The Impact of Anaemia on Maternal Health in PNG. **Odette Douma**

Maternal health is a priority in Papua New Guinea (PNG) as part of its push to meet the Millennium Development Goals (Morgan & Byrne 2011). Despite this, maternal death rates in PNG continue to be the highest in the Pacific Area with 870/100 000 women dying annually (Hinton & Earnest 2010). One of the important factors that contribute to this burden of disease is anaemia (de Benoist et al 2008). This paper discusses the impact that anaemia has on maternal health in PNG as well as its consequences for infant morbidity and mortality. Some of the more prevalent causes of this condition are examined as well as the comprehensive approach required its prevention and treatment. Finally, it concludes that all women of reproductive age should be included in the interventions to combat anaemia in order to reduce maternal morbidity and mortality.

Anaemia is due to a reduction in the haemoglobin levels in the blood. What is considered to be normal concentration of haemoglobin varies between men and women and between non pregnant women and pregnant women. The haemoglobin concentration threshold for men is 13g/dl, for non pregnant women 12g/dl, pregnant women 11g/dl and for children between 11g/dl and 12dg/l depending on age (de Benoist et al, 2008). In their Global Database on Anaemia, the World Health Organization (WHO) has classified the impact that anaemia has on its member countries. When less than 4 % of the population groups surveyed (i.e. children, non pregnant women of reproductive age and pregnant women) are affected, anaemia is not considered to be a public health issue. For up to 20% it is considered a mild public health issue, between 20-39.9% a moderate health issue and over 40% is considered to be a severe public health issue. Therefore according to WHO classification, anaemia is a severe public health concern in PNG because it affects more than 40% of these populations groups (de Benoist et al 2008).

There are a number of causes of anaemia, some of which co-exist. These include; dietary deficiencies due to a poor intake of iron, folate, Vitamin A and B12, as well as malaria and parasite infections such as hookworm (Savage et al 2007). However, women have an additional demand on their bodies because of menstruation and pregnancy that puts them at greater risk of developing anaemia (Viteri 1994). Menstruating women, including teenage girls, require on average between 1.36 and 1.73mg of absorbed iron per day. A pregnant women’s iron requirement increases as her pregnancy progresses to more than double this, from between 3.54 and 8.80 mg per day (Viteri 1994). From the second trimester, there is a steady increase in the plasma volume which results in haemodilution because of the “differential rise between the red cell mass and plasma volume” (Amoa 1998, p 124). This causes a decrease in haemoglobin levels reaching the lowest point at 34 weeks (Amoa 1998). To increase the red cell mass requires iron (Amoa 1998) at an amount that cannot be met through diet alone (Viteri 1994). In PNG the diet is largely carbohydrate based and there is often little or no protein food or food rich in iron consumed. (Tracer 1997).The end result is that women are either already anaemic at the start of the pregnancy so have no iron reserves to draw upon (Viteri 1994) or they develop anaemia during the pregnancy due to the drop in haemoglobin levels (Amoa1998). In Port Moresby (POM) General Hospital more than 40% of women attending the antenatal clinic have haemoglobin lower than 10g/dl at some stage in their pregnancy with 8% having levels less than 8g/dl (Mola et al 1999). Global averages of anaemia in pregnant women are about 42% (Morgan 2008). Furthermore the more pregnancies a woman has the more likely she is to develop anaemia (Savage et al 2007).

Anaemia is usually classified as mild, moderate or severe. In the developing world a person with a haemoglobin of less than 10g/dl is considered to be anaemic (Amoa et al 1998), although WHO defines anaemia in pregnancy as a haemoglobin of less than 11g/dl and severe anaemia a haemoglobin of less than 7g/dl (Savage et al 2007). Mild to moderate anaemia causes symptoms such as fatigue and weakness which in turn impacts on a women's ability to work productively and care for her family (Buseri et al 2008). Severe anaemia affects a women's ability to recover from moderate blood loss during labour and puts women at risk of dying due to postpartum haemorrhage (Buseri et al. 2008). According to Viteri (1994) anaemia is the major contributor for 20-40% of such deaths. Severe anaemia also lowers a women's resistance to infections and makes her more susceptible to disease (Buseri et al 2008) due to a decrease in lymphocyte stimulation (Allen 1997). A haemoglobin level of less than 4g/dl can result in cardiac failure during or soon after delivery (Buseri et al 2008).

The impact of anaemia is not limited just to the mother as anaemia has also been shown to impact on the growth and development of the foetus. This can result in low birth weights (LBW), premature births and neonatal deaths (Burseri et al 2008). The risk of low birth weight and stillbirth is evident even when the mother is only anaemic in the first half of her pregnancy (Viteri 1994.). A study lead by Mola et al (1999) at POM General Hospital found that the incidence of LBW was almost 40% when the haemoglobin levels were less than 6g/dl as opposed to 8% when haemoglobin levels where between 10- 10.9g/dl. The number of stillbirths was also higher at 9.4% (or 94 per 1,000 births) when the haemoglobin levels were less than 6g/dl as opposed to 1.4% when haemoglobin levels where between 10- 10.9g/dl (Mola et al 1999). Maternal anaemia impairs the oxygen delivery to the foetus which in turn retards the intrauterine growth of the baby (Buseri et al 2008). Allen (1997) points out that there is a negative correlation at 9-11 weeks gestation between maternal haemoglobin and human chorionic gonadotropin and placental lactogen. Again at 18 weeks gestation the placental volume negatively correlates to the maternal haemoglobin. The placenta's increased volume is due to hypoxia in the anaemic mother. The study by Mola et al (1999) also found that there was an increase in the likelihood of meconium stained amniotic fluid (this is an indicator of foetal distress), when the mother was severely anaemic (Mola et al 1999). The babies of anaemic mothers are born with low iron reserves. This makes them at risk of developing anaemia which makes them more susceptible to infections - resulting in an increased risk of morbidity and mortality (Buseri et al 2008). Allen (1997, p97) reports that earlier studies have found this to be most significant for the infant at around 4-6 months when the “destruction of foetal haemoglobin has ended and breast feeding or weaning puts stress on the infants iron store”. This perpetuates a continuous cycle for the female starting life with a low birth weight, being undernourished during childhood into adulthood (Steketee 2003), not afforded equality of care due to her gender (Hinton & Earnest 2010) and finally entering the pregnant state in poor health with little or no iron reserves. Consequently this leads to the subsequent low birth weight of the next generation (Steketee 2003).

As referred to earlier there are many potential causes of anaemia (Savage et al 2007). In order to make informed decisions regarding treatment and properly utilise resources for the control of anaemia it is necessary to determine what the predominant cause is. To that end a number of studies have been undertaken. One such study compared the haemoglobin of women attending an antenatal clinic in an area where malaria is endemic – Madang to a clinic in the Highlands at Goroko, a non malarias area where both populations had a similar nutritional status (Bradin & Piper 1997). These findings suggested that in malarias areas malaria appears to be the primary cause of maternal anaemia. In Madang 89% of the women were anaemic as opposed to Goroko where 29.2% were anaemic with severe anaemia occurring in 1in 5 pregnancies in Madang and in only 1 in 100 pregnancies in Goroko (Bradin & Piper 1997). The study also showed that in malarias areas primigravidae have higher incidences of anaemia than multigravidae (Bradin & Piper 1997). This despite the fact that in normal circumstance a multigravidae is more likely to develop anaemia because of the heavy toll pregnancy has upon a women’s iron stores (Allen 1997). One of the reasons for this is that primigravidae are more susceptible to Plasmodium falciprum malaria (Savage et al 2007), due to a lowered immune response (Mutabingwa, 1994). Although the risk of low birth weight due to anaemia had been previously established the authors of this study discovered that malaria related anaemia compounded the risk of low birth weight (Bradin & Piper 1997). The increased risk of low birth weight for women in Madang was between 16%-21% for primigravidae with a haemoglobin below 13g/dl and from 7%-9% increased risk for multigravidae. This is due most likely to malaria parasitaemia of placenta and hypertrophy of the placenta in severe anaemia (Bradin & Piper 1997).

Studies have also shown that low haemoglobin levels provide population groups some immunity from malaria (Kabyemela et al 2008). This gives rise to some debate as researchers try to determine if it is beneficial to treat a pregnant woman for anaemia thereby make her more susceptible to malaria and its risk to her and the foetus health (Steketee 2003). A study of pregnant women by Mendez et al (1994) compared the impact of malaria on haemoglobin levels on a group being treated with iron and a group receiving a placebo. The results showed that there was a greater impact by malaria on the haemoglobin level of women at 36 weeks pregnancy of those receiving treatment. Within the group of women receiving treatment, their haemoglobin fell more markedly from 10.5g/dl – 9.9g/dl as opposed to the women not being treated 9.6g/dl – 9.4g/dl, however, the women receiving treatment recovered their haemoglobin levels more quickly than the not treated group. Mendez et al (1994) believes that the improvement in haemoglobin level outweighs the risk of lowered malaria immunity. Nevertheless Kabyemela et al (2008) contends that further randomised trials need to be conducted on pregnant women in order to provide treatment guidelines that give the best response with the least risk.

Initially it was concluded that in malarias areas the primary cause of anaemia was malaria infection (Brabin & Piper 1997). However, a more recent study conducted in two more remote PNG communities in 2007 found that even in holoendemic malarias areas where malaria is a key factor to anaemia, nutrition and other factors played an important role (Morgan 2008). Although the women who tested positive for malaria had lower haemoglobin levels than those who tested negative, when malaria was excluded from the analyses, it was found that in the negative group 89.7% of non pregnant women had a haemoglobin of less than 12g/dl and 83.5% of pregnant women had a haemoglobin less than 10g/dl (Morgan . 2008). Brabin et al (2001. p604) had also revisited this earlier conclusion by examining previous cross sectional, longitudinal and case-control studies and estimating that even in holoendemic malarias areas, in the primigravidae with anaemia, 9 deaths are related to severe anaemia malaria and 41 deaths to non malaria anaemia in every 100 000 live births.

Nutritional deficiencies contribute to anaemia by impairing the immune response. In the case of moderate anaemia it is particularly iron deficiency that contributes the most to maternal mortality (Bradin et al 2001). The WHO attributes 60% of anaemia due to iron deficiency in non malarias areas and 50% of anaemia due to iron deficiency in malarias areas (Black et al 2008).

Nutritional deficiencies have also been found to increase the risk of parasite infections such as hookworm (Steketee 2003). Hookworm in itself is a significant contributing factor to the low haemoglobin levels in PNG. Hookworm infestation causes intestinal bleeding that leads to anaemia and studies have shown that even women with a light infestation have lower haemoglobin levels than uninfected women (Brooker 2008).

Finally there are socioeconomic reasons that compound the causes of anaemia borne out by the fact that it is most prevalent among the poor in developing countries (Viterri 1994). Tracer (1997) conducted a study amongst women in a subsistence farming community in PNG. The study compared the haemoglobin levels of women in wage earning households (approximately 15% of the community) and those households without a wage to determine what impact socio-economic status had on maternal haemoglobin levels. They found that wage earners had higher haemoglobin levels- 0.6g/dl difference in mean values. The findings were significant with regards to those pregnant without a household income in that there was a 1.3g/dl differences in mean values in their haemoglobin levels as opposed to pregnant with a household income. The study also found that over 50% of pregnant non wage income women were severely anaemic. One could also hypothesize that socioeconomic reasons due to the geographical location may have contributed to the results in Brabin & Piper's (1997) earlier study on maternal anaemia and malaria. Madang and Goroko are urban centres which provide opportunity for employment and a better standard of living as opposed to the two remote communities in Morgan's (2008) study where one was an island community and the other in the Sepik.

Without dispute all would agree that the reduction of anaemia is imperative to improve maternal health and consequently reducing the risk of infant morbidity and mortality (Bursei et al 2008). Previously women suffering the effects of severe anaemia could be treated with blood transfusions, however due to an increase in the prevalence of HIV this is no longer regarded as a desirable option (Buseri et al 2008, Mola et al 1999). However the treatment of anaemia is a complex issue because of the contributing factors which vary between communities due to geography, disease prevalence and socioeconomic status (de Bonoist et al 2008; Viteri, 1994). Therefore the WHO recommend in their report that strategies to address the causes and treatment of anaemia should be designed to suit the local conditions (de Bonoist et al 2008). In malarias areas which include much of PNG, Brooker (2008) recommends that Intermittent Preventative Treatment of Malaria, iron supplements, and antihelminth treatment should be part of antenatal care. These interventions have all been included for pregnant women by the Burnett Institute in their policy report "Improving maternal, newborn and child health in PNG through Family and

Community Health Care". The report has also rated these interventions as "very good" value for money (Morgan & Byrne 2011). McGready (2010) also includes the distribution of insecticide impregnated bed nets for the prevention of malaria. This was also incorporated as part of the interventions in the "Enhancing Pregnancy Outcomes" EPO research program based in PNG (Morgan 2008). McGready (2010) emphasizes that pregnant women have a right to effective treatment. Therefore McGready (2010) disputes the use of chloroquine and sulfadoxine-pyrimethamine (SP) in the treatment and prevention of malaria as they do not eliminate all parasites and prevent reinfection. Morgan (2008) reports that although studies have shown a high resistance to chloroquine it was still in use as part of the current policy in PNG for malaria prophylaxis. According to Poespoprodjo et al (2008) chloroquine resistance was first reported more than 40 years ago but remained the standard treatment in pregnant women until 2006. Morgan (2008) did find, however, that there was still benefit in the use of SP drugs (which are given early in the pregnancy just after quickening and again between 30-38 weeks) as there was a reduction in malaria infection from 41% to 20%. McGready (2010) believes that the WHO guidelines should be followed which recommends an artemisinin-based combination therapy that is safe for pregnant women as repeating treatments with ineffective drugs is harmful (McGready 2010).

Including micronutrients as part of the interventions to prevent anaemia saw some positive results in the EOP program. All women of reproductive age were included in the distribution of micronutrients which included iron, folate acid and Vitamin A (Morgan 2008). In one of the two communities all the women experienced an improvement in their haemoglobin levels, particularly the primigravidae, with an increase in mean haemoglobin of 2.5g/dl .This is significant because a mean increase in haemoglobin of 1g/dl in late pregnancy decreases the risk of maternal deaths (Morgan 2008). It was also believed that the micronutrients had an effect on birth weights as after just four months of interventions there was an increase in birth weights in both study groups (Morgan 2008). Morgan (2008) cites findings from studies in other countries such as Nepal that had similar results. Noteworthy too, is the results for the non pregnant women as the percentage of anaemia amongst this group fell from 91.3% to 83.7% (Morgan 2008). This bears weight to the necessity of including all women of reproductive age in any intervention which improves their health and, as a consequence, enables them to enter pregnancy with better health resulting in less risk of maternal morbidity and mortality thereby improving outcomes for infants (Morgan 2008). This endorses the sentiments expressed by Hinton & Earnest (2010) who believe the view to health care in PNG is too narrow when it focuses too exclusively on antenatal care to lower maternal death rates. Steketee (2003) also supports this concept as this would be a time when the risks of treatment would be at the lowest for both the women and the foetus. However, Steketee (2003) recognises the difficulty of reaching all women of reproductive age, particularly the poor in developing countries as the opportunities for contact are few. Hinton & Earnest (2010) would attribute this lack of opportunity to the low status of women in PNG and the perpetuation of gender inequalities within the PNG health system.

Before researching this paper I had no real knowledge of the impact of anaemia on maternal health. In the course of my volunteer work at the antenatal clinic at POM General Hospital I had at times recorded the haemoglobin levels of some of the patients without realizing what the numerical value meant in real terms for the patient. Researching this paper has been a valuable learning experience. It has taught me that firstly that the causes of anaemia are most prevalent in a vulnerable population group – women with low socioeconomic status. Secondly, that the outcomes have far reaching consequences that can result in morbidity or mortality for both the mother and infant. Finally that some of the preventative and treatment solutions are quite simple and can even be carried out at a community level as the EPO study showed. Having been made aware of some of these issues will enable me to incorporate this information into my teaching sessions here at the Bible College and in my practice as I begin voluntary work as a nurse at one of the local health clinics. It will also be with renewed interest that I will monitor the implementation of the PNG National Health Plan for 2011-2020 that has set a target of reducing maternal mortality by 32% by delivering the interventions listed in the Burnet report (Morgan & Byrne 2011).

In PNG there has been little change in the improvement to maternal health over the last 10-20 years. Anaemia is still a severe public health issue affecting over 40% of this population group. Although preventative and treatment interventions have been identified that can effectively reduce this rate, the high rate of anaemia points to a failure in the delivery of these interventions. The question that must be asked is what stands in the way of effective treatment reaching those that need it most – woman of reproductive age. It is imperative that researchers continue to investigate this dilemma in order to reduce PNG's maternal and infant mortality rate.

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