Prevalence of hyaline membrane disease in black and white low-birth-weight infants

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Abstract **Previous studies in South Africa and elsewhere have suggested that there are ethnic differences in the prevalence of hyaline membrane disease (HMD). This study compared the prevalence of HMD between black and white infants with birth weights of 1 000 - 1 749 g. A cohort of black and one of white low-birth-weight infants were enrolled at Baragwanath and Johannesburg Hospitals respectively. Black infants were found to have a higher rate of intra-uterine growth retardation. When compared according to either birth weight or gestational age categories, black infants had a significantly lower prevalence of HMD. For example, between 29 and 34 weeks' gestation 36,2% of black and 62,5% of white infants developed HMD ($P < 0,001$). The reasons for these differences are not clear, however, and require further study.**

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The prevalence of respiratory distress caused by hyaline membrane disease (HMD) in premature newborn infants appears to differ according to ethnic group. Previously reported figures from Cape Town have shown lower prevalences in black and mixed race infants than in white infants,[1,2] as do data from the USA.[3,4] In addition, there is evidence that the surge in the production of lecithin, which is the major constituent of surfactant, occurs earlier during the third trimester of pregnancies in black African women compared with white women in North America.[5]

Local differences in the prevalence of HMD between white and black infants, when compared only in terms of birth weight, do not take into account the fact that a large number of black infants are growth-retarded.[6] To show a true difference in the prevalence of HMD, it is therefore essential for gestational age to be assessed accurately.

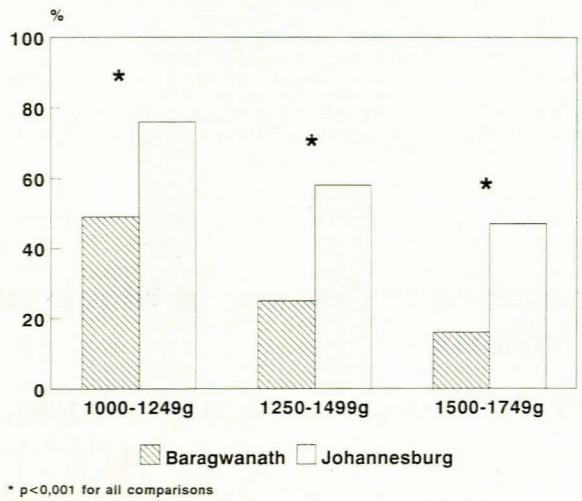
Historically the vast majority of infants admitted to the neonatal unit at Johannesburg Hospital have been white, while those admitted to Baragwanath Hospital have been almost exclusively black. This enabled us to compare the prevalence of HMD by weight and gestation in white and black low-birth-weight infants born at two large hospitals in the Johannesburg area.

Methods

Infants weighing 1 000 - 1 749 g at birth were the subject of this study. Black infants were prospectively enrolled from admissions to the neonatal unit at Baragwanath Hospital, while white infants were identified from a retrospective survey of admissions to the unit at Johannesburg Hospital.

Baragwanath Hospital cohort

Baragwanath Hospital serves the population of Soweto and had over 20 000 deliveries during 1989. In addition there were approximately 12 000 deliveries in the Soweto maternity clinics. Infants with birth weights of 1 000 - 1 749 g admitted to the Baragwanath Hospital neonatal unit from 1 August to mid-December 1989 were enrolled. Since any infant born at one of the maternity clinics and weighing less than 2 000 g is immediately referred to the hospital and there were no recorded deaths of such infants at any of the clinics over the study period, clinic deliveries were included in this study because no selection bias was considered to be present. However, infants transferred to the unit from outside hospitals or born at home were excluded.



* p<0,001 for all comparisons

FIG. 1.
Comparison of the prevalence of HMD by weight group between black low-birth-weight infants at Baragwanath Hospital and white low-birth-weight infants at Johannesburg Hospital. All weight categories showed significant differences.

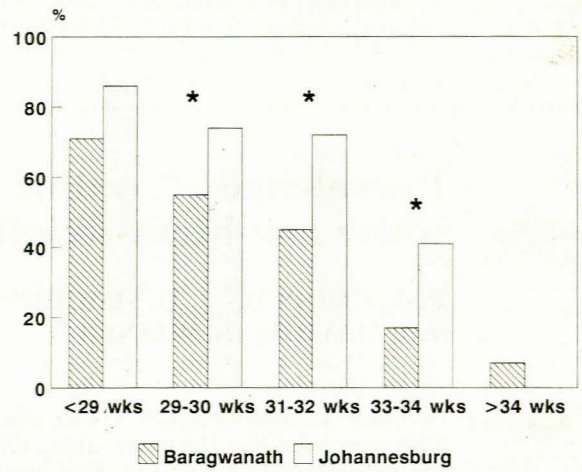
Since accurate information on dates from the mothers and early obstetric ultrasound findings to assess gestational age were not routinely available, gestational age was assessed by the Ballard score.[7] This was done by two investigators (D.L.S. or I.D.S.) only. Infants were classified as small for gestational age (SGA) on the basis of a birth weight below the 10th percentile on the Lubchenco growth curve.[8] All chest radiographs were reviewed jointly by three neonatologists, who were unaware of the clinical and laboratory findings. The diagnosis of HMD was made on the basis of respiratory distress developing in the first 6 - 12 hours after birth, a chest radiograph showing a diffuse reticulogranular pattern in both lung fields with air bronchograms, and no laboratory evidence of infection.[9] Ten infants who required mechanical ventilation for early-onset respiratory distress died before a chest radiograph could be taken. None of these infants had positive blood cultures or other evidence suggestive of infection and were assumed to have had HMD. Some infants who had mild respiratory distress which resolved within 48 hours were not radiographed. They were assumed to have transient tachypnoea of the newborn, since none of the proven cases of HMD in this study resolved so rapidly.

Johannesburg Hospital cohort

A retrospective search for all infants weighing 1 000 - 1 749 g admitted to the neonatal unit of Johannesburg Hospital over a 6½-year period from January 1983 until mid-1989 was performed on the computerised neonatal data base. Again, to exclude bias, only inborn infants were selected for inclusion in this study. This hospital had between 2 000 and 2 500 such deliveries annually over this period.

Gestational age was taken from antenatal data (maternal dates and early antenatal ultrasound examination) wherever possible and confirmed by Ballard scores. The diagnosis of HMD had been made using the same criteria as described for the Baragwanath cohort, and similar clinical and laboratory data were utilised. Although the chest radiographs were not reviewed specifically for this study, one paediatric radiologist had reported on the vast majority of the chest radiographs during this period.

Data from both cohorts were computerised and analysed using the Epi Info program.[10] Statistical analysis of the data was performed by χ^2 analysis; where an expected cell was < 5, Fisher's exact test was used. The study was approved by the Committee for Research on Human Subjects of the University of the Witwatersrand.



* p<0,05 or lower

FIG. 2.
Comparison of the prevalence of HMD by gestational age groups between black low-birth-weight infants at Baragwanath Hospital and white low-birth-weight infants at Johannesburg Hospital. The differences were significant at 29 - 34 weeks' gestation.

Results

A total of 257 black infants born at the hospital or one of the Soweto clinics formed the Baragwanath cohort and 358 inborn white infants formed the Johannesburg cohort. They were divided into 250 g weight categories and 2-week gestational age categories. There was no significant difference between the distribution of infants in the three weight categories, but the Baragwanath cohort had significantly higher gestational ages ($P < 0,001$ for comparison of gestational age distribution). The Baragwanath cohort was therefore more mature at a given birth weight than the infants at Johannesburg Hospital. Furthermore, 131 (51,0%) of the 257 Baragwanath infants were SGA according to Lubchenco's growth charts, while this applied to only 113 (36,6%) of the 358 making up the Johannesburg cohort ($P < 0,001$,

odds ratio (OR) 2,25; 95% confidence interval (CI) 1,6 - 3,18).

The overall prevalence of HMD for the entire cohort was 30,8% for black infants and 57,8% for white infants ($P < 0,001$, OR 0,32; 95% CI 0,23 - 0,46).

Fig. 1 shows the comparison of the prevalence of HMD according to the three weight categories. It can be seen that HMD was diagnosed significantly more frequently in white infants in each of the categories. Although this could be explained in part by the greater maturity of the black infants, Fig. 2 shows that in each 2-week period between 29 and 34 weeks' gestation black infants were significantly less likely to develop HMD than white infants. For the groups born at 29 - 34 weeks' gestation, 36,2% of black and 62,5% of white infants were diagnosed as having HMD ($P < 0,001$, OR 0,34; 95% CI 0,23 - 0,51).

Discussion

This study shows that black infants at Baragwanath Hospital weighing 1 000 - 1 750 g at birth were generally more mature than white infants at Johannesburg Hospital and had a higher prevalence of intra-uterine growth retardation. This was an expected finding and partially explained the lower prevalence of HMD in the Baragwanath group as a whole as well as in the weight subgroups. However, while white infants in this study appeared to have a prevalence of HMD similar to that described for white low-birth-weight infants in other parts of the world,[3,11-13] the prevalence of HMD was clearly lower in black infants between 29 and 34 weeks' gestation than in white infants, regardless of birth weight.

While this difference is in keeping with findings of other studies,[1-5] its explanation is complex and it is not possible to make conclusions from this study. The facts that the mothers of the Baragwanath infants had generally received little antenatal care (54% of the cohort had not attended antenatal clinics), had often arrived at the hospital in advanced premature labour and had seldom received antenatal steroids, and that their infants were frequently asphyxiated at birth, would all have been expected to increase the prevalence of HMD[9,14,15] rather than decrease it as shown in this study.

It may be that the generally smaller size of the Baragwanath infants at a given gestational age resulted in their suffering greater intra-uterine stress, which in turn may have resulted in more rapid or earlier induction of mature surfactant production. Studies on the relationship between intra-uterine growth retardation and HMD are conflicting, some studies suggesting that growth retardation may be protective against HMD and others that it may be an aggravating factor.[16-18] Clearly, further investigation into environmental and possibly genetic factors that may account for the differences shown in the prevalence of HMD in black and white LBW infants is required.

This study also provides important baseline information in the South African context for the rational use of artificial surfactant for the prophylaxis and/or rescue treatment of HMD. Of black infants in this study born at less than 29 weeks' gestation, only 43% required ventilation during the first 48 hours of life for HMD, while this applied to only 30% of those born at 29 - 30 weeks' gestation. Since few hospitals in this country routinely ventilate infants weighing less than 1 000 g (the lower cut-off weight for this study), prophylactic use of artificial surfactant for black infants would not appear to be warranted. While the prevalence of HMD in white infants in this study was higher, it is noteworthy that the mortality rate was low (11,7% overall) and routine use of prophylactic surfactant at birth would have resulted in a large number of infants deriving little benefit. For infants weighing over 1 000 g at birth in South Africa, it would therefore seem advisable to reserve the use of artificial surfactant for rescue treatment once a definite diagnosis of HMD has been made, especially in view of the very high cost of the product.

In conclusion, this study, conducted at two hospitals in the Johannesburg area, showed that black infants weighing 1 000 - 1 749 g at birth and born at 29 - 34 weeks' gestation had a significantly lower prevalence of HMD than white infants. The reasons for these differences are not clear and warrant further study. While it was necessary to conduct this comparative study at two different hospitals, it should be noted that since its completion great changes have taken place within the hospitals as a result of political changes in the country and the differences in the patient profile between the two hospitals are rapidly disappearing.

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