

HOW TYPE 1 DIABETIC PATIENTS WITH GOOD OR POOR GLYCEMIC CONTROL COPE WITH DIABETES-RELATED STRESS

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SUMMARY - Objective: To determine the link between glycemic control and the strategies adopted by patients in coping with diabetes-related stress.

Material and methods: In a cross-sectional study of 122 type 1 diabetic patients, glycemic control was evaluated on the basis of the last mean annual HbA_{1c} level, and a comparison was made of two groups of patients, i.e., those with "good control" (HbA_{1c} < 7.5%) and "poor control" (HbA_{1c} > 8.5%). Sociodemographic were collected for all patients by the referring physician. The nature of the diabetes-related stress and the coping strategies adopted by patients were determined by analyzing validated self-assessment questionnaires.

Results: Comparison showed that there was no significant difference between the two groups in terms of the patients' age, level of education, age at onset, duration of the diabetes, or the nature of diabetes-related stress factors. In contrast, the difference between the groups was significant in that patients in the "well controlled" group carried out more home blood glucose tests ($p < 0.02$), had fewer complications ($p < 0.003$), and made greater use of so-called "task oriented" strategies ($p = 0.023$), regardless of the existence of any complications.

Conclusions: Even though the nature of the diabetes-related stress appears to be the same for the two groups, type 1 diabetic patients with good glycemic control manage their condition differently (more frequent home blood glucose tests) and use coping strategies that place greater emphasis on problem solving.

RÉSUMÉ - Gestion du stress lié au diabète chez le diabétique de type 1 bien ou mal contrôlé.

Objectifs : Définir le lien entre l'équilibre glycémique et les stratégies d'adaptation au stress secondaire au diabète dans le diabète de type 1.


Matériel et méthodes : Dans une étude transversale menée chez 122 patients présentant un diabète de type 1, l'équilibre glycémique a été évalué sur la dernière moyenne annuelle d'HbA_{1c}. Deux groupes de patients ont été individualisés et comparés : ceux dits avec un bon équilibre (HbA_{1c} < 7,5 %) *versus* un mauvais équilibre (HbA_{1c} > 8,5 %). Les données médicales et démographiques ont été recueillies par le diabétologue référent. La nature du stress secondaire au diabète et les stratégies d'adaptation des patients ont été déterminées à l'aide d'auto-questionnaires validés.

Résultats : On note l'absence de différence significative entre les 2 groupes concernant l'âge, le niveau d'étude, l'âge d'apparition et la durée du diabète, ou la nature du stress secondaire au diabète. Par contre, les patients du groupe dit « bien équilibré » font significativement plus de contrôles glycémiques quotidiens ($p < 0,02$), ont moins de complications ($p < 0,003$) et utilisent d'avantage les stratégies d'adaptation au stress dites de « résolution de problème » ($p = 0,023$), qu'il existe ou non des complications liées au diabète.

Conclusion : Bien que la nature du stress secondaire au diabète semble être la même pour les 2 groupes, les patients diabétiques de type 1 ayant un bon équilibre glycémique gèrent leur diabète différemment et utilisent des stratégies d'adaptation au stress privilégiant la résolution de problèmes.

Mots-clés : diabète de type 1, facteurs de stress, équilibre glycémique, adaptation au stress.

Key-words: type 1 diabetes, coping, stress factors, glycemic control.

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As shown by the DCCT study [1], an HbA_{1c} level less than 7.5%, must be achieved if the complications related to microangiopathy in type 1 diabetes are to be prevented or stabilized. This objective can only be reached at the cost of more intensive management involving 3 or 4 daily injections of insulin, the doses being adjusted on the basis of 3 or 4 capillary blood glucose tests per day. In most cases, such an intensive treatment gives rise to several weekly episodes of hypoglycemic malaise which the patient must learn to prevent and treat. Thus, a complex therapeutic behavior pattern must be mastered in learning to personally manage diabetes. However, more than a theoretical knowledge is needed to achieve satisfactory glycemic control [2, 3]. Other parameters appear to be involved, such as socioeconomic status [4], and many psychological variables [5-12], though the link between the latter and glycemic control remains far from clear.

Numerous constraints must also be accepted by the patient in adopting the appropriate long term therapeutic behavior that chronic diabetes implies. Such constraints can cause stress that the patient has to be able to handle. The level of such stress can also be affected by the degree of glycemic control achieved by the patient and the presence of complications. In the stress and coping model used by Lazarus and Folkman [13], the individual is considered to handle stressful situations by using special reactions known as coping strategies, i.e., "a set of cognitive and behavioral efforts designed to control, reduce and/or tolerate" stress factors. Studies on the correlation between glycemic control and styles of coping have yielded contradictory results [14, 15]. We therefore felt that it would be of interest to: 1) describe our sample in terms of a certain number of medical and behavioral variables that would permit evaluation of the extent of diabetes-related constraints accepted by the patients; 2) examine the nature of the perceived disease-related stress as a function of glycemic control, assuming that the variability in the nature of the stress is linked to the patient's level of acceptance of treatment-related constraints; 3) analyze the results concerning the reaction to such stress, i.e., the adoption of coping styles, using a validated psychometric instrument.

■ PATIENTS AND METHODS

Subjects

Were adult type 1 diabetic patients from the Diabetes Unit of the Pitié-Salpêtrière Hospital (Paris, France). Inclusion criteria were as follows: C peptide-negative patients who had been diabetic for at least two years previously, regularly followed-up in our unit for at least 2 years (consultation every 4 to 6 months). All patients had 100% social security cover-

age and were therefore eligible to receive the same quality of medical attention (whether as outpatients or hospitalized patients), irrespective of their socioeconomic status. Over a six-month period, all outpatients (i.e., 187) were approached consecutively at the time of their medical visit and asked to complete a series of self-assessment questionnaires, requiring 40 minutes to answer at home. 43 (23%) refused to participate because of a lack of time. Questionnaires had to be returned by mail. The evaluation of metabolic control was based on the mean of three HPLC determinations of HbA_{1c} carried out over the last 1-year period. As with the DCCT results mentioned above [1], our results were expressed by assigning patients with a mean HbA_{1c} level < 7.5% to the "good control" group (n = 34), and by allocating those with a mean HbA_{1c} > 8.5% to the "poor control" group (n = 48).

144 patients agreed to participate in the study and 22 of these patients (19%) failed to return the questionnaires. However, their metabolic control was similar to that in patients who did return the questionnaires: mean HbA_{1c} 8.2% and 41% of patients with HbA_{1c} < 8%, compared with mean HbA_{1c} 8.4% and 47% of patients with HbA_{1c} < 8%, respectively. Lastly, a total of 122 patients (65% of patients who consulted over a 4-month period and satisfied the inclusion criteria) participated fully in the study.

Clinical and sociodemographic data

Were collected by the diabetologist during the medical visit. Educational level was defined as: 1 = Primary school, 2 = Some high school, 3 = High school graduate, 4 = College. The diabetologist determined the presence of diabetes-related complications on the basis of the last annual assessment and the physical examination, using the following criteria: 1) Retinopathy: at least 5 microaneurysms at ophthalmoscopy, 2) Neuropathy: abolition of Achilles tendon reflex and reduction in perception of the Semmes-Weinstein monofilament, 3) Nephropathy: proteinuria ≥ 20mg/l on 3 occasions, 4) Neuropathy of the autonomic nervous system: evaluated by measuring variations in the R-R interval during standard tests, looking for orthostatic hypotension and, in men, impotence, 5) Coronary heart disease: signs or symptoms at ECG or complementary exploration, 6) Arteritis: abolition or decrease in distal pulse, confirmed by Doppler ultrasound.

Treatment behavior

The two principal criteria used in evaluating the patient's behavior in personal treatment management were the number of home blood glucose tests carried out and daily insulin injections administered. These data were collected retrospectively for a one-year period by the diabetologist, either from the patient's records and/or statements.

Psychological measurements

The following questionnaires were used:

A. The Stress in Diabetic Patients questionnaire (QSD-R): this was originally designed in Germany [16] as a self assessment questionnaire for diabetic patients. Its purpose is to record 45 everyday problems involved in coping with the illness and its treatment. The patient has to evaluate whether the discomfort is perceived, and to what extent it is problematic. Possible replies ranged from “scarcely” to “highly” on a 5-point scale. The French version, obtained after cross-translation, was validated by two successive factorial analyses carried out on our sample. The first produced four principal factors, whose items were very close to the definition of four of the eight factors in the German version. Items which made little contribution ($p < 0.400$) were discarded. The remaining items were subjected to a second factorial analysis which produced two others factors similar to those in the original version. After analyses of the factors, items 1, 2, 4, 5, 6, 8, 9, 10, 12, 13, 14, 16, 18, 19, 20, 21, 22, 24, 25, 26, 27, 28, 30, 31, 33, 34, 36, 38, 39, 40, 41, 42, 43, 44, 45 from the original version were retained in the French version. All statistical analyses are available upon request.

Thus, the following 6 stress factors were selected:

1) physical complaints: 7 items such as “I suffer from body pain related to the diabetes”. Internal consistency $\alpha = 0.76$,

2) psychological distress: 4 items such as “I suffer from inner tension”. $\alpha = 0.81$,

3) leisure restrictions: 6 items such as “I can’t spend my free time as I should like because of my illness”. $\alpha = 0.81$,

4) conscious experience and management of hypoglycemia: 7 items such as “I get emotional when I’m hypoglycemic”. $\alpha = 0.76$,

5) treatment and diet: 8 items such as “I have to give up eating tasty food”. $\alpha = 0.76$,

6) difficulties at work: 3 items such as “my potential for career advancement is limited by diabetes”. $\alpha = 0.78$.

B. One coping questionnaire was derived from the Coping Inventory for Stressful Situations (CISS) [17]. We adapted the original version to a situation encountered by diabetic patients. Patients were given the following instructions: “For many patients, treatment and everyday constraints are a nuisance and can trigger negative emotions. There are many different ways of handling or adjusting to such situations or thoughts: you are asked to indicate what you normally do when you think about your treatment and the constraints imposed by diabetes in your daily life”. The questionnaire contains 48 items and evaluates problem-focused (also called task-oriented) reactions (16 items: e.g., “I decide on a plan of action and I put it into effect”), emotion-focused reactions (16 items: e.g., “I blame myself for not knowing what to do”), and

avoidance reactions (16 items: e.g., “I shall go for a walk”). The patient had to score each item on a five-point scale. The scales were factor-analyzed using confirmatory factor analysis (multiple group method). All alphas (internal consistency) were above 0.79. The inventory gives three scores corresponding to three subscales: task oriented, emotion-focused, and avoidance strategies.

Statistical analysis

Student’s test was used to compare the groups. However, the non parametric Mann-Whitney test had to be used sometimes because of the size of the groups and the distribution of the variables.

■ RESULTS

Sample characteristics and glycemetic control

A total of 122 patients took part in the study. The main characteristics of our sample were: 48% men, mean age 38.9 years, mean duration of diabetes 17.2 years, mean HbA_{1c} 8.2%, and diabetes-related complications present in 39.3% of patients. Three groups of patients were differentiated on the basis of glycemetic control: 34 patients (28%) had HbA_{1c} < 7.5%, 48 (39%) had HbA_{1c} > 8.5%, and 40 (33%) had an intermediate glycemetic status.

In the remainder of the study, we compared only patients with “good” glycemetic control (HbA_{1c} < 7.5%) with those having “poor” glycemetic control (HbA_{1c} > 8.5%). Thus, a comparison of diabetes characteristics and management in the two groups (*Table I*) showed that there was no significant difference in terms of the patients’ age and sex, age at onset of diabetes, duration of the diabetes, or history of severe hypoglycemia (requiring the intervention of a third party). The educational level of “well controlled” patients was higher than that of “poorly controlled” patients, but the difference failed to reach the level of significance ($p < 0.06$). In contrast, the number of patients presenting with one or more complications was significantly higher in the second group than in the first: 62% *versus* 26%, respectively ($p = 0.003$).

As far as patient behavior towards treatment was concerned, the two groups were comparable in terms of the number of daily insulin injections. Conversely, there was a significant difference in the number of daily home blood glucose tests carried out: 3.6 ± 1.7 for the first group *versus* 2.7 ± 1.7 for the second ($p = 0.013$).

Stress factors and diabetes

Table II shows the stress factors found for the entire group of patients and their rating scale: 6 aspects

TABLE I. Comparison of demographic variables, and diabetes characteristics, in 2 groups differentiated on the basis of chronic glycemetic status.

Glycemetic status	HbA _{1c} < 7.5 % (n = 34)	HbA _{1c} > 8.5 % (n = 48)	p
Sex: male (%)	20 (59)	20 (42)	0.176
Age (years)	38 ± 14	43 ± 16	0.065
Educational level	4.3 ± 0.9	3.8 ± 1.1	0.06
Age at diabetes onset (years)	24 ± 10	25 ± 12	0.480
Duration of diabetes (years)	14 ± 11	18 ± 12.5	0.083
History of hypoglycemic coma (%)	15 (44)	21 (44)	0.472
One or more diabetes complications (%)	9 (26)	30 (62)	0.003*
Number of daily blood glucose tests	3.6 ± 1.7	2.7 ± 1.7	0.013*
Number of daily injections	3.1 ± 0.9	3.1 ± 0.9	0.834

Student's test was used to compare patients with good and poor glycemetic control for numeric values. Otherwise, Fisher's exact test was used. *: p < 0.05.

TABLE II. Diabetes-related stress factors for the entire group of patients (n = 122).

	No. of items in French version	Relative score (mean ± SD)
Experience and management of hypoglycemia	7	2.09 ± 1.53
Treatment and dietary constraints	8	1.93 ± 1.09
Diabetes-related psychological distress	4	1.71 ± 1.40
Leisure restrictions	6	1.38 ± 1.48
Physical complaints	7	1.11 ± 0.98
Diabetes-related difficulties at work	3	0.7 ± 1.05

QSD-R score results are expressed in terms of the mean ± SD.

of the illness were perceived as stressful. Since the scales relate to different numbers of items (see Materials and Method), comparisons could only be made in terms of relative scores (raw scores expressed with respect to the number of items). Analysis showed that the two predominant stress factors were: "treatment and diet" and "conscious experience and management of hypoglycemia". However, scores for "psychological distress" and "leisure restrictions" came fairly close to the first 2.

The same held true for the two separate sub-groups of "well controlled" and "poorly controlled" patients. Moreover, no significant difference was noted between the two sub-groups when their scores for each individual diabetes-related stress factor were compared (Table III).

Coping strategies and glycemetic control

The CISS scale gives a score for each style of coping in reply to set questions (see Methods). As Table IV shows, patients make the same use of avoidance and emotional strategies, irrespective of their glycemetic control. On the other hand, by comparison with patients with poor glycemetic control, well controlled patients make significantly greater use of task-oriented strategies when "diabetes-related constraints" are mentioned.

Since the complications of diabetes occur more frequently in patients with poor glycemetic control, we investigated whether the low coping score based on task oriented among poorly-controlled patients was linked to the presence of complications. As Table V shows, this coping score was not statistically different

TABLE III. Diabetes-related stress factors as a function of glycemic control.

	QSDR- relative score		P
	HbA _{1c} < 7.5 % (n = 34)	HbA _{1c} > 8.5 % (n = 48)	
Experience and management of hypoglycemia	1.64 ± 1.22	1.83 ± 1.36	0.541
Treatment and dietary constraints	1.51 ± 1.31	1.85 ± 1.28	0.285
Diabetes-related psychological distress	1.15 ± 1.05	1.81 ± 1.69	0.205
Leisure restrictions	1.12 ± 1.23	1.29 ± 1.23	0.457
Physical complaints	0.67 ± 0.68	1.20 ± 1.20	0.095
Diabetes-related difficulties at work	0.53 ± 0.95	0.70 ± 1.11	0.677

QSD-R relative score results are expressed in terms of the mean ± SD. The non parametric Mann-Whitney test was used to compare the two groups.

TABLE IV. Differences in coping strategy scores as a function of glycemic control.

	CISS score for coping style		P
	HbA _{1c} < 7.5 % n = 34	HbA _{1c} > 8.5 % n = 48	
EMOT	33.8 ± 13.3	37.6 ± 15.9	0.266
TASK	50.4 ± 12.8	42.8 ± 14.3	0.023*
AVOID	39.5 ± 14.9	37.4 ± 15.6	0.567

CISS questionnaire score results are expressed in terms of the mean ± SD. EMOT indicates "emotional strategy", TASK indicates "task-oriented strategy", and AVOID indicates "avoiding strategy". Patients with good and poor glycemic control were compared using Student's test. Any significant differences were confirmed using the non-parametric Mann-Whitney test. * p < 0.05.

for poorly controlled patients, regardless of whether or not they had complications. The same was also true for well-controlled patients. However, no statistically valid comparison could be made due to the small number of patients involved in each sub-group.

■ DISCUSSION

Diabetic patients hoping to achieve glycemic control that would effectively shield them from complications requires not only the acquisition of knowledge and the material means for self-care [4] but also an acceptance of treatment-related limitations. The patients regularly monitored in our department are covered by social security that provides access to identical quality in terms of care and to identical training structures, regardless of their socioeconomic status. However, well-controlled patients have a slightly higher level of education than other patients, although the difference is not statistically significant. In our particular sample, the educational level - which can

TABLE V. Differences in coping strategy scores as a function of glycemic control and presence or absence of any diabetes-related complication.

	Ciss score for coping style			
	HbA _{1c} < 7.5 % n = 34		HbA _{1c} > 8.5 % n = 48	
	Without complication n = 25	With complication n = 9	Without complication n = 18	With complication n = 30
EMOT	34.6 ± 14.5	32.1 ± 9.3	35.9 ± 14.8	40.4 ± 16.3
TASK	51.4 ± 12.9	49.9 ± 11	42.5 ± 17.7	41 ± 10.8
AVOID	41.2 ± 16.2	39.1 ± 8.7	41.6 ± 17.2	35.4 ± 13.4

reflect both socioeconomic status and training to acquire knowledge - is therefore linked to glycemic control, but does not seem to be a determinant factor.

Since treatment-related restrictions can act as a source of stress, we evaluated such constraints in terms of two parameters, i.e., the number of insulin injections and home blood glucose tests performed every day. Well-controlled patients differed significantly from the others in that they carried out a greater number of home blood glucose tests each day. This confirms that the latter parameter gives a clear indication of the quality of glycemic control [2] and the result might also suggest that well-controlled patients are more ready to accept the limitations required in achieving such good control. Studies carried out among adolescents have shown that certain types of behavior noted in reaction to the illness during the first year could be used as predictors of subsequent glycemic control [6, 18]. However, a longitudinal study would be needed to conclusively show that a difference in the level of constraint acceptance partially accounts for the difference in glycemic control. On the other hand, as previously suggested [14], the length of time patients have had to cope with such constraints does not appear to affect glycemic control since the duration of diabetes was no different in the two groups of patients.

Our results indicate that, irrespective of the glycemic status, the principal stress factors were treatment and dietary limitations, and prior experience and management of hypoglycemic malaise. The nature of the prime stress factors is thus comparable between our two groups of patients, although the QSD-R questionnaire cannot be used for quantitative analysis of stress intensity. However, the conclusion may be drawn that, if patients with $HbA_{1c} < 7.5\%$ achieve their result by carrying out a mean of 3.6 home blood glucose tests per day, it is not because these restricting tests have ceased to be a source of stress. Similarly, all patients find hypoglycemic malaise (whose incidence increases as the HbA_{1c} level decreases) stressful. Thus, the blood-testing behavior, essential for correct regulation of the blood glucose level, is still the main stress factor, even when daily efforts are rewarded by glycemic control as the final result.

In our study, the Endler and Parker model was used in analyzing the coping strategies adopted by diabetic patients in response to illness-related stress [19] and provided an accurate measurement of coping styles. The model includes the following three types of strategy in coping with stressful events: 1) task oriented responses, designed to alter the stressful environment in a concrete manner by "solving problems", 2) emotion-focussed responses, aimed at controlling stress-induced emotional distress, without affecting the stressful environment itself, 3) avoidance responses, aimed at lowering stress by sidestepping the actual factors causing the stress. A study has already

been made of the effects of the various strategies on the behavior of patients suffering from chronic diseases other than diabetes [20]. In the case of type 1 diabetes, Smari *et al.* [14] showed that well controlled patients generally adopted "problem-solving" strategies in response to the stressful events of daily life. In contrast, Marrero *et al.* [15] found that poorly controlled adolescents adopted this type of strategy, but in response to stressful situations in their relationship with their parents. For our part, we studied the nature of coping strategies employed by patients not recently diagnosed as being diabetic when faced with stress engendered by management of the diabetes itself. Our results show that our 2 groups of patients make similar use of avoidance strategies. Such strategies allow an escape from reality and are known to relieve stress, especially over the short term [19, 21]. This result comes as no surprise, given that treatment-related restrictions are the major source of stress. On the other hand, the group of well controlled patients is significantly different from the other in that it more frequently adopts task-oriented strategies, meaning that patients place greater emphasis on the possibility of facing up to stressful reality (e.g. by carrying out capillary blood glucose tests and changing their behavior as a function of the results). However, although "task-oriented" strategies are probably suitable for achieving a correct mean blood glucose level, it remains difficult to define the nature of the relationship observed in our sample between such behavior and good glycemic control since no prospective studies have been carried out.

Since well controlled patients have fewer complications, we checked that the presence of complications was unrelated to the lower coping score based on problem solving aptitude. Our results show that poorly controlled patients use fewer problem-solving (task-oriented) strategies, even when they have not yet developed diabetic complications. Yet again, a prospective study would be necessary to determine whether coping strategies alter as the disease progresses, or whether patients adopt specific strategies right from the onset of diabetes, some of which lead to good control while others do not. The study by Smari appears to point to this conclusion since it showed that diabetic patients who made greater use of problem-solving strategies in all of life's stressful situations also achieved better glycemic control. Additionally, psychologists consider that coping styles can be consistently measured using the Endler and Parker coping model.

In conclusion, although the nature of diabetes-related stress is comparable between good and poor glycemic status groups, insulin dependent diabetic patients with correct glycemic control adopt a different approach in managing their illness (more home blood glucose tests) and their adaptation strategies are more frequently based on problem-solving techniques.

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