Frequency of stressful life events as risk indicating factors for the onset of type 1 diabetes in African children

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A TOTAL OF 42 CHILDREN AGED 6–15 YEARS with type 1 diabetes, and 49 control children aged 6–14 years, participated in this study. Life events during the year prior to the clinical onset of type 1 diabetes that occurred within the family were recorded on a survey consisting of 45 questions. The mean frequencies of these life events were higher in diabetic children (7.7) than in the healthy control group (4.9). Diabetic children were found to experience higher relative frequencies of stressful life events within the range of 38–48%, compared with the children of the control group (range 8–16%). The highest relative frequency of 55% for both groups was the birth or adoption of a brother or sister. Life events involving actual or threatened losses within the family, such as serious illness or death of the mother, death of brother or sister, or hospitalization of mother or father, showed significantly increased frequencies in the diabetic group (range 10–30%) than in control children (range 4–10%). We propose that these stressful life events may be factors that precipitate severe emotional stress, increasing consequent risk of later development of type 1 diabetes.

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Introduction

Diabetes mellitus is a syndrome with disordered metabolism and inappropriate hyperglycaemia (high blood glucose) due to either a deficiency of insulin secretion or to a combination of insulin resistance and inadequate compensating insulin secretion.[1] An international commission has recommended the term type 1 diabetes for insulin-dependent diabetes (IDDM) and type 2 diabetes for non-insulin-dependent diabetes (NIDDM). Type 1 diabetes is also known as juvenile diabetes.[2] According to Masharani and Karam,[1] type 1 diabetes is immune-mediated in 90% of the cases and in less than 10% is idiopathic (no evidence of autoimmune beta cell destruction). The highest incidence of type 1 diabetes is found in Scandinavia and northern Europe and the lowest in China and parts of South America. Most of the patients with idiopathic type 1 diabetes are of Asian or African origin.

A background to the aetiology of diabetes has been given in a previous paper by the authors.[3] In a disease in which both nature (genes) and nurture (environment) could make a contribution, it is important to identify indicators for the relative proportion of impacting factors. Large differences in the incidence of IDDM observed between various populations and socio-economic classes within populations raises issues concerning dietary and other environmental factors in the development of IDDM.[4] Various nutrition-related environmental factors may influence the onset of type 1 diabetes.[5–9] Socio-demographic factors such as mother's educational level and age, and childbirth order have been related to the risk of IDDM in some study populations.[10,11] Rapid weight and height gain during childhood have both been noted as risk determinants of type 1 diabetes.[12–14] Several studies have suggested the possible aetiological role of stressful life events and psychological factors in the period preceding the clinical onset of diabetes.[15–17]

According to Hines and Moore,[18] there are three basic categories of stressful life events: catastrophic events affecting a large number of people (such as natural disasters, wars), major life events affecting one or a few people (for instance, divorce, loss of a job) and day-to-day adversity (for example irritating and distressing minor incidents). Life changes and to a large extent changes in social structures and processes confront humans with the necessity to adapt. Life changes act as stressors, provoking stress reaction.[19] The relationship between exposure to psychosocial stress and subsequent disease is supported by numerous experimental and epidemiological studies.[20–22] Psychosocial stimuli, including conditions of everyday life, are capable of evoking hormonal responses that may modulate immune function.[20–23]

Diabetes mellitus is increasing in previ-

ously disadvantaged groups in South Africa, Zimbabwe and other African countries, as well as in developed countries, including the Far East (Japan and China). Unlike North America, Scandinavian countries and Japan, Africa has very few epidemiological studies documenting such matters. The clinical characteristics and hyperglycaemic emergencies in black Africans with IDDM and NIDDM have been analysed, identifying infections as a leading precipitating factor for severe diabetic ketoacidosis and non-ketotic hyperglycaemia.[24]

The onset of type 1 diabetes in black African children has not been investigated and discussed in relation to stress and various harsh socio-economic and environmental circumstances. We now report on the frequency and the structure of the stressful life events as risk indicating factors for the onset of type 1 diabetes in black Zimbabwean children.

Subjects and methods

Details of the participating diabetic and control subjects have been given in our previous paper.[3] Both groups (diabetic and control) were considered to have almost the same geographical, social and educational circumstances. A life events questionnaire modified by Hagglof *et al.*[16] in English, and translated into Ndebele, was presented to the families of diabetic and control children. The questionnaire listed 45 stressful life events that could have occurred during the year prior to clinical onset of IDDM. Each question was carefully explained to the children and family members participating in the study. The participants were instructed to answer the questions (reply 'yes' or 'no') and all answers were recorded. Calculation was made of the total frequency of life events and relative frequency of each event. Statistical analysis of the frequencies was by chi-squared test.

The study was approved by the Research Board of the National University of Science and Technology, Bulawayo. Informed consent was received from all families.

Results

The relative frequencies of identified stressful life events experienced by diabetic and control children are presented in Table 1 in supplementary material online. The most frequent event in both groups, with 55% relative frequency, is the birth or adoption of a brother or sister. Stressful life events (2, 3, 6, 10, 15, 16, 18, 34, 39) were recorded with relative frequencies within the range 36–48% in diabetic children. The same events are found to have significantly lower relative frequencies, ranging from 2% to 20%, in the control group. Life event 14 (mother married to a step-parent) occurred with relative frequency of 26% in diabetic children compared to 6% in the control group, whilst event 4 (serious illness or injury of the father) was of similar relative frequency in both groups.

Life events involving actual or threatened losses within the family such as serious illness of the mother, death of the mother, death of brother or sister, and hospitalization of mother or father show significantly increased frequencies in the diabetic group (range 10–30%) relative to the control children (range 4–10%).

The mean frequencies of life events experienced by diabetic and control groups were 7.7 and 4.7, respectively. The total number of life events experienced by the 42 diabetic children was also higher (324 versus 230 by the 49 controls).

Hagglof *et al.*[16] reported that questions 8 (hospitalization of the child) and 45 (serious illness or injury of the child) were excluded from their analysis, as the parents tended to regard the onset of diabetes as a 'hospitalisation' or 'serious illness'. We included these questions as their meaning was verbally explained to the participants as 'another hospitalisation' or 'another serious illness' during the same period of time. The relative frequency of these two events has shown opposite distribution between diabetic and control groups.

We excluded the analysis of the results from the self-esteem analogue scale from our study.[16] The use of this scale requires participants to be able to estimate the severity ('how stressful' or 'how upsetting') of the life event on a scale of 0–100 points.[16] The concept of self-evaluation was found to confuse participants, and the results were deemed to be inconsistent. The analysis of relative frequencies was thus done on the basis of a simple 'yes' or 'no' for the occurrence of each event.

Discussion

Hagglof *et al.*[16] have reported a total mean frequency of life events of 1.9 for diabetic and control children. The result is much lower than in our current study (7.7) and in our previous report (5.84).[3] This may be attributable to the difference in the number of participants (338 in the Swedish survey, and 42 and 19, respectively, in both of our studies). Our sample size was relatively small. Secondly, socio-economic conditions in Zimbabwe and Sweden differ widely.

The significant difference found between this study and our previous investigation could be ascribed to deteriorating socio-economic conditions in the country. There is a change in terms of decrease in parents' financial status of 48% in this study, versus 33% in the previous report. Hines and Moore[18] point out an ambiguity in some questions, such as change in financial situation, as there is no indication of positive or negative direction of the life change. The participants were instructed to indicate direction of the change in our study.

A larger number of severe stressful life events, with higher relative frequencies, was registered in the current study of diabetic children. Increase in number, and the intensity of the changes in the children's life over a specified period of time, raises the risk of undergoing a subsequent decrease in health status.[25]

A comparison between the control groups in our two studies showed almost similar mean frequencies (4.7 versus 4.2, respectively). We postulate that if the stress pattern of response to psychosocial stimuli is more frequent and/or lasts long enough, it may elicit a stronger pathogenic effect.

We compared the ranking of the life events considered as most stressful between our two studies in diabetic children. We observe that in the present study actual losses such as the death of a mother, death of a father, of a brother or sister had higher frequencies of 14%, 12% and 10%, compared to the death of a mother and death of a father of 5% each in our previous report. This report did not record any death of a brother and sister.

Hagglof *et al.*[16] conclude that severe emotional stress, induced by actual or threatened loss within the family, is associated with the onset of childhood diabetes in the age group of 5–9 years. They suggest that this age group could be especially vulnerable to the influence of stressful life events, due to the discrepancy between cognitive skills and actual emotional development. In our age group of 6–14 years, some other factors such as separation traumas, and parents' deteriorating financial status, in conjunction with emotional changes and the perception of personality during puberty, should be taken into consideration.

The immune system is modulated by psychological stress in various ways[26] and severe stress may influence the autoimmune destruction of the beta cells. There is a general trend of progressive beta cell loss in the preclinical stage of type 1 diabetes.[27] Remaining beta cells have an ability to hyperfunction, main-

taining metabolic balance by elevated insulin secretion. Secondary triggers such as emotional stress, onset of puberty, infections, trauma and surgery may lead to hyperglycaemia, due to stress-induced elevated levels of catecholamines, growth hormone and glucagon. This affects the insulin demand by peripheral tissues. Elevated peripheral insulin requirements may be a possible pathophysiological mechanism.[16] Disproportionately elevated proinsulin levels preceding the onset of IDDM, reflecting beta cell dysfunction, were found in siblings of diabetic patients.[28] Newborn siblings have proinsulin levels similar to those of control newborns, indicating that environmental factors later in life could be major determinants.

According to Ganong,[2] stress causes increases in plasma glucorticoids to high 'pharmacological' levels that in the short run are life-saving but in the long run are harmful and disruptive. Hagglof *et al.* [16] have suggested that stressful life events may serve as an initiating factor, turning a prediabetic state into overt type 1 diabetes.

The present study has some methodological problems. Retrospective completion of the questionnaire can introduce errors from memory lapses of interviewees. We found that the parents of a diabetic child, seeking a reason for the child's sickness, are inclined to retain memory of a greater number of life events prior to diabetes diagnosis, compared with the parents of a healthy child.[16,29] This could introduce data bias.

Under harsh socio-economic conditions, the stressful life events adversely affect the day-to-day management of type 1 diabetes in African children. Parents and close relatives need to acquire coping skills, guided by professional experts in the care of diabetes.

Our findings shed light on the latent dimensions of life event stress and the event types' significance. This can be an aid to the implementation of social strategies for the management and control of fully overt type 1 diabetes and its complications.

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Supplementary material to:

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Table 1. Relative frequencies of stressful life events in the diabetic and control children.

Life events		Relative frequencies (%)	
		Diabetic*	Control†
1.	Birth or adoption of a brother or sister	55	55
2.	Serious illness or injury of the mother	38	20
3.	Loss of job by a parent	36	14
4.	Serious illness or injury of the father	21	27
5.	Death of the mother	14	4
6.	Martial separation of the parents	40	6
7.	Jail sentence of parent	14	22
8.	Hospitalisation of the child	14	22
9.	Addition of a third adult to the family	19	4
10.	Change in the parents' financial status	48	8
11.	Death of the father	12	10
12.	Serious illness or injury of a sibling	2	12
13.	Brother or sister leaving home	12	14
14.	Mother married to a step-parent	26	6
15.	Father married to a step-parent	40	12
16.	The family moves to another place	38	12
17.	Discovery of being an adopted child	–	–
18.	Divorce of parents	36	10
19.	Death of a brother or sister	10	4
20.	Hospitalisation of the father	20	12
21.	Mother beginning to work	20	16
22.	Death of a grandparent	21	20
23.	Death of a close friend of the child	5	12
24.	The family changes apartment/house	26	8
25.	Hospitalisation of the mother	21	10
26.	Hospitalisation of a brother	7	6
27.	Beginning of the pre-school year	12	8
28.	Change of pre- or nursery school	7	6
29.	Change of 'nursery mother'	–	–
30.	Beginning of first year of compulsory education	12	6
31.	Change to a different class or school	26	10
32.	Father beginning to work	5	8
33.	Decrease of arguments between parents	5	12
34.	Increase of arguments between parents	38	16
35.	Decrease in arguments with parents	5	8
36.	Increase in arguments with parents	12	10
37.	Outstanding personal achievement	7	22
38.	Beginning of the seventh year of compulsory education	7	8
39.	Failure of a year in school	36	2
40.	Menarche	10	6
41.	Unmarried pregnancy	–	–
42.	Fathering an unmarried pregnancy	–	–
43.	Abortion	–	–
44.	Breaking up with a boy- or girlfriend	2	2
45.	Serious illness or injury of the child	21	12

*$n = 42$; †$n = 49$.