PNG Med J 1997 Mar;40(1):4-13

Birth defects recognized in 10,000 babies born consecutively in Port Moresby General Hospital, Papua New Guinea

RICHARD DRYDEN[1]

Faculty of Medicine, University of Papua New Guinea, Port Moresby

SUMMARY

A daily record was made of defects recognizable at birth or soon afterwards in 10,000 babies born consecutively at Port Moresby General Hospital, Papua New Guinea, between January 1985 and May 1986. The overall prevalence of birth defects in this series was 1.16%. All of the affected babies were singletons, 27% presented with multiple defects, and 14% were stillborn. There was a predominance of male babies in the series as a whole and more particularly in the group of affected babies (female:male ratios 1:1.15 and 1:1.50 respectively). The parts of the body most commonly affected were the limbs, head and neck, and central nervous system. The majority of the mothers originated from provinces neighbouring Port Moresby, although all the provinces were represented. Defects were more common in babies of mothers from island provinces (1.9%) than from highland (1.1%) or coastal/lowland (1.0%) provinces. The mean birthweight for all the babies in the series for whom records were available was 3.03 kg (SD 0.57), and for the abnormal babies 2.86 kg (SD 0.70). The highest mean birthweight was recorded for babies of highland mothers and the lowest for babies of coastal/lowland mothers.

Introduction

The primary aim of this project was to record the prevalence of birth defects recognizable at birth or soon afterwards in a series of 10,000 babies delivered in Port Moresby General Hospital, Papua New Guinea. Although records of births and birth defects are kept routinely in the major hospitals in Papua New Guinea (PNG), analysis and publication of the findings occur infrequently and there is reason to doubt the completeness and standardization of the records (1).

The protocol for the present study was derived from the one used in a large international study commissioned by the World Health Organization, in which priority was given to obtaining reliable observations (2). The potential for inaccuracy inherent in retrospective studies was reduced in the present study by supplementing the information derived from routine ward registers with direct observations on a daily basis and discussions with the health teams delivering and caring for the babies.

The mothers of the babies in the present series originated from all 19 provinces and the National Capital District of Papua New Guinea. Therefore, a secondary aim of the present study was to see whether the genetic and cultural diversity of the mothers had any detectable influence on the occurrence of birth defects.

Method

The labour ward of Port Moresby General Hospital was visited each weekday morning throughout the period of the study (January 1985 to May 1986) to monitor the births of 10,000 consecutive babies. Visits were timed to coincide with the obstetrical team's review of deliveries during the previous 24 hours. Further details about each birth were obtained from the labour ward registers: the mother's place of birth, her parity, any medical problems

1 Faculty of Medicine, University of Papua New Guinea, PO Box 5623, Boroko, NCD 111, Papua New Guinea
Present Address: Department of Biological Sciences, University of Plymouth, Drake Circus, Plymouth, Devon PL4 8AA, England, United Kingdom

she experienced during pregnancy, each baby's mode of delivery, and its sex, birthweight and condition at birth. Most mothers were unable to recall their age reliably, and records of maternal age were not included in either the ward registers or the present study. Uncertainties also precluded the recording of details about the father. Additional visits were made to the labour ward when information was received that a baby with a birth defect had been born. With parental permission, photographs were made of babies with externally visible defects; a selection of these photographs has been published (3).

Supplementary information about babies with birth defects was sought regularly from the nearby Special Care Nursery, to which neonates with special needs were referred. Reports were occasionally received from other postnatal wards where birth defects unrecognized in the Labour Ward were identified in the immediate postnatal period. Since the majority of mothers and babies remained in hospital for less than 24 hours after delivery, only the defects obvious at or soon after birth were recorded and analyzed in this study.

To determine whether maternal origin influenced the occurrence of birth defects, comparisons were made between observations derived from mothers originating from different provinces. Further comparisons were drawn by grouping maternal data in the following way:

highland provinces:	Eastern Highlands, Enga, Simbu, Southern Highlands, Western Highlands
coastal/lowland provinces:	Central (including the National Capital District), East Sepik, Gulf, Madang, Milne Bay, Morobe, Oro, Western, West Sepik
island provinces:	East New Britain, Manus, New Ireland, North Solomons, West New Britain

Observations

The 10,000 babies that formed the basis of this study were born to 9867 mothers. Multiple births (twins and one set of triplets) occurred in 1.3% of deliveries. The majority of mothers (94%) were admitted as public patients (0.4% of whom were non-Papua New Guinean) and 6% as private patients (12% of whom were non-Papua New Guinean). There was a marked excess of male babies in the sample as a whole and particularly amongst the babies with birth defects. The overall female:male ratio was 1:1.15, and for the affected babies 1:1.50.

Birth defects were recognized at or soon after birth in 116 babies, a prevalence of 1.16%. All the affected babies were singletons. 27% presented with multiple defects, and 14% were stillborn (compared with 2.3% for all babies in the series: public births 2.35%; private births 1.45%). Table 1 summarizes the prevalences of abnormal babies and twinning for mothers from different provinces. Defects were more common in babies of mothers from island provinces (1.9%) than from highland (1.1%) or coastal/lowland (1.0%) provinces.

In Table 2, the defects are classified according to which parts of the body were affected, together with the prevalence and stillbirths in each category. The limbs, head and neck, and central nervous system were most commonly affected, together constituting two-thirds of all defects.

The mean birthweight of the 9920 babies for whom records were available was 3.03 kg (SD 0.57). The mean for 4585 females was 2.98 kg and for 5307 males was 3.07 kg. The mean birthweight for the babies with birth defects was 2.86 kg (SD 0.70). Figure 1 compares the distribution of birthweights for abnormal and normal babies.

The majority of mothers in this study originated from coastal/lowland provinces, with highland mothers forming the next largest group, and island mothers forming the smallest group. There was not a simple correlation between the mean birthweights of highland, coastal/lowland and island groupings when compared with the observed incidence of birth defects (Figure 2).

TABLE 1

PROVINCES OF ORIGIN OF MOTHERS RELATED TO THE PREVALENCES OF TWINNING AND BIRTH DEFECTS

Mother's province	Total babies	Twins %	Birth Defects No	Birth Defects %
Central	3646	1.48	39	1.07
Gulf	1514	1.20	17	1.12
Eastern Highlands	722	1.55	10	1.39
Morobe	460	0.88	2	0.43
Milne Bay	332	1.53	2	0.60
Western	285	0.71	3	1.05
Oro	261	1.16	1	0.38
Simbu	253	0.80	2	0.79
Southern Highlands	191	1.06	0	–
East New Britain	189	2.16	4	2.12
East Sepik	165	1.85	4	2.42
Manus	146	1.39	2	1.37
Enga	125	0	3	2.40
Madang	84	1.20	0	–
New Ireland	77	1.32	1	1.30
Western Highlands	69	0	0	–
North Solomons	44	0	1	2.27
West Sepik	26	0	1	3.85
West New Britain	21	0	1	4.76
Unknown	1284	1.50	20	1.56
Non-PNG	106	0.95	3	2.83
Total	10000	1.33	116	1.16

There was no obvious correlation between the minor fluctuations in the birthweight means during the period of the study and the timing of the wet and dry seasons in Port Moresby. For the whole series, the highest mean birthweights were recorded for babies born to mothers from highland provinces and the lowest for those born to coastal/lowland mothers, with an intermediate value for babies of island mothers. This pattern has been reported before, and a comparison between the findings of the present study and earlier studies has been made in Figure 3. It is notable that there has been a consistent birthweight increase in Papua New Guinea over the intervening years, and it appears that this upward trend is continuing (5).

Parity of the mothers (disregarding miscarriages before week 24) ranged from 0 to 13, with a very skewed distribution in which the great majority of the mothers were towards the lower end of the range. Highland mothers showed the greatest skew, while the coastal/lowland mothers showed a flatter distribution with more mid-range parities. Island mothers were intermediate between these two groups, although they differed in having more primiparous than nulliparous mothers. In general nulliparous mothers gave birth to babies 0.3 kg lighter than higher parity mothers. Compared with the mothers of normal babies, there were fewer nulliparous mothers and relatively more higher parity mothers amongst the mothers of abnormal babies (Figure 4).

Discussion

Prevalence

Comparisons between birth defect prevalence figures from different populations should be made with care, since different criteria and interpretations may have been applied during collection of the observations. These factors are discussed at length in a study in which data

TABLE 2

TYPES OF BIRTH DEFECTS CLASSIFIED ACCORDING TO REGION OF BODY AFFECTED

	Number	Stillborn
Limbs		
talipes	20	1
polydactyly	7	0
shortened, deformed limbs	6	1
arthrogryposis	4	1
dislocated hip	4	1
club hands	3	1
missing digits	3	0
hyperextended knees	2	0
Total	49	5
	(29.7%)*	(10.2%)**
Head and neck, and central nervous system		
ear defects	10	0
cleft lip	7	1
cleft palate	7	1
facial defects	6	2
craniostenosis	2	2
cystic hygroma	2	1
laryngeal stenosis	2	0
micrognathia (Robin syndrome)	1	0
microphthalmia	1	0
Total	38	7
	(23.0%)*	(18.4%)**
Neural tube defects		
hydrocephalus	8	7
microcephalus	8	0
anencephalus	3	3
spina bifida/lumbosacral swelling	4	1
Total	23	11
	(13.9%)*	(47.8%)**
Abdomen		
Abdominal defects		
bowel obstruction	7	0
exomphalos, umbilical hernia	2	0
distended abdomen	1	0
renal agenesis	1	1
urachal fistula	1	0
ileal atresia	1	0
oesophageal atresia	1	0
Total	14	1
	(8.5%)*	(7.1%)**

continued next page

Perineal defects		
ambiguous genitalia	7	1
hypospadias	3	0
hydrocele	2	0
imperforate anus	1	0
Total	13 (7.9%)*	1 (7.7%)**
Thorax		
congenital heart disease	9	0
diaphragmatic defect	7	0
hypoplastic lungs	1	0
asphyxiating dwarfism	1	0
Total	18 (10.9%)*	0
Defects with a major genetic component		
Down syndrome	4	1
trisomy 18 (Edward syndrome)	2	0
Turner syndrome	1	0
cri-du-chat syndrome	1	0
Total	8 (4.8%)*	1 (12.5%)**
Skin defects		
extensive haemangioma	2 (1.2%)*	0

* percentage of all recognized defects (165)

** percentage of stillborn in this category of defects

from 24 centres worldwide are compared (2). Certainly, difficulties were sometimes encountered during the present study when categorizing particular babies. In Table 3 the prevalence of birth defects derived from the present study has been compared with results from several other countries. It will be seen that the prevalence of 1.16% recorded for Papua New Guinea is relatively low, although it falls within the range reported in the WHO study.

Not all developmental errors and malformations are detected at birth, so the prevalences recorded in Table 3 inevitably underestimate the occurrence of birth defects. Defects of internal organs may not become apparent until months or years after birth. This is particularly the case with heart defects: for example, a follow-up study in China showed a 5-fold increase in the detection rate of heart defects by the second year after birth (14).

Types of defects

In the present study, the most commonly affected regions of the body were the limbs, the head and neck, and the central nervous system. Reports of similar studies carried out in other countries during the same period have shown a predominance of central nervous system defects in India (6,13), Mexico (10) and Singapore (15). Limb defects, especially polydactyly, were common in Zaire (9).

In the present study, a substantial proportion of the defects observed were of types that have

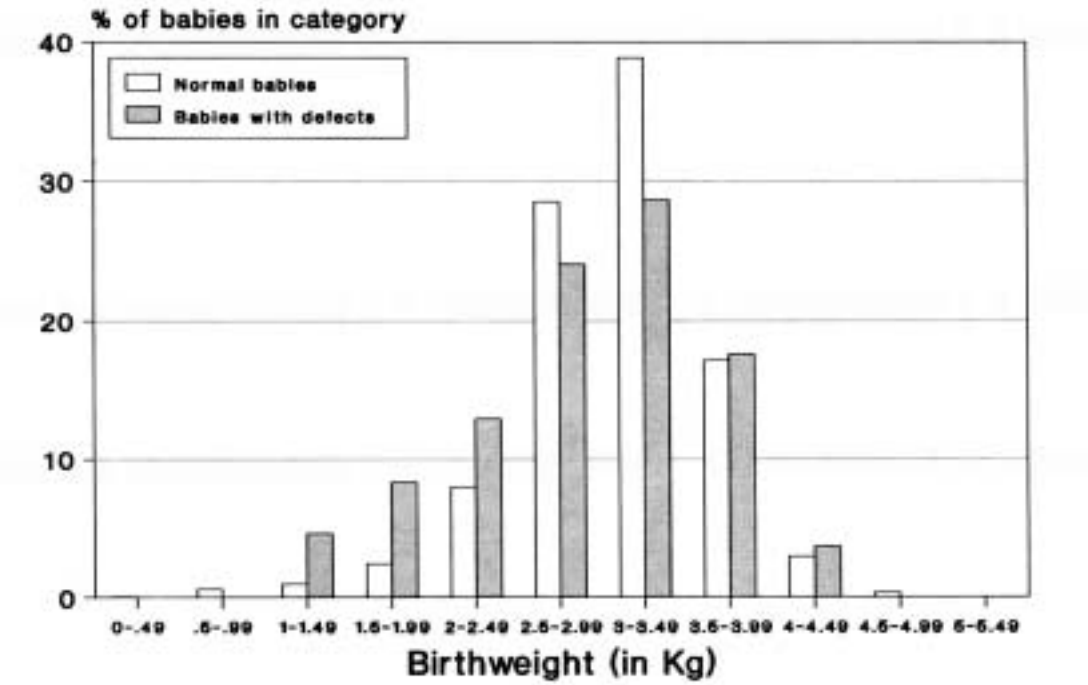


Figure 1. Distribution of birthweights for normal babies (babies in whom no birth defects were identified) and babies with recognized birth defects.

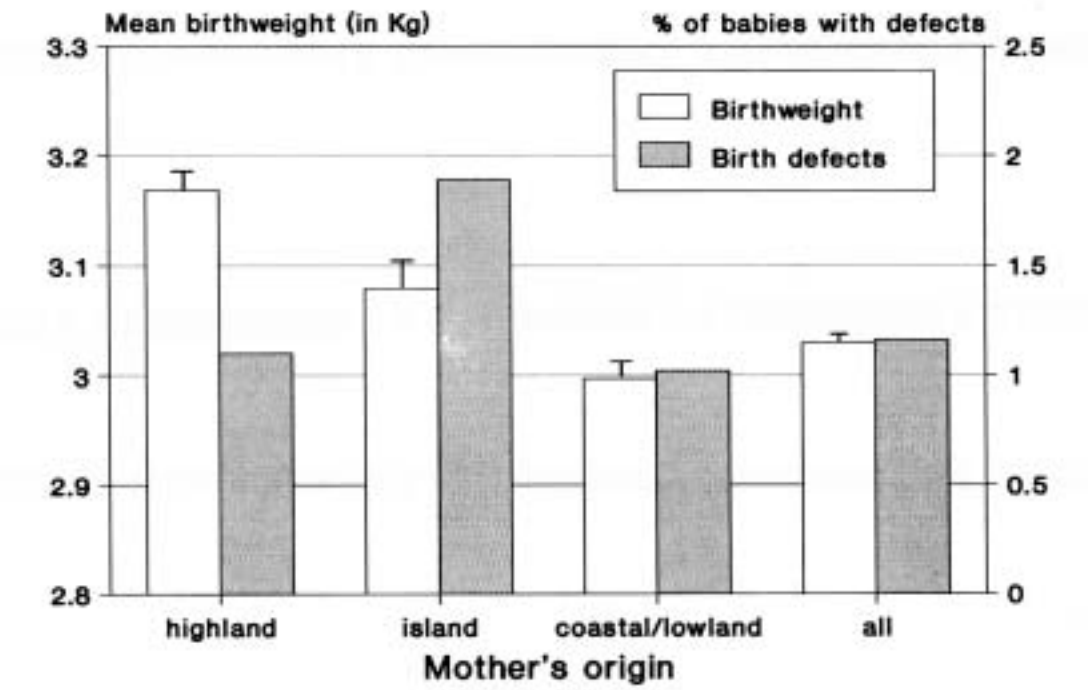


Figure 2. Relationship between mean birthweight and prevalence of birth defects for mothers from different regions of Papua New Guinea. Standard errors are shown for the birthweights.

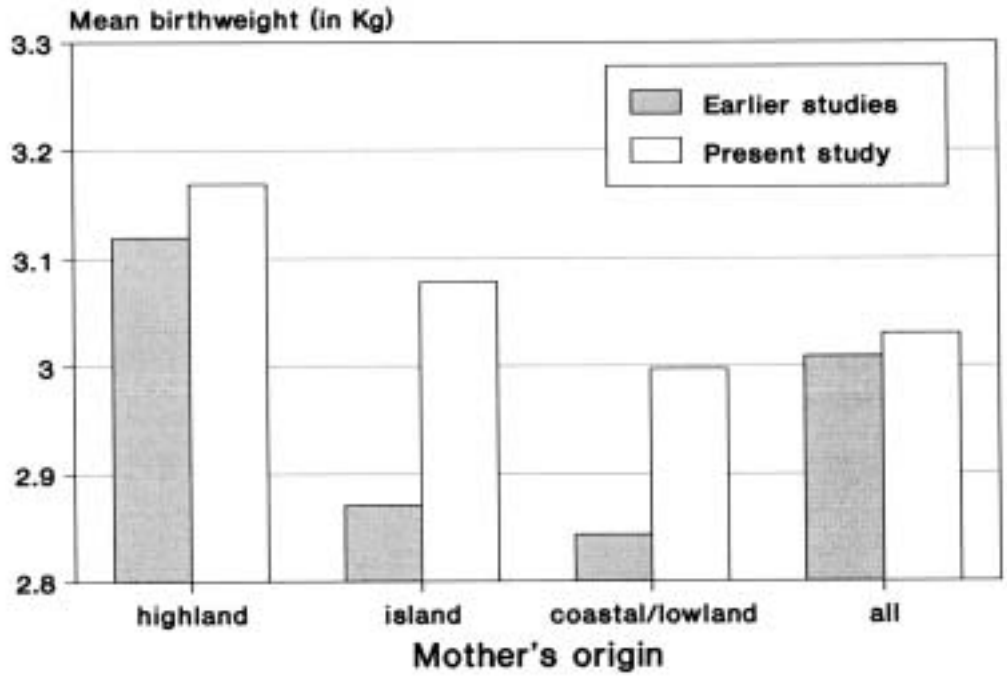
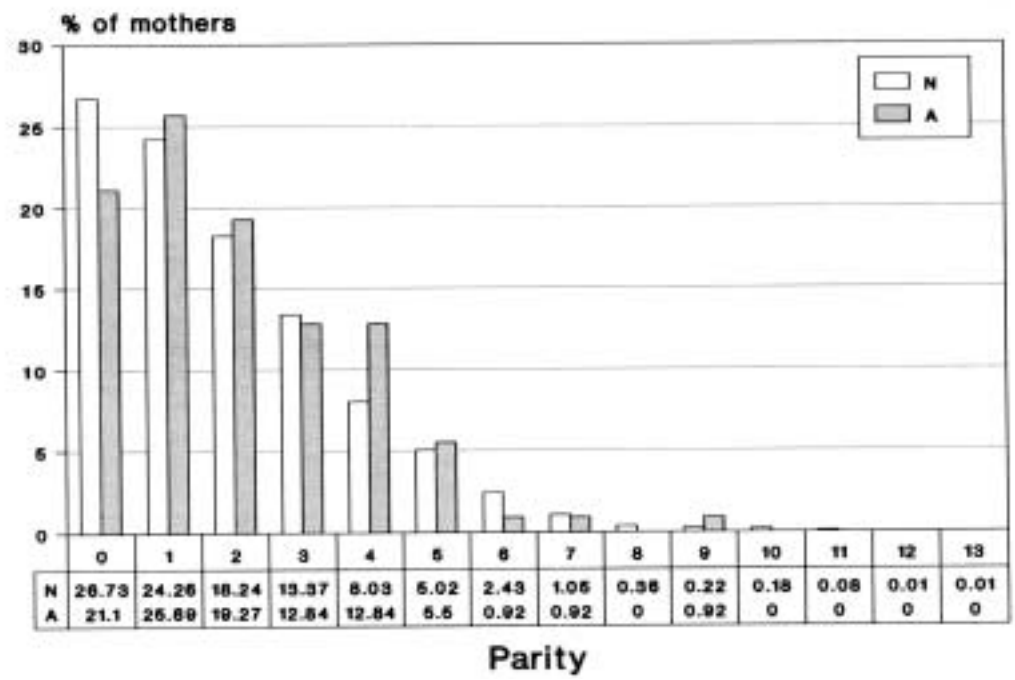


Figure 3. Comparison between birthweights recorded in the present study and earlier studies, for mothers from different regions of Papua New Guinea. Comparative data were derived from Table 4 in reference 4.



	0	1	2	3	4	5	6	7	8	9	10	11	12	13
N	26.73	24.26	18.24	13.37	8.03	5.02	2.43	1.06	0.36	0.22	0.18	0.08	0.01	0.01
A	21.1	25.89	19.27	12.84	12.84	5.5	0.92	0.92	0	0.92	0	0	0	0

Figure 4. Comparison of parity distributions for mothers of normal and abnormal babies. N = mothers of normal babies; A = mothers of abnormal babies.

TABLE 3

REPORTED PREVALENCES OF BIRTH DEFECTS (RECOGNIZED AT BIRTH OR SOON AFTERWARDS) IN SEVERAL POPULATIONS

India, 1983-1989 (6)		3.60%
Western Australia, 1980-1987 (7)		3.50%
Argentina, 1978-1988 (8)		3.09%
Zaire, 1985-1986 (9)		2.50%
Mexico, 1987-1988 (10)		2.31%
Liberia (11)		2.24%
China, 1983-1988 (12)		1.93%
India (13)		1.46%
24 centres worldwide, 1961-1964 (2)	mean	1.25%
	range	0.31% - 2.25%
Papua New Guinea (1985-1986) (present study)		1.16%

commonly been attributed to the influence of uterine constraints rather than errors in developmental processes. For example, talipes was the most commonly occurring deformation (20 cases) and it has been suggested that possible causes include restricted fetal movement due to a small uterus (for example, in a small mother or a first pregnancy), the presence of uterine tumours or malformations, or oligohydramnios (16). Arthrogryposis, which was observed more frequently in the present study than in most reports (compare 17), is a more complex syndrome of defects and probably has a more complex aetiology than talipes (18).

Maternal factors

Papua New Guinea is remarkable for its degree of genetic and cultural diversity. In the present study, there was evidence that the mother's province of origin had some bearing on several measures, including the prevalence of birth defects, birthweight and parity distributions. These influences became more obvious when data were clustered into highland, coastal/lowland and island groupings. However, the interpretation of such evidence is complicated by several confounding factors, and should therefore be considered as tentative at this time. For example, in the present series mothers from provinces near Port Moresby greatly outnumbered those from more remote provinces. Also, no account was taken of the length of time that mothers had spent in Port Moresby before having their babies, so the contribution of differing environmental factors could not be assessed. Furthermore, it may be questioned whether the highland, coastal/lowland and island groupings are valid, given the rich diversity within a single province and the extensive geographical span of some provinces. However, this approach is not without precedent and justification (4,19).

Birthweight

Birthweight data are useful both with regard to predicting the status of individual babies and as an indicator of population characteristics such as maternal health and nutrition. In the present study it was observed that babies born to highland mothers were on average heavier than those born to island mothers, which in turn were heavier than those born to mothers originally from coastal/lowland regions. In a recent discussion about the factors that may be involved in producing the pattern of birthweight differences observed within Papua New Guinea, the conclusion was reached that nutritional and genetic factors probably have a greater influence than malaria, which is endemic at lower altitudes (20). However, it has been reported that malarial infection predisposes to maternal anaemia and a consequential lowering of birthweight (21, 22), so it would be premature to rule this out as a contributor to the observed differences. Indeed, a detailed study of a sample of the mothers included in the present study revealed that 59% had a haemoglobin level of less than 10 g/dl, and that the haemoglobin levels in mothers from Central and Gulf provinces were

significantly lower than those in highland women (23).

Many reports have drawn attention to a striking inverse relationship between birthweight and the prevalence of birth defects (24), so it was of interest to see whether the pattern of different birthweights observed in the present study correlated with the prevalences of birth defects in the different groups. The mean birthweight of abnormal babies in the present study was indeed significantly lower than that of normal babies overall, but there did not appear to be a simple correlation between birthweight and the prevalence of birth defects in the babies of mothers from different regions (Figure 2).

Postmortem identification of defects

In the present study, there was often doubt about the exact cause of death when a baby was stillborn or died soon after birth. During the study only one postmortem examination of an affected baby was carried out, since the parents of the other babies were not prepared to give their consent to disfiguring postmortem procedures. It is probable that many internal developmental defects passed unrecorded: a study of perinatal deaths in Jamaica revealed that 3 times as many major malformations were identified during postmortem examination as had been recognized by external examination alone (25). Similar cultural constraints relating to postmortem investigations have been reported in Africa (9), and alternatives to invasive portmortem techniques such as ultrasound examination will be needed if a more accurate assessment of birth defects is to be obtained.

The contribution of birth defects to infant mortality

It is encouraging that infant mortality continues to fall in Papua New Guinea as a consequence of general improvements in health, improved health care provision, reductions in infectious disease and the implementation of immunization programs. However, it would appear from experience in other countries (26) that the relative contribution of birth defects to infant death and disability in Papua New Guinea, and the concomitant need for specialized medical and social resources, will steadily rise as public health improves. Fortunately, this trend may not be as inevitable as it once was: there is a growing confidence that at least some birth defects are already preventable (27) and that others will become preventable as our understanding of causation improves.

ACKNOWLEDGEMENTS

This study was funded by a grant from the Medical Faculty of the University of Papua New Guinea. Grateful acknowledgement is given for the enthusiastic support of colleagues in the Medical Faculty and Port Moresby General Hospital, particularly Professor J. Everitt, Dr J. Vince, Dr R. Primhak and Sister Rae.

REFERENCES

1 **Mai M, Wal A, Dryden R.** Congenital abnormalities recorded at Port Moresby General Hospital, 1980-1984. *PNG Med J* 1986;29:237-245.

2 **Stevenson AC, Johnston HA, Stewart MIP, Golding DR.** Congenital malformations: a report of a study of series of consecutive births in 24 centres. *Bull World Health Organ* 1966;34 Suppl:9-127.

3 **Dryden R, Vince J.** Birth Defects in Papua New Guinea. Port Moresby: University of Papua New Guinea Press, 1988.

4 **Lourie J.** Trends in birthweights over 43 years at Kwato, Milne Bay Province. *PNG Med J* 1986;29:337-343.

5 **Klufio CA, Kariwiga G, MacDonald R.** Normal birthweight at Port Moresby General Hospital: a retrospective survey of normal term births to determine birthweight distribution. *PNG Med J* 1992;35:10-16.

6 **Verma M, Chhatwal J, Singh D.** Congenital malformations - a retrospective study of 10,000 cases. *Indian J Pediatr* 1991;58:245-252.

7 **Bower C, Forbes R, Seward M, Stanley F.** Congenital malformations in Aborigines and non-Aborigines in Western Australia, 1980-1987. *Med J Aust* 1989;151:245-248.

8 **Sanchez O, Salazar A, Brito Arreaza A, Ramirez N, Alvarez Arratia MC.** Epidemiology of congenital malformations at the Ruiz and Paez Hospital of Bolivar City: a 10 years' experience. *Invest Clin* 1989;30:159-172.

9 **Sengeyi MA, Tshibangu K, Tozin R, Nguma M, Tandu U, Sinamuli K, Mbanzulu PN, Tshiani K.** Etiopathogenesis and type of congenital malformations observed in Kinshasa (Zaire). *J Gynecol Obstet Biol Reprod* 1990;19:955-961.

10 **Arredondo de Arreola G, Rodriguez-Bonito R, Trevino-Alanis MG, Arreola-Arredondo B, Astudillo-Castillo G, Russildi JM.** Congenital malformations in live-born neonates. *Bol Med Hosp Infant Mex* 1990;47:822-827.

11 **Njoh J, Challaram R, Ramas L.** Congenital abnormalities in Liberian neonates. *West Afr J Med* 1991;10:439-442.

12 **Feng DX.** Survey of birth defects in Huixian. *Chung Hua Yu Fang I Hsueh Tsa Chih* 1989;23:99-101.

13 **Mishra PC, Baveja R.** Congenital malformations in the newborn - a prospective study. *Indian Pediatr* 1989;26:32-35.

14 **Hu YH.** Follow-up study on prevalence rate of congenital defects in children at birth and age of two years. *Chung Hua Liu Hsing Ping Hsueh Tsa Chih* 1989;10:219-222.

15 **Ho NK.** Congenital malformations in Toa Payoh hospital - an 18-year experience (1972-1989). *Ann Acad Med Singapore* 1991;20:183-189.

16 **Cohen MM Jr.** Syndromology: an updated conceptual overview. VIII. Deformations and disruptions. *Int J Oral Maxillofac Surg* 1990;19:33-37.

17 **Higurashi M, Oda M, Iijima K, Iijima S, Takeshita T, Watanabe N, Yoneyama K.** Livebirth prevalence and follow-up of malformation syndromes in 27,472 newborns. *Brain Dev* 1990;12:770-773.

18 **Lourie J.** Arthrogryposis multiplex congenita. *PNG Med J* 1983;26:170-171.

19 **Pataki-Schweizer KJ.** Epidemiology, behaviour and health: a Melanesian example. *Asia Pac J Public Health* 1987;1:69-76.

20 **Primhak RA, Macgregor DF.** Ethnic and environmental factors affecting fetal growth in Papua New Guinea. *Ann Hum Biol* 1991;18:235-243.

21 **Everitt VJ.** Report of the Obstetrical and Gynaecological Unit, Port Moresby General Hospital, 1985. Port Moresby: Port Moresby General Hospital, 1986.

22 **Taufa T.** Malaria and pregnancy. *PNG Med J* 1978;21:197-206.

23 **Sill PR, White JC, Cheetham JM.** A survey of haemoglobin concentration in pregnancy in Port Moresby, Papua New Guinea. *PNG Med J* 1986;29:221-224.

24 **Mili F, Edmonds LD, Khoury MJ, McClearn AB.** Prevalence of birth defects among low-birth-weight infants. A population study. *Am J Dis Child* 1991;145:1313-1318.

25 **Coard K, Escoffery C, Codrington G, Keeling JW, Ashley D.** Fatal malformations in Jamaica. *Pediatr Pathol* 1990;10:729-742.

26 **Kalter H.** Five-decade international trends in the relation of perinatal mortality and congenital malformations: stillbirth and neonatal death compared. *Int J Epidemiol* 1991;20:173-179.

27 **Department of Health, London.** Folic Acid and the Prevention of Neural Tube Defects. Report from an Expert Advisory Group. Heywood: Health Publications Unit, 1992.