# Effect of War on Glycemic Control in Type II Diabetic Patients

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**OBJECTIVE** — To determine the effect of war-related, protracted stress on glycemic control in type II diabetic patients.

**RESEARCH DESIGN AND METHODS** — We examined 35 patients with type II diabetes as part of their routine control in October 1990. We reexamined them in October 1991, 3 mo after the war in Croatia began. We also administered a questionnaire to assess the patients' exposure to stress and changes in diet and exercise.

**RESULTS** — The patients were exposed to considerable stressors. The wartime diet differed from the prewar diet. We found significant changes in total serum cholesterol and TG values ($P < 0.01$), but we observed no significant changes in body weight, FBG, postprandial blood glucose, and $HbA_{1c}$ values. Insulin and glibenclamide dosages did not change.

**CONCLUSIONS** — We detected no significant impact of stress on glycemic control, probably because of differences in individual stress responsiveness. Changes in the lipid status probably were attributable to changes in dietary habits caused by specific circumstances.

The state of war is a recognized health hazard. The effects of war on glycemic control have not been investigated. Serious fighting in Croatia began in July 1991. By October 1991, several doctors believed that glycemic control in many of their type II diabetic patients had deteriorated. They hypothesized that exposure to war events resulted in disrupted glycemic control, necessitating changes in the approach to treatment.

## RESEARCH DESIGN AND METHODS

— We examined 35 patients, 14 men and 21 women, 38–72 yr of age, with duration of type II diabetes for at least 3 yr. All were residents of Zagreb, Croatia. Each patient was scheduled for a routine control visit in the second half of October 1991 and had completed a previous routine control visit in October 1990. None of the patients was taking any drugs of known adverse effect on lipid metabolism. Of the 35 patients, 7 were being treated with insulin, 21 with glibenclamide, and 7 with diet only.

To measure serum lipids and lipoproteins, we took a venous blood sample during each of the two visits, after a 12-h overnight fast (1–3). At the same time we drew capillary blood to estimate blood glucose and $HbA_{1c}$ levels (4). The patients then took their regular medication and had breakfast. We obtained another capillary blood sample 90 min later to measure blood glucose with the glucose oxidase method.

At each visit the patients were weighed barefoot and in inner garments. Actual body weight was divided by ideal body weight, derived from Metropolitan Life Insurance Tables, and expressed as a percentage.

To provide some measure of the patients' level of stress, they were invited to complete a questionnaire about personal experiences brought on by the war from July to mid-October 1991. The patients were asked how many of their first- and second-degree relatives were involved in combat, wounded, or dead; whether they had experienced loss of property; whether close relatives had been displaced; and whether they were sharing living space with refugee relatives or friends. Other questions asked about the regularity of their meals, the quantity and type of food consumed, and their daily exercise routine, compared with patients' prewar habits.

### Statistical analysis

The distributions of variables were tested for normality and log-transformed where appropriate. The significance of differ-

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TYPE II DIABETES, NON-INSULIN-DEPENDENT DIABETES MELLITUS; TG, TRIGLYCERIDE; FBG, FASTING BLOOD GLUCOSE; CI, CONFIDENCE INTERVAL; HDL, HIGH-DENSITY LIPOPROTEIN.

Table 1—*Clinical characteristics of 35 patients before and during war*

| | Before the war | During the war | *P* value | 95% CI |
|---|---|---|---|---|
| Ideal body weight (%)* | 114.5 ± 16.8 | 113.9 ± 16.6 | 0.72 | −2.4–3.4 |
| FBG (mM)* | 9.9 ± 3.8 | 11.0 ± 3.6 | 0.07 | −2.4–0.10 |
| Postprandial blood glucose (mM)* | 13.4 ± 5.1 | 12.3 ± 3.8 | 0.35 | −1.18–3.26 |
| $HbA_{1c}$ (%)* | 9.13 ± 2.50 | 9.53 ± 2.21 | 0.40 | −1.33–0.54 |
| TG (mM) | 2.46 (0.90–9.37) | 1.84 (0.51–4.77) | 0.002 | 1.12–1.60 |
| Total cholesterol (mM) | 6.67 (4.47–9.89) | 5.93 (3.47–9.18) | 0.001 | 1.07–1.18 |
| Daily insulin dosage (IU) | 42 (36–46) | 48 (40–52) | 0.40 | |
| Daily gliben clamide dosage (mg) | 10 (6.75–15.0) | 10 (7.50–16.25) | 0.68 | |

*Data are means ± SD.
†Data are geometric means (range).
‡Data are medians (interquartile range).

ences between the findings before and during the war were tested with the two-tailed paired Student's *t* test. The Wilcoxon signed-rank test was used for variables not normalized by transformation. The significance of change in the proportions of three different treatments (diet only, oral agents, insulin) was assessed with the Stuart-Maxwell $\chi^2$ statistic (5).

**RESULTS** — The results of our tests on the 35 patients before and during the war are presented in Table 1.

In our study group, 21 patients had close relatives involved in combat, 2 had severely wounded relatives, 8 had relatives that were displaced, 5 were providing refuge for their relatives, and 10 had suffered loss of a house or land. All the patients lived within 1 km of the bombed center of the city, and all lived within hearing distance of cannon fire. They experienced 18 air-raid alarms.

The questionnaire also revealed that 13 patients experienced a slightly reduced food intake in wartime, because of loss of appetite, increasing cost of food, disrupted meal schedule, and difficulty cooking during air-raids. The reduction came mostly in meat and vegetables. In the preceding month, 8 patients had supplemented their diets by eating tinned fish 2–3 times/wk, more than before the war, and 3 patients declared increased consumption of bread and canned pork. The other patients perceived their food intake as irregular, but not changed in daily quantity and quality. None of the patients reported a change in daily exercise, except in the timing.

In the year preceding the second examination, 3 patients were switched from oral agents to insulin. Glibenclamide was introduced in 2 patients who had been treated with diet only. These changes were not statistically significant. Moreover, in 4 of these 5 patients the change in treatment occurred before July 1991.

**CONCLUSIONS** — Despite evidence from animal studies on the deleterious effect of stress on glycemic control in type II diabetes (6), this study has not demonstrated a predictable unidirectional effect of war-related stress on glycemic control. The results confirm the importance of individual response to stressors (7), suggesting a balance of different coping styles in the examined group (8).

The wide 95% CI for differences observed in FBG and postprandial blood glucose and $HbA_{1c}$ point to a possible lack of information, probably attributable to our small sample size. Also, the difference in FBG approaches the 0.05 significance level. The dosages of insulin and oral agents appear to have increased compared with the prewar dosages. This could have accounted for nonsignificant changes in glycemia and $HbA_{1c}$ values, but the increase occurred before July 1991 in 74% of patients whose dosage had been increased since October 1990.

Even with the small sample size, we observed a significant lowering of serum cholesterol. Because of the many comparisons, the difference could be attributable to chance. It could also result from dietary changes, with decreased total calorie intake and possible increase in highly unsaturated fatty acids (9). The change probably was recent because no significant changes occurred in HDLcholesterol values and body weight.

Glycemic control in type II diabetic patients in wartime is more likely affected by imposed and unavoidable behavioral changes than psychological stress, the effect of which probably is modified by individual coping mechanisms.

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