOUT FATHER

If the father is not able to complete this section, please tick the box below and try and fill this section as much as possible.

It is not possible for the father to complete the questionnaire □

1. Father's date of birth
   □□ □□ □□
   Day    Month    Year

2. Father's height (in meters or feet and inches)

3. Father's own birth weight – if known (in kilograms or pounds)

4. Does the father smoke?
   □       □
   Yes    No
   If yes, how many cigarettes per day does he smoke?
   □       □       □
   1-9     10-20   >20

5. Occupation.
   □       □
   Paid employment    Unemployed

Current or previous job title description
6. Ethnic origin

☐ White
☐ Black Caribbean
☐ Black African
☐ Black other
   please specify

☐ Chinese
☐ other
   Please specify

7. Which of the following qualifications has the father obtained?

☐ GCSEs or equivalent
☐ A levels or equivalent
☐ degree/ post A level education
☐ other please specify
SECTION C – INFORMATION ABOUT BABY

Some of the information may be obtained from your baby’s booklet.

1. Baby’s date of birth

□□ □□ □□
Day Month Year

2. a) Baby’s birth weight (kilograms or pounds)


b) Baby’s length at birth (centimetres or inches) – if known


c) Baby’s head circumference at birth (centimetres or inches) – if known


3. Baby’s gender

□□
Male Female

4. Baby’s gestational age (weeks)

ie. At how many weeks of pregnancy did you give birth?


5. Number of babies delivered (ie. 1 for single, 2 for twins etc)


If you have any extra information that you may wish to add, please write it here.
THANK YOU FOR COMPLETING THIS QUESTIONNAIRE.

IT SHOULD PROVIDE US WITH VERY VALUABLE INFORMATION AS WELL AS BENEFITTING FUTURE MOTHERS AND THEIR BABIES.
Dear

I am writing to ask for your help in a study into maternal nutrition and pregnancy outcome that is being carried out by the University of Surrey.

We are interested in the mother’s diet before and during her pregnancy, and how that affects the outcome of the pregnancy (such as birth weight and gestational age). In order to test this effect, we have to ask about other factors eg. mother’s background, father’s background and information about the pregnancy. This information, in addition to questions regarding maternal diet, will allow us to assess the relationship of maternal diet and the outcome of pregnancy.

We have chosen to look at all births from St. Luke’s Surgery in the past year, and I understand that you have given birth during that time; hence your name has been included in this selection.

All partners at St. Luke’s are in agreement to take part in this study.

I realize how busy you are with a new baby, but I would be very grateful if you could spare the time to fill in the enclosed questionnaire, it should take about 15 minutes of your time.

The results of this study will help us in conducting further studies. Moreover, we hope they will benefit future mothers and their babies.

Participation in this study is entirely voluntary. If you choose not to take part, this will in no way affect the care you receive in the future. If you do decide to take part in this study, please fill in and sign both consent forms provided, as well as answering the questionnaire. Please return the questionnaire in the pre-paid envelope marked questionnaire and one consent form in the pre-paid envelope marked consent form as soon as possible (preferably within one months time). The second consent form, as well as the information sheet is for you to keep.

The information you give to us is treated in strict confidence, and you will be identified by a code number only. No information about your name or address will be given to any members of the public or press. The results of this survey will be shown as statistics only.

This study has been approved by the South West Surrey Local Research Ethics Committee.

Thank you in advance for your help.

Yours faithfully,

Supported By
Dr D R Elliott
Dr J G Williams
Dr A P Cross
Dr J N Barnardo
Dr Mary Morrison
P.S If you have any queries regarding the questionnaire, please do not hesitate to contact

Buthaina Al-Rasasi

EIHMS
Duke of Kent Building
Level 5
University of Surrey
GU2 5TE

Telephone: 01483 300 800
Ext 4580

(Calls preferably between 9:00 a.m and 5:00 p.m)
CONSENT FORM

MATERNAL NUTRITION AND PREGNANCY OUTCOME

1. I CONFIRM THAT I HAVE READ AND UNDERSTOOD □ THE INFORMATION SHEET DATED 23/10/20 FOR THE ABOVE STUDY.

2. I UNDERSTAND THAT MY PARTICIPATION IS VOLUNTARY □ AND THAT WITHDRAWAL FROM THE STUDY AT ANY STAGE WILL NOT AFFECT MY CARE.

3. I AGREE TO TAKE PART IN THIS STUDY □

NAME OF PARTICIPANT _____________________________
DATE _____________________________
SIGNATURE _____________________________

NAME OF RESEARCHER Buthaina Al-Rasasi
DATE 11-02-2000
SIGNATURE _____________________________
Dear Madam,

I contacted you several months ago to ask for your help with a study on Nausea and Vomiting in Pregnancy, Maternal Nutrition and Pregnancy Outcome.

My records show that I have not yet received your questionnaire.

If you have already sent your questionnaire, please ignore this letter.

However, if not, please fill in the consent form and questionnaire and post them in the pre paid envelopes provided, within two weeks if possible.

If you require a new questionnaire, please contact me at the address below.

I would really appreciate it if you could take part in this study. It should only take 15 minutes of your time.

The results of this study should help future mothers and their children.

Yours Faithfully,

Buthaina Al-Rasasi
EIHMS,
Duke of Kent Building,
University of Surrey,
GU2 5TE

Tel: 01483 300 800
Ext. 4580

Or

Mobile: 0403 312 834.
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<td>15. unitspre</td>
<td>numeric</td>
<td>units alcohol/day during pregnancy</td>
<td>999</td>
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<td>16. etohpreg</td>
<td>numeric</td>
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<td>numeric</td>
<td>units alcohol per week during pregnancy</td>
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<td>18. nochild</td>
<td>numeric</td>
<td>number of children excluding this child</td>
<td>999</td>
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<td>did mom take any nutritional supplements pre-pregnancy</td>
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<td>20. suppreg</td>
<td>numeric</td>
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<td>21. nvp did mom suffer from nvp</td>
<td>numeric</td>
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<td>22. type type of nvp</td>
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<td>1= mild, 2= moderate, 3= severe</td>
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<td>23. time time of day suffered</td>
<td>numeric</td>
<td>1= only mornings, 2= only nights, 3= few hours, 4= all day</td>
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<td>24. stagenvp when did nvp start (weeks)</td>
<td>numeric</td>
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<td>999</td>
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<td>25. long how long did nvp last (weeks)</td>
<td>numeric</td>
<td>none</td>
<td>999</td>
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<td>26. hospital was mom hospitalized due to nvp</td>
<td>numeric</td>
<td>1= yes, 2= no</td>
<td>999</td>
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<td>27. eat how did nvp affect mother’s eating</td>
<td>numeric</td>
<td>1= more, 2= less, 3= the same</td>
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<td>Variable name</td>
<td>Definition</td>
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<td>28. avoid</td>
<td>did nvp cause mom to avoid any foods</td>
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<td>1 = yes</td>
<td>999</td>
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<td>29. more</td>
<td>did nvp cause mom to eat more of some foods</td>
<td>numeric</td>
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<td>did mom seek help for the nvp</td>
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<td>did mom have any aversions</td>
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<td>did mom receive any dietary advice</td>
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<td>34. ethnicm</td>
<td>mom's ethnic origin</td>
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<td>1 = white</td>
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<td></td>
<td>1= upto 9,999</td>
<td>2= 10,000-19,000</td>
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<td>3= unemployed</td>
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<td>43.</td>
<td>ethnicd</td>
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<td>1= white, 2= black caribbean</td>
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<td>3= black african, 4= black other</td>
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<td>5= chinese, 6= indian, 7= pakistani</td>
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<td>8= bangladeshi, 9= other</td>
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<td>44.</td>
<td>quald</td>
<td>numeric</td>
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<td>4= post degree, 5= none</td>
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9 February 2000

Miss B Al-Rasasi
Mole 4
Surrey Court
University of Surrey
GUILDFORD
GU2 5XH

Dear Miss Al-Rasasi

Morning sickness, maternal nutrition and pregnancy outcome: A Questionnaire Survey

Further to my letter of 18 January I am pleased to inform you that at its meeting held on 25 January 2000 the Ethics Committee ratified Chairman’s Action and approved the above study.

The Committee’s decision was based on its review of your Application Form dated 23 November 1999 which enclosed a Protocol, Information letter, Consent Form, Questionnaire and GP agreement to the study. The Committee also took account of your response to the Committee’s concerns set out in your letter to me dated 15 December 1999 and the Information Letter, Consent Form and revised questionnaire which you enclosed with that letter.

The Committee’s approval is subject to the following conditions:

(i) No deviations from or changes of the protocol should be initiated without prior written agreement of the Committee.
(ii) The Committee should be provided with a copy of the report on the outcome of the study or a copy of any published document.
(iii) If the start of the project is delayed by more than one year from the date of approval the protocol should be resubmitted to the Committee for further review.

Yours sincerely

JOHN KERSLAKE
Co-ordinator
15 February 2000

Miss Buthaina Al-Rasasi
European Institute of Health & Medical Sciences
University of Surrey

Dear Miss Al-Rasasi

**Morning Sickness, Maternal Nutrition and pregnancy Outcome: A Questionnaire Survey (ACE/2000/11/EIHMS)**

I am writing to inform you that the Advisory Committee on Ethics has considered the above protocol and the subsequent information supplied and has approved it on the understanding that the Ethics Guidelines are observed.

The letter of approval relates only to the study specified in your research protocol (ACE/2000/11/EIHMS). The Committee should be notified of any changes to the proposal, any adverse reactions and if the study is terminated earlier than expected (with reasons). I enclose a copy of the Ethics Guidelines for your information.

Date of approval by the Advisory Committee on Ethics: 15 February 2000
Date of expiry of Advisory Committee on Ethics approval: 14 February 2005

Please inform me when the research has been completed.

Yours sincerely

Helen Schuyleman (Mrs)
Secretary, University Advisory Committee on Ethics
Registry

cc: Professor L J King, Chairman, ACE
    Dr Jane Coad, EIHMS
    Dr Jane Morgan, SBS
Morning Sickness in Pregnancy

Morning sickness is very common in pregnancy. It is very likely that you have suffered from it, or know someone who has. Morning sickness is also known as nausea and vomiting in pregnancy, as it can occur anytime during the day, not only in the morning.

Have you ever wondered why some women suffer from nausea and vomiting in pregnancy and others do not? What causes these symptoms? What can be done to reduce it? What effect does it have on the outcome of pregnancy? A study is being carried out by the University of Surrey and doctors from Fairlands, Dapdune and St.Luke’s Medical Centres, which is looking to answer these questions.

We are looking for women who are suffering from morning sickness, and those women who are not, so that we can compare the results. The results of the study should help other pregnant women.

What does this study involve?

♦ A short interview with a dietitian about your social and dietary history. Your weight and body fat will be measured. This should not last more than 15 minutes.

♦ You will be asked to keep a record of your food intake for one week in your early pregnancy and for another week towards the end of your pregnancy.

♦ If you suffer from morning sickness, you will be asked to record your symptoms.

♦ On delivery, the weight of your baby, and the placenta will be recorded by the midwife.

All information collected in the study will be kept strictly confidential, and will not be disclosed in any way that would allow identification of you or your family. Participation in this study is entirely voluntary. If you chose not to take part, this will not affect the care you receive in the future.

Thank you for your co-operation.

For further information, please contact:

Beth Al-Rasasi

Telephone: 01483 300 800 ext 4580

Address: EIHMS, Duke of Kent Building
University of Surrey
Guildford, GU2 7TE

e-mail: b.al-rasasi@surrey.ac.uk
CONSENT FORM

Nausea and vomiting in pregnancy, maternal nutrition and
Pregnancy outcome: A prospective study.

Researcher: Buthaina Al-Rasasi
EIHMS, Duke of Kent Building, University of Surrey, GU2 7TE
01483 300 800 EXT 4580

1. I confirm that I have read and understand the information sheet
for the above study.

☐

2. I understand that my participation is voluntary and that I am free
to withdraw at any time, without giving any reason, without my
medical care or legal rights being affected.

☐

3. I understand that sections my medical notes may be looked at
by the researcher only, where it is relevant to the research. I
give permission for the researcher to have access to my records.

☐

4. I agree to take part in the study.

☐

Name of Volunteer ______________________________
Date __________________________
Signature __________________________

Name of Researcher B. Al-Rasasi
Date 23/5/2005
Signature __________________________

Please complete all three consent forms, keep one with you, and send the other two in the
pre-paid envelope provided. One will be kept in your medical records, and the other is for
the researcher.
To enable me to accurately assess your diet, please complete this food and drink diary for 7 days and send it back to me in the pre-paid envelope provided.

- Record the quantities as weight (using the scales provided) where possible, or in handy measures eg. 1 tablespoon, 1 teaspoon.

- For ready made items eg. Carton of yoghurt, the weight Can be found on the package eg 30g pot yoghurt.

- If you have a meal outside the home, try and estimate The quantity, if not, describe the meal, 1 beef burger And 1 medium french fries.

- Only record food that is eaten/consumed. Otherwise, indicate how much was left Eg. Only ate half the meal.

- Remember to record all drinks that are taken.

- The more information that you are able to Provide, the more accurate the assessment.

- It is important that you do not change your Regular diet during this week.
<table>
<thead>
<tr>
<th>Time</th>
<th>Food description</th>
<th>Quantity</th>
<th>For research use Only</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time</th>
<th>Food description</th>
<th>Quantity</th>
<th>For research use only</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
## Day 7

<table>
<thead>
<tr>
<th>Time</th>
<th>Food Description</th>
<th>Quantity</th>
<th>For Research Use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

### For example:

**Breakfast:**
- 50 g cornflakes
- 2 teaspoons sugar
- 100 ml semi-skimmed milk
- Cup of tea, no sugar

**Mid-morning:**
- 1 digestive biscuit

**Lunch:**
- Sandwich:
  - 170g egg
  - 1 teaspoon mayonnaise
  - 2 slices wholemeal bread
- 160g pot fromage frais, low-fat

**Mid-afternoon:**
- 100g roast chicken
- 2 tablespoons peas
- 1 160g orange
<table>
<thead>
<tr>
<th>Time</th>
<th>Food description</th>
<th>Quantity</th>
</tr>
</thead>
</table>

**DAY 2**

<table>
<thead>
<tr>
<th>Time</th>
<th>Food description</th>
<th>Quantity</th>
</tr>
</thead>
</table>

**DAY 5**

<table>
<thead>
<tr>
<th>Time</th>
<th>Food description</th>
<th>Quantity</th>
</tr>
</thead>
</table>
SYMPTOM DIARY

Name

Date Started symptom diary

Date completed symptom diary

Researcher Buthaina Al-Rasasi
Instructions

- Please fill this diary on a daily basis, until the nausea and vomiting resolves.

- For days that are symptom free, the diary does not need to be completed.

- Please make sure to date all entries.

- Please write down the time you wake up and the time you go to bed.

- Your symptoms should be recorded on a half hourly basis.

- If you feel nauseous, write the letter 'N'.

- If you vomit, write the letter 'V'.

- If you suffer from retching, write the letter 'R'.

- Follow the example on the following page.

- If you have no symptoms, then leave the box empty.

- Some other names for nausea, vomiting and retching include

<table>
<thead>
<tr>
<th>Nausea</th>
<th>Vomiting</th>
<th>Retching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feeling sick</td>
<td>throwing up</td>
<td>heaving</td>
</tr>
<tr>
<td>Queasy</td>
<td>spewing</td>
<td>gagging</td>
</tr>
<tr>
<td>Bilious</td>
<td>chucking up</td>
<td>dry boak</td>
</tr>
<tr>
<td>Off colour</td>
<td>regurgitating</td>
<td>dry heaves</td>
</tr>
<tr>
<td>Green at the gills</td>
<td>puking</td>
<td></td>
</tr>
<tr>
<td>Under the weather</td>
<td>barfing</td>
<td></td>
</tr>
<tr>
<td>Sick at the stomach</td>
<td>chundering</td>
<td></td>
</tr>
<tr>
<td>Waterbash</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- In the end of the diary, there is a section about any measures which you tried to help alleviate the nausea and vomiting, this could include foods, medication, alternative therapies. Please mention if any of them worked for you.

- Once your symptoms have resolved, and you have had two weeks symptom free weeks, please send the symptom diary in the pre-paid envelope provided.
Day | Mo Tue We Thu Sat Sun
---|---|---|---|---|---|---
Time | | | | | | |
01:00 | | | | | | |
01:30 | | | | | | |
02:00 | | | | | | |
02:30 | | | | | | |
03:00 | | | | | | |
03:30 | | | | | | |
04:00 | | | | | | |
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09:00 | | | | | | |
09:30 | | | | | | |
10:00 | | | | | | |
10:30 | | | | | | |
11:00 | | | | | | |
11:30 | | | | | | |
12:00 | | | | | | |
12:30 | | | | | | |

Time woke up: [ ]

Time went to sleep: [ ]
Measures used to help alleviate Nausea and Vomiting
Thank you for completing this diary, it should provide us with valuable information.

If you have any queries, please contact
Buthaina Al-Rasasi
Tel 01483 300 800 ext 4580
EIHMS, Duke of Kent Building, University of Surrey, Guildford, GU2 5TE
e-mail: b.al-rasasi@surrey.ac.uk
SECTION A - INFORMATION ABOUT MOTHER

1. Date of birth
   □ □ □ □ □ □ □ □
   Day       Month       Year

2. Marital status
   □ □
   Single       Living with husband/partner

3. Pre-pregnancy weight (in kilograms or stones and pounds)
   ____________________________

4. Your birth weight (if known)
   ____________________________

5. Your height (in meters or feet and inches)
   ____________________________

6. a) Occupation.
   □ □
   Paid employment       Full time mother

   Current or previous job title description
   ____________________________

7. a) Did you smoke prior to your pregnancy?
   □ □
   Yes       No

   If yes, how many cigarettes per day did you smoke?
   □ □ □
   1-9       10-20       >20
b) Did you smoke during your pregnancy?

☐  ☐  ☐
Yes  ☐  No

If yes, how many cigarettes per day did you smoke?
☐  ☐  ☐
1-9  10-20  >20

8. a) Did you drink alcohol prior to your pregnancy?

☐  ☐  ☐
Yes  ☐  No

If yes, how many units per day did you drink? (1 unit = half a pint of beer, 1 glass of wine, 1 measure of spirit such as gin or vodka)
☐  ☐  ☐
1-2  3-4  >4

b) Did you drink alcohol during your pregnancy?

☐  ☐  ☐
Yes  ☐  No

If yes, how many units per day did you drink? (1 unit = half a pint of beer, 1 glass of wine, 1 measure of spirit such as gin or vodka)
☐  ☐  ☐
1-2  3-4  >4

9. Is this baby your first child?

☐  ☐  ☐
Yes  ☐  No

If no, please write the number of children that you have, and their dates of birth (d.o.b) (excluding this baby)
10. a) Did you take any nutritional/dietary supplements pre-pregnancy?

□ □
Yes □ No □
If yes, please specify

b) Did you take any nutritional/dietary supplements throughout the pregnancy?

□ □
Yes □ no □
If yes, please explain eg Iron, Vitamin C, Multi Vitamins, and when did you start taking them.

11. Did you suffer from nausea and/or vomiting during this pregnancy?

□ □
Yes □ no □
If no, please go to question 19.

If yes, was it
□ □ □
Mild (nausea) moderate (nausea and vomiting) severe (hyperemesis gravidarum)

12. At what time of day did the nausea and/or vomiting tend to occur?

□ □ □ □
Only Mornings only nights a few hours/day the whole day (24hrs)

13. a) At what stage in your pregnancy did the nausea and vomiting start?
b) How long did the period of nausea and/or vomiting last (days, weeks, months)?


14. Were you hospitalised due to the nausea and/or vomiting?

Yes no

15. Did the nausea and vomiting cause you to eat

more less the same

16. a) Did the nausea and/or vomiting cause you to avoid certain foods?

Yes no

If yes, please explain which foods you avoided.

b) Were any foods that you ate more of as they helped reduce the nausea and/or vomiting?

Yes no

If yes, please explain which food you ate more of.

17. a) Did you seek help for the nausea and/or vomiting?

Yes no
b) Was this (please tick one or more)

- [ ] Anti sickness Tablets
- [ ] alternative therapy (please specify)
- [ ] other (please specify)

18. Did any foods, medication, alternative remedies, help to alleviate the symptoms? Please explain.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

19.a) Did you suffer from dietary aversions during pregnancy?

- [ ] Yes
- [ ] no

Please explain (ie the foods you avoided and why)
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

b) Did you crave any foods during your pregnancy?

- [ ] Yes
- [ ] no

Please explain (ie the foods you craved and why)
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
20. Did you receive any dietary advice during pregnancy?

□ Yes □ no

If yes, who was this from, (please tick one or more)
- Doctor
- Midwife
- Dietitian
- Magazine
- Book
- Relative
- Friend
- Leaflets eg. From supermarkets
- Other (please specify) ____________________________

21. Ethnic origin

□ White □ Indian
□ Black Caribbean □ Pakistani
□ Black African □ Bangladeshi
□ Black other
- please specify ________________
□ Chinese
□ Other
- Please specify ________________

22. Which of the following qualifications have you obtained?

□ GCSEs or equivalent
□ A levels or equivalent
□ degree/post A level education
□ Other please specify

23. Approximate household income/year before tax is deducted is in the range

□ Upto £9,999
□ £10,000-£19,000
□ £20,000-£29,000
□ £30,000-£39,000
□ over £40,000
SECTION B – ABOUT FATHER

If the father is not able to complete this section, please tick the box below and try and fill this section as much as possible.

It is not possible for the father to complete the questionnaire  

1. Father’s date of birth
   □□ □□ □□
   Day    Month   Year

2. Father’s height (in meters or feet and inches)

   ___________________________

3. Father’s own birth weight – if known (in kilograms or pounds)

   ___________________________

4. Does the father smoke?
   □  □
   Yes  No

   If yes, how many cigarettes per day does he smoke?
   □  □  □
   1-9   10-20   >20

5. Occupation.
   □  □
   Paid employment  Unemployed

   Current or previous job title description
6. Ethnic origin

☐ White
☐ Black Caribbean
☐ Black African
☐ Black other
   please specify ________________________

☐ Chinese
☐ other
   Please specify ________________________

7. Which of the following qualifications has the father obtained?

☐ GCSEs or equivalent
☐ A levels or equivalent
☐ degree/ post A level education
☐ other please specify

____________________________
Miss B Al-Rasasi  
Mole 4  
Surrey Court  
University of Surrey  
GUILDFORD  
GU2 5XH  

Dear Miss Al-Rasasi  

Nausea and vomiting in pregnancy, maternal nutrition and pregnancy outcome: A prospective study  

I am pleased to inform you that at its meeting held on 16 May 2000 the Ethics Committee approved the above study.  

The Committee's decision was based on its review of your Application Form dated 28 March 2000 including appendix to 11 inclusive.  

The Committee's approval is subject to the following conditions:  

(i) No deviations from or changes of the protocol should be initiated without prior written agreement of the Committee.  
(ii) The Committee should be provided with a copy of the report on the outcome of the study or a copy of any published document.  
(iii) If the start of the project is delayed by more than one year from the date of approval the protocol should be resubmitted to the Committee for further review.  
(iv) The Consent Form (appendix 8) and the Information Sheet (appendix 10) should both be produced on headed paper.  

Yours sincerely  

JOHN KERSLAKE  
Co-ordinator
Our Ref: EC51/00

7 August 2000

Ms B Al-Rasasai
EIHMS
Duke of Kent Building
University of Surrey
GUILDFORD
GU2 7TE

Dear Ms Al-Rasasai

Nausea and Vomiting in Pregnancy, Maternal Nutrition and Pregnancy Outcome: A prospective study

Thank you for your letter of 4 July.

I am pleased to be able to inform you that the Vice-Chairman has approved the extension of recruitment for this study to include St Luke’s Surgery and Dapdune House Surgery.

The Vice-Chairman’s decision is subject to ratification by the Committee when it meets on 12 September. I will be in touch with you again shortly after that date.

Yours sincerely

JOHN KERSLAKE
Co-ordinator
05 July 2000

Miss Buthaina Al-Rasasi
European Institute of Health & Medical Sciences
University of Surrey

Dear Miss Al-Rasasi

**Nausea and vomiting in pregnancy, maternal nutrition and pregnancy outcome: A perspective study (ACE/2000/52/EIHMS)**

I am writing to inform you that the Advisory Committee on Ethics has considered the above protocol and the subsequent information supplied and has approved it on the understanding that the Ethics Guidelines are observed.

The letter of approval relates only to the study specified in your research protocol (ACE/2000/52/EIHMS). The Committee should be notified of any changes to the proposal, any adverse reactions and if the study is terminated earlier than expected (with reasons). I enclose a copy of the Ethics Guidelines for your information.

Date of approval by the Advisory Committee on Ethics: 05 July 2000
Date of expiry of Advisory Committee on Ethics approval: 04 July 2005

Please inform me when the research has been completed.

Yours sincerely

Helen Schuylenman (Mrs)
Secretary, University Advisory Committee on Ethics
Registry

cc: Professor L J King, Chairman, ACE
    Dr Jane Coad, Principal Investigator, EIHMS
    Dr Jane Morgan, Principal Investigator, SBS
    Dr J Nichols, Co-Investigator, Fairlands Practice, Guildford