Details of children with BMX bike injuries sustained over 40 days (this series) and of children with ordinary bike injuries sustained over six months (previous series)

	Children with BMX bike injuries (n = 100)	Children with ordinary bike injuries (n = 150)
Mean age (years)	10	14 (9)
No (%) with previous cycle injury	28	50 (33)
No (%) with injuries of grade:		
1-2	52	68 (45)
3	37	66 (44)
4	11	14 (9)
5		2 (1)
No (%) with:		
Fractures	14	33 (22)
Head injury	7	44 (29)
Soft tissue injury above neck	22	30 (20)
No (%) admitted	9	14 (9)
No (%) undergoing radiography	44	74 (49)
No (%) with stunts as probable cause of injury	40	3 (2)

more serious lacerations, fractures of arms or legs that were undisplaced and for which admission was not required, minimally displaced greenstick fractures, and minor head injuries; grade 4, fractures for which admission was essential, seriously displaced fractures that needed a general anaesthetic for reduction, and head injuries with concussion or skull fracture or both; grade 5, conditions such as a ruptured viscus or a serious head injury in which there was a potential risk to life.

The table shows the severity of injuries sustained and compares findings in the present with those from a previous study of ordinary bicycle accidents.[1] There was no significant correlation between severity and age, sex, or history of previous injury (which had occurred in 28). Five children had concussion, two minor head injuries, 12 lacerations (two above the neck), two injury to teeth, and eight abrasions or bruises above the neck. Injuries to arms and legs included 14 fractures (13 in the arm), 13 lacerations, 35 abrasions or bruises, five sprains, and one avulsion of the fingertip. Three children had minor body injuries. Nine were admitted.

Discussion

BMX bike injuries differed little from those described in a previous paper on injuries on ordinary bikes except, in the greater proportion of injuries due to stunts on BMX bikes (40 on BMX bikes, three (2%) on ordinary bikes) and the higher incidence of head injuries on ordinary bikes. In 23 of the BMX bike injuries the child had fallen over the handlebars, a potentially dangerous accident; as the jargon says "one wrong move and you're OTB" (over the bars) and "eating dirt."

Reference

1 Illingworth CM, Noble D, Bell D, Kemm I, Roche C, Pascoe J. One hundred and fifty cycle injuries to children: a comparison with accidents due to other causes. *Injury* 1981;13:7-9.

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Effect of glycaemic control and duration of disease on overnight albumin excretion in diabetic children

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Abstract

Urine albumin excretion rates were measured in overnight timed samples from diabetic and non-diabetic schoolchildren. The excretion rates in the diabetics were significantly higher than those in the controls and were positively correlated with age, duration of diabetes, and glycaemic control. Diabetic children aged 12 years and older had significantly higher albumin excretion rates than younger diabetic children matched for duration of disease. Among the non-diabetic controls there was no correlation between albumin excretion rate and age and the girls excreted significantly more albumin than the boys.

Measurement of the overnight albumin excretion rate may provide a useful early indicator of the progression to clinical proteinuria in diabetes and is free from random variations such as that due to exercise.

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Introduction

By the time that albuminuria is detectable by standard laboratory or clinical methods the albumin concentration is greater than 100 mg/l urine.[1] Present clinical evidence suggests that from this point the development of diabetic nephropathy is inexorable.[2] Earlier detection of lower but still abnormal concentrations of albumin (10-50 mg/l)—so called microalbuminuria—followed by stricter glycaemic control may, however, retard or even arrest this progression.[3 4]

Several immunological assays for albumin have been described,[4-7] and all are sensitive enough to detect early increases in urine albumin concentration beyond the normal range. More problems have been encountered in deciding which method of collecting urine best differentiates between early onset diabetic nephropathy and normality. Random urine samples collected at clinics are convenient but show wide variations in concentration and the effects of exercise.[8 9] Such variations may be overcome by using a rest period and correcting for urine creatinine concentration, but this entails further laboratory analyses and increased inconvenience. Without a timed interval of collection an albumin excretion rate cannot be calculated. Twenty four hour urine collections are tedious to perform and are often subject to large errors in collection. Different degrees of exercise within the collection time may influence the albumin excretion.[9]

These disadvantages may be obviated by performing a timed urine collection overnight with the patient recumbent. This is a simple, non-invasive procedure already used by many patients

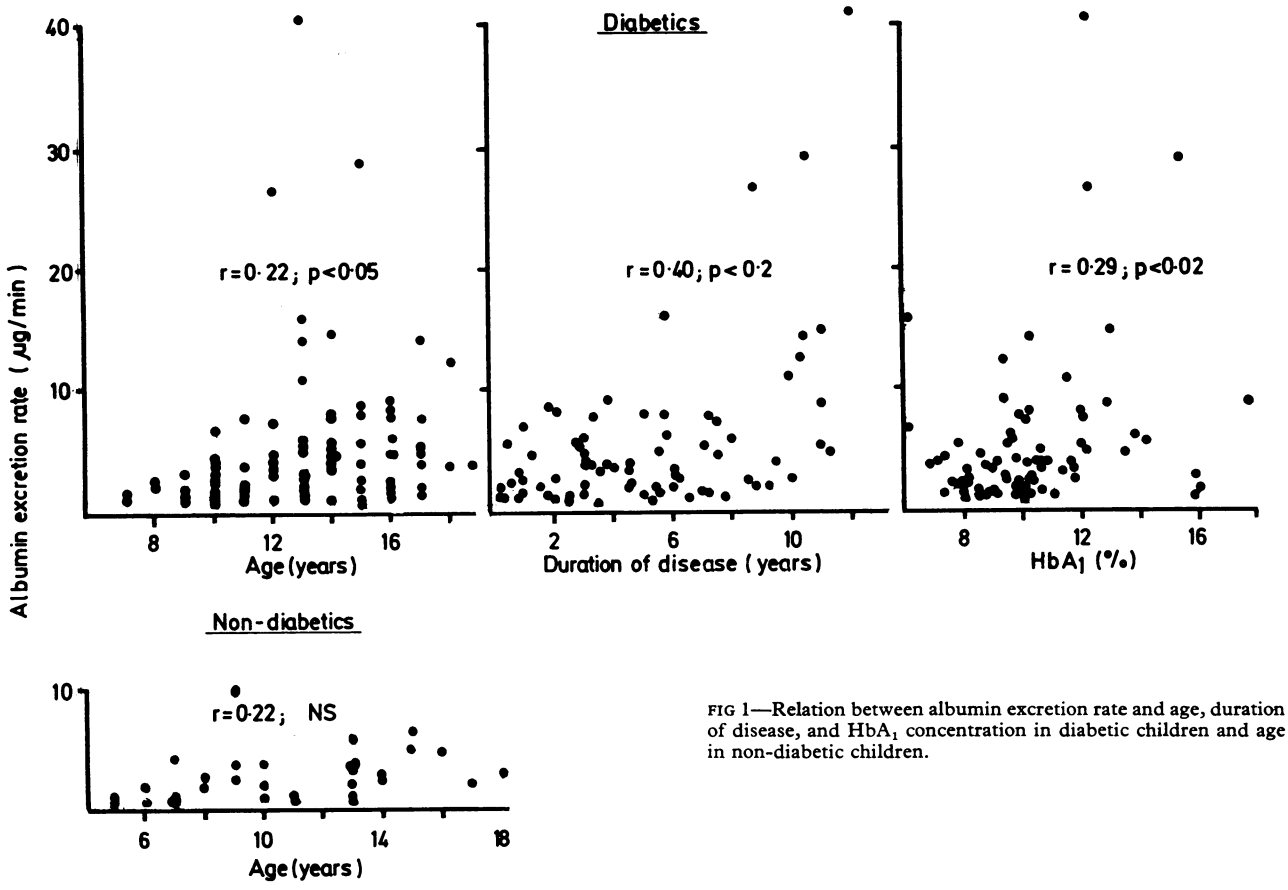

FIG 1—Relation between albumin excretion rate and age, duration of disease, and HbA_1 concentration in diabetic children and age in non-diabetic children.

to monitor glucose excretion. We therefore measured overnight albumin excretion in timed urine collections from groups of diabetic and non-diabetic schoolchildren matched for age and sex.

Methods

We studied 47 boys and 39 girls with insulin dependent diabetes and 17 boys and 19 girls who were non-diabetic. All lived in the Southampton health district. The diabetic children were aged 7-19 (mean 13·2) years and had had diabetes for between two months and 15 years (mean duration 5 (SD 3·4) years). The non-diabetic children were aged 5-17 (mean age 10·3 years). None of the diabetics had clinical evidence of renal disease or hypertension, and all consistently gave negative results on testing with Albustix at clinic visits. They were receiving twice daily injections of highly purified porcine insulin. Glycaemic control was monitored at home by blood glucose measurements on finger prick samples (BM test strips). Haemoglobin A_1 (HbA_1) concentrations were measured after each clinic visit with a commercial electroendosmotic method (Corning Medical, Halsted, Essex). The 95% reference range for HbA_1 concentration in our laboratory is 5·2-7·3%. The coefficient of variation of the method is 0·034 between batches at an HbA_1 concentration of 12%.

All subjects passed urine immediately before going to bed, discarded this sample, and recorded the time. The urine passed immediately after they got up in the morning was then collected without preservative, and this time was also noted. Any urine passed at night was also collected into the same container. The urine volume was recorded and aliquots stored at −20°C until analysis.

Albumin was measured by a modification of an immunoturbidimetric method.[5] An aliquot (50 μl) of each urine sample was diluted ninefold in 0·1 M phosphate buffer pH 7·4 containing 4% macrogol (polyethylene glycol). Rabbit antiserum to human albumin (Dako Laboratories) was diluted 12-fold in the same buffer, and 100 μl was added to each diluted urine sample using an LKB reaction rate analyser. The reaction was monitored for two minutes, and results were calculated from the absorbance at 340 nm of standard solutions of albumin (2-80 mg/l; Human protein standard, Dade Diagnostics). Samples giving readings below the lowest standard were reanalysed using a 100 μl sample and 400 μl of the phosphate buffer and macrogol solution. This change in the final concentration of macrogol did not change the absorbance of the reaction mixture. The sensitivity of the assay was 2 mg/l, and the coefficients of variation at concentrations of albumin of 5 and 40 mg/l were 0·1 and 0·03 respectively. Final results were expressed in terms of albumin excretion rate (μg/min) and albumin concentration corrected for urine creatinine excretion (mg/mmol creatinine).

The creatinine concentration in each urine sample was measured by the Jaffe reaction using a Vickers SP 120 analyser. Each population was examined by age and sex. Results were positively skewed and were log transformed before statistical analysis with linear regression analysis and t tests.

Results

The table shows urine albumin excretion rates in all the children studied. The overall 95% confidence limits for albumin excretion rate were 0·26-12·2 μg/min in the non-diabetic children and 0·49-21·2 μg/min in the diabetic group ($p<0·02$). Non-diabetic boys had significantly lower albumin excretion rates than non-diabetic girls ($t=2·51$, $p<0·02$) and diabetic boys ($t=3·4$, $p<0·01$) and girls ($t=4·1$, $p<0·01$). There was no significant difference in albumin excretion rate between diabetic boys and girls. Diabetic girls tended to be older than diabetic boys (13·8 *v* 12·9 years; $t=1·66$; $0·05<p<0·1$). There was no significant difference in duration of disease (4·8 *v* 5·5 years) or glycaemic control (10·2 *v* 10·3%).

There was a significant linear correlation between albumin excretion rate and age ($r=0·22$, $p<0·05$), duration of disease ($r=0·4$, $p<0·02$), and HbA_1 concentration ($r=0·29$, $p<0·02$) in the diabetic children.

Mean albumin excretion rates and 95% confidence limits using log transformed data (μg/min) in diabetic and non-diabetic children

	Diabetic			Non-diabetic		
	n	Mean	95% limits	n	Mean	95% limits
Male	47	2·97	0·44-20·2	17	1·21	0·21-6·85
Female	39	3·52	0·55-22·7	19	2·56	0·41-15·9
Overall*	86	3·21	0·49-21·2	36	1·80	0·26-12·2

*Diabetics *v* non-diabetics: $t=2·38$, $p<0·02$.

No correlation was found between albumin excretion rate and age in the non-diabetic group (fig 1).

Eleven of the 47 diabetic boys (23%) and two of the 39 diabetic girls (5%) had albumin excretion rates above the upper 95% confidence limit for the non-diabetic controls of the same sex. The mean age of this diabetic group was 14·3 (range 12-18) years and the mean duration of disease 9·3 (range 2-12) years. Their mean (SD) HbA_1 concentration was significantly higher than that in the diabetic children with albumin excretion rates within the reference range (11·6 (2·9)% *v* 9·9 (2·2)%; n=77, $t=3{\cdot}40$, $p<0{\cdot}02$).

In an attempt to assess any effect of puberty on albumin excretion we grouped the diabetic children into those aged less than 12 and those aged 12 and older and matched them for duration of disease to within four months. Overall, the older group had significantly higher albumin excretion rates (n=15; paired *t* test: $t=3{\cdot}23$, $p<0{\cdot}01$, mean of the difference=2·63; fig 2).

Urine albumin concentration expressed as mg/mmol creatinine provided less separation between diabetic and non-diabetic groups, although the results in the diabetics remained significantly higher.

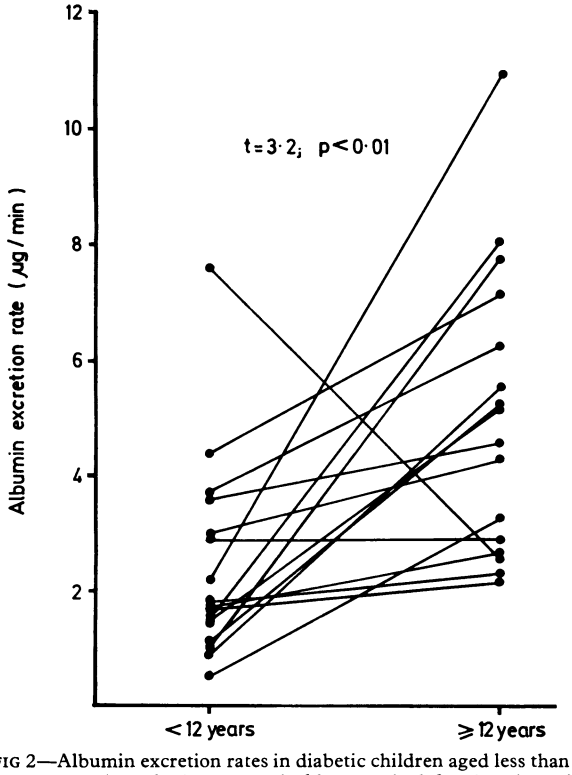

FIG 2—Albumin excretion rates in diabetic children aged less than 12 years and aged 12 years and older matched for duration of disease to nearest four months (see text).

Discussion

These results indicate that subclinical changes in renal function may be present in diabetic children from an early age. Obtaining timed urine samples overnight and calculating the albumin excretion rate may therefore provide a useful and simple non-invasive test in the clinical management of diabetes in children. Furthermore, the test is not subject to unpredictable exercise effects and does not require exercise provocation or extended periods of urine collection. Such variables may explain the lack of a significant difference in resting albumin excretion (urine collection during the day) between juvenile diabetics and non-diabetics in a study by Huttunen *et al*, although their reference range was similar to ours.[10] These workers also noted that both at rest and during exercise the albumin excretion rate was highest in those with poorest glycaemic control and that there was a significant correlation between urine albumin excretion and HbA_1 concentration.[10]

The significant relation between the albumin excretion rate and duration of disease in diabetic children agrees with findings in adult diabetics. The correlation with HbA_1 concentration indicates that the onset of nephropathy may be related to lack of diabetic control. Thus studies in both insulin dependent[11] and non-insulin dependent[12] adult diabetics showed that the development of clinical nephropathy was related positively to albumin excretion rate and urine albumin concentration during long term follow up (over 10 years). Further long term clinical studies are needed to confirm whether improved diabetic control improves the prognosis for renal failure. In the short term stricter glycaemic control reduces exercise induced albuminuria in insulin dependent[13] and non-insulin dependent diabetics.[4]

In the non-diabetic controls there was a significant difference in albumin excretion rate between girls and boys. When the diabetic children were divided by sex 23% of the boys and 5% of the girls had an albumin excretion rate above the 95% confidence limit in their control group. These findings indicate that future studies should be assessed in relation to the sex of the subjects. The fact that roughly five times more boys than girls had increased albumin excretion rates may be relevant as other work suggests that renal failure is more common in men than women.[14] Davies *et al* found a raised overnight albumin excretion rate in 9% of diabetic children compared with non-diabetics but did not give their results according to sex. They suggested that the albumin excretion rate overnight may be a more sensitive indicator of changes in renal function than a daytime measurement (paper presented at third joint meeting of the British Endocrine Society, Edinburgh, 27-30 March 1984 (abstract No 154)).

To our knowledge there have not been any previous reports of increased albumin excretion rates in adolescent compared with preadolescent diabetic children matched for duration of disease. This finding suggests that changes associated with puberty may affect the albumin excretion rate in diabetics. No similar changes could be detected in non-diabetic controls. No information exists on whether such changes are maintained into adulthood.

The significant difference in albumin excretion rate between non-diabetic boys and girls could not be explained by menstrual contamination of the urine. The presence of occult infection of the urinary tract was not investigated. This unexpected finding is being investigated further, and we are studying the diabetic children to assess the clinical usefulness of random urine collections and exercise stimulation tests compared with overnight urine collections.

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