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ORIGINAL ARTICLE

Attachment and stress in children with type 1 Diabetes and their mothers

Apego y estrés en niños con Diabetes tipo 1 y sus madres

Costa-Cordella, Stefanella[a,f], Luyten, Patrick[a,b,f], Giraudo, Franco[c,d], Mena, Francisca[d,f], Shmueli-Goetz, Yael[a,e,f], Fonagy, Peter[a,e,f]

[a]Research Department of Clinical, Educational and Health Psychology, University College London, Londres, Reino Unido
[b]University of Leuven, Leuven, Bélgica
[c]Faculty of Medicine, Universidad de Chile, Santiago, Chile
[d]Juvenile Diabetes Foundation (Fundación Diabetes Juvenil), Santiago, Chile
[e]The Anna Freud Centre, Londres, Reino Unido
[f]Psychologist

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What do we know about the subject matter of this study?

Type 1 diabetes mellitus (T1D) causes stress in both patients and caregivers. Post-traumatic and parental stress is common in caregivers and affects the child's condition causing higher levels of psychopathology and low adherence to treatment. Attachment is a bio-behavioral system of stress regulation, a key element in caring relationships.

What does this study contribute to what is already known?

Both maternal and child attachment strategies are important in T1D outcomes (DO), although with unexpected sex differences. Maternal avoidant attachment showed association with unfavorable DO and infant secure attachment showed association with favorable DO.

Abstract

Objective: To understand the relationship between attachment and diabetes and the role of stress mediators in children with type 1 diabetes (T1D) and their mothers. **Material and Method:** The following assessment instruments were applied as self-report measures: Attachment Scale (ECR-R), Perceived Stress Scale (PSS), Security Scale (SS), and the Stress in Children (SiC) questionnaire, which were completed by children and their mothers. We analyzed demographic variables, diabetes onset time, and the average of the last three glycosylated hemoglobin (HbA1c) measurements as a parameter of metabolic control in the last year. **Results:** Attachment strategies of both mother and child, as well as maternal stress, showed a significant association with the child's diabetes outcomes, although with important gender differences. **Conclusions:** Both mother and child attachment strategies are relevant aspects of the T1D course.

Keywords:
Type 1 diabetes;
attachment;
stress, emotional bonds;
mother;
caregiver;
children

Correspondence:
Stefanella Costa-Cordella
stefanella.cordella.15@ucl.ac.uk

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Introduction

There is growing evidence on the role of stress in the course of type 1 diabetes mellitus (T1D)[1]. The relationship between stress and T1D is bi-directional (Figure 1) since the burden of diagnosis and treatment of T1D causes stress and, at the same time, stress can directly affect the diabetes control, through physiological mechanisms linked to metabolic control[2] or indirectly, through decreased adherence to treatment[2].

In childhood, the relationship between stress and T1D also involves caregivers, who have the greatest responsibility regarding treatment. Evidence shows that parents of children with T1D suffer from parental and post-traumatic stress. In addition, parental stress affects the course of the condition in the child, which is associated with higher levels of psychopathology and low adherence to treatment.

A bio-behavioral system for stress regulation is attachment. The attachment theory raises the innate human need for generating close emotional ties, which is especially evident during times of stress. The attachment system (AS) gets activated in case of extreme threat which can be external, such as a natural disaster, or internal such as a disease. In childhood, the stress experienced by the child activates the AS towards her/his caregiver, and in the caregiver, the perception of threat to the child activates their care system resulting in helping them to regulate their stress response[8].

The repetition of interpersonal regulation of stress generates a system of expectations about oneself and others, or an 'internal model'[12] of how a care relationships work, rising a pattern or strategy of attachment.

There are four predominant attachment strategies: secure, anxious-avoidant, anxious-ambivalent, and disorganized. Children with secure attachment pattern express their stress knowing that the caregiver will recognize it and calm them down. When the child presents this type of attachment, the stress decreases, deactivating the AS.

In the anxious-avoidant pattern, children tend not to show signs of stress even when it is physiologically active. They present an affective over-regulation suppressing signs of stress in order to stay close to the caregiver, fearing their rejection when expressing negative emotions, and they also do not look for the caregiver in stressful situations[15].

In contrast, the anxious-ambivalent pattern characteristics show an exaggerated expression of discomfort to get the caregiver's attention, who often responds inconsistently. Emotions are under-regulated and stress appears with intensity, however, closeness to the caregiver does not calm the child down and the stress response -as well as the AS- remain activated[15].

Children with disorganized attachment show an inconsistent pattern resulting from repeated experiences with threatening caregivers who are unable to recognize and calm down the stress in their children, resulting in chronic activation of negative emotional states[15].

According to longitudinal studies, attachment is important and can be measured throughout the life cycle, with 69 to 75% concordance between childhood and adulthood. Attachment measurements can be categorical and classify the subject into a specific or dimensional attachment strategy, and place the subject within a continuum between secure and insecure attachment.

The relevance of individual differences in attachment over the course of T1D has been demonstrated. Patients with anxious-avoidant pattern have less adherence to treatment than those with secure and anxious-ambivalent attachment. Parents of children with T1D that present the avoidant pattern have greater parental stress and more negative impact of T1D than those caregivers with other attachment patterns.

The patient-physician relationship mediates the association between attachment and adherence to treat-

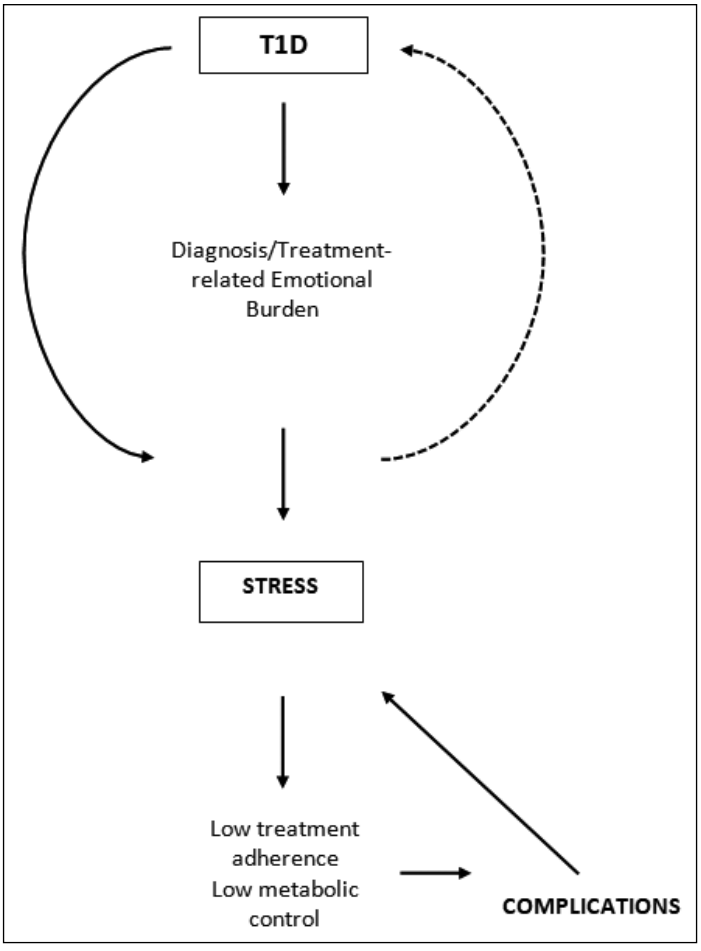

Figure 1. Bidirectional Association between Type 1 Diabetes (T1D) and Stress.

ment. A population-based study in adults with T1D and T2D (n = 4,095)[20] showed that patients with secure attachment presented higher collaboration levels with the medical team than those with other attachment styles, showing better adherence to treatment.

The AS has a direct effect on the stress response which is regulated in a cooperative process with attachment figures[23]. Therefore, the relationship between attachment and stress is bi-directional, with two possible paths: stress activates the AS which regulates the stress response, thus reestablishing the homeostasis or, conversely, its ineffective activation triggers the activation of so-called 'secondary attachment strategies' (hypo- and hyper-activation) which are insufficient to regulate stress (Figure 2). This triggers a chronic stress activation which reactivates secondary attachment strategies, in a vicious circle that would generate an allostatic load, which would explain the origin of certain diseases related to the dysregulation of the main endocrine system for stress regulation, the hypothalamic-pituitary-adrenal (HPA) axis.

In T1D, chronic AS activation generated by stress can cause metabolic dysregulation resulting in unfavorable control.

Adolescence is known as a particularly sensitive period for deregulation. For this reason, the adolescent population with DM1 has been extensively studied, unlike the previous stage, which represents an important gap considering that during pre-adolescence the foundations for self-care are laid. In addition, it is known that one cause of non-adherence during adolescence is the slow transfer of responsibilities from parents to the adolescent. Therefore, it is important to study the pre-adolescent population.

Furthermore, there are no studies that consider how the attachment patterns of children with T1D and their caregivers influence diabetes outcomes (DO). Also, the role of stress as a mediator in the relationship between attachment and diabetes has not been studied.

In response, the following hypotheses were investigated:

1) Greater security of attachment, both in caregivers and children, is associated with favorable DO.
2) Higher levels of stress in both children and caregivers are associated with unfavorable DO.
3) Stress (of the caregiver and/or child) mediates the relationship between attachment (caregiver and/or child) and DO.

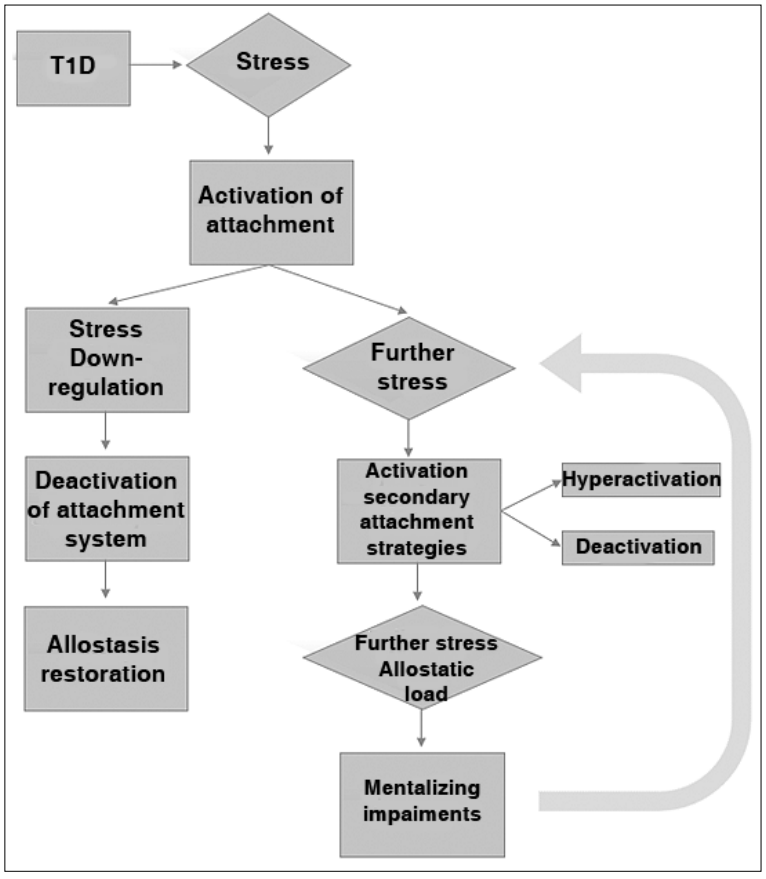

Figure 2. Attachment and Stress Activation/Deactivation Process.

The objective of this study is to understand the relationship between attachment and diabetes and the mediator role of stress in children with T1D and their mothers*. Using a cross-sectional design, we used empirical data from self-report measures completed by children aged between 8 and 12 years and their mothers.

Material and Method

An observational study was conducted with children and their mothers, members of the *Fundación Diabetes Juvenil de Chile* (Juvenile Diabetes Foundation of Chile), were asked to participate via email. Those who were interested in participating were given an information sheet, informed consent, and a link to the study website (RedCap platform).

This study was approved by the ethics committee of the University College London (the United Kingdom, UCL Research Ethics Committee) number 8899/001.

Inclusion criteria

Children aged between 8 and 12 years with their mother with at least one year since the diagnosis of T1D.

Exclusion criteria

Psychiatric diagnosis (child or mother) and concomitance with other chronic diseases.

Table 1 shows the instruments used to evaluate the participants.

Data analysis

Pearson's correlations between the study variables were carried out using the SPSS 24 software. Each correlation was analyzed in boys and girls independently, considering, in an exploratory manner, the possibility of sex differences appearing in any of the relationships. This was decided based on the results of previous studies in diabetes and psychology**.

Hayes (2012) PROCESS macros for SPSS 24 software were used to explore the mediating role of stress

* In order to safeguard homogeneity in the sample, only mothers were included as primary caregivers, considering the data from the CASEN survey (2011), which indicates that fathers represent only 4% as primary caregivers in Chile.

** In this study, gender differences were not addressed from the design and theoretical formulation of the study, so they are not part of the working hypotheses.

Table 1. Measures used and Variables

Variable	Instrumento	Descripción
Diabetes (child)	Glycosilated Haemoglobin (HbA1c)	Indicates average blood glucose concentration over the previous 90-120 days, is considered the best marker of longer-term diabetes control[30] In pediatric patients is values lower than 7% are recommended and higher levels are associated with chronic complications The mean of the last three recorded HbA1c levels was used for analysis, as a parameter of the last year's metabolic control
	Pediatric Quality of Life Inventory[2] (diabetes module parent-report PEDSQoL 3.2)	Measures the child's Parent-Reported Diabetes Specific Quality of Life. It is a key psychosocial indicator, as asuggested by international clinical guidelines. The integration in the everyday life of the condition is assessed. Responses are on a 5-point Likert scale (ranging from never a problem to almost always a problem) with higher scores meaning fewer problems (therefore, higher Diabetes Specific Quality of Life). In this study, the scale was used as an indicator of DO
Attachment (mother)	Experience in Close Relationships Scale-Revised[4] (ECR-R) Chilean Version[5]	Assesses attachment styles in adults through items scored using a 7-point Likert format It measures two attachment dimensions: anxiety and avoidance (18 items each scale)
Stress (mother)	Perceived Stress Scale[6] (PSS) Chilean Version[7]:	A 14-item questionnaire where participants are asked to report how often they felt in a particular way during the past month, from 1 ('never') to 4 ('very often'), with higher scores representing higher levels of perceived stress
Attachment (child)	Security Scale[8] (SS) Latinamerican version[9]:	A 15-item questionnaire that assesses a child's perception of attachment security in relation to their mother. Items are scored from 1 to 4, with a higher score indicating greater perception of security
Stress (child)	Stress in Children (SiC)[10] Chilean version[11]	a 21-item questionnaire for school-age children designed to assess perceived distress, levels of well-being and aspects of coping and social support. Participants are asked to rate how often they thought or felt a certain way during the last month, ranging from never to very often, with higher scores meaning higher levels of stress

(of the child and caregiver) in the relationship between attachment and diabetes.

Results

Sample description

77 mother-child dyads were recruited, distributed in 44.2% boys and 55.8% girls. The average age of the children, considering both sexes, was 10.12 ± 1.57 years and that of their caregivers 38.95 ± 7.07 years. They were also asked about their educational and socioeconomic level (table 2). None of the study variables showed a significant correlation with socio-demographic variables.

Table 2. Sociodemographic description

	Media (SD) o %	n
Mothers information		
Age (Years)	38.9 (± 7.07)	77
Educational Level (%)		
Basic/elementary school	2.6%	2
Secondary school	14.3%	11
Technical education incomplete	9.1%	7
Technical education complete	23.4%	18
University incomplete	14.3%	11
University complete	27.3%	21
Postgraduate studies	9.1%	7
Socioeconomic level (%)		
High	44.2%	34
Middle	48.1%	37
Low-middle	6.5%	5
Poverty	1.3%	1
Children Information		
Age (Years)	10.12 (± 1.57)	77
Sex (%)		
Female	55.8%	43
Male	44.2%	34
Time since diabetes onset (months)	38.7 (±31.8)	77
Hba1c	8 (±1.2)	77

Correlations

Table 3 shows the results of Pearson's correlation analyses.

Caregiver attachment and diabetes

In children, there was a high negative correlation between levels of anxious-ambivalent and anxious-avoidant attachment of caregivers and diabetes-specific quality of life (D-QoL) in children (r= -.50, p< .01; r= -.42, p< .01, respectively). In other words, in boys, the higher the anxiety or avoidance of the mother, the lesser the D-QoL.

In contrast, in girls there was no significant correlation between caregiver attachment and D-QoL, however, the variable HbA1c showed a negative correlation with caregiver avoidance (r= -.33, p<.01). That is the more avoidance, the better metabolic control in girls.

Child attachment and diabetes

D-QoL showed no significant correlation with the attachment of the child.

HbA1c showed a negative correlation with secure attachment in boys (r = -.35, p < .05) but not in girls. That is to say, the more secure the attachment, the better the DO in children.

Caregiver Stress and Diabetes

Perceived caregiver stress (PSS) showed a negative correlation with D-QoL (r = -.32, p < .05) in boys, but not in girls.

In girls, the PSS showed a negative correlation with HbA1c (r=-.41, p<.05), showing that the higher maternal stress, the better the DO in girls, contrary to expectations.

Child stress and diabetes

Surprisingly, none of the stress scales in children showed any correlation with HbA1c or D-QoL.

Mediation models

No mediation model was significant.

Table 3. Correlations between Child's Attachment (SS), Mother's Attachment (ECR) and Diabetes Outcomes (PEDSQoL and HbA1c)

		All ECR Scale Mother's Attachment)			Boys ECR Scale (Mother's Attachment)			Girls ECR Scale (Mother's Attachment)		
		Avoidance	Anxiety	SS (child's attachment)	Avoidance	Anxiety	SS (child's attachment)	Avoidance	Anxiety	SS (child's attachment)
Dimensions PEDSQoL	PEDSQoL Total	-0.502**	-0.420**	0.203*	-0.322*	-0.285*	0.194	-0.261	-0.548**	0.166
	Hba1c	-0.003	-0.022	-0.166	0.291‡	-0.017	-0.358*	-0.334*	-0.056	0.096

Note: ‡p < 0.1; *p < 0.05, **p < 0.01.

Discussion

We assessed the relationship between attachment, stress, and diabetes in children with T1D and their mothers. The results indicate that maternal and child attachment strategies are relevant in the DO, although with important sex differences that were not anticipated. In children, as expected, maternal avoidant attachment showed association with unfavorable DO*** while infant secure attachment was associated with favorable DO. This is in line with previous studies where patients with insecure attachment showed unfavorable DO[20], especially those with anxious-avoidant attachment[19].

This study specifically analyzed the mother's attachment since it is known that mothers with anxious-avoidant attachment tend to reject their children's expressions of vulnerability, emphasizing self-efficacy and achievement. Thus, these children learn to omit the expression of attachment needs due to fear of maternal rejection, achieving early autonomy at a high socio-emotional cost (the expression of the emotions is suppressed and there is a tendency towards social isolation)[10] and at the physiological level (the stress response is activated without appearing in behavior, so it is not recognized and becomes more difficult to regulate)[16].

Our results show that this interactive system could affect differently according to sex, and this forces us to discuss the results considering this variable despite not having contemplated it in the theoretical formulation of the research problem.

In boys,, stress dysregulation resulting from the maternal avoidance attachment is associated with unfavorable DO. In contrast, in girls, maternal neglect would push them towards early autonomy sufficient to control diabetes (at least in the short term), although this strategy is likely to be characterized by compulsive self-sufficiency which, as such, tends to fail in the long term.

This sex difference could be understood from an anthropological and social perspective. First, caring for one's body is experienced differently by women than by men. In Latin American cultures, women are perceived as innate caregivers (woman and mother as synonymous) of others and themselves. Second, Western culture values control of one's body, especially in women, which is reflected in the value of thinness and control of sexual impulses linked to the feminine[38]. And finally, the T1D treatment promotes and rewards control, due to its evident value in the metabolic balance. These three points show how rewarding could be for girls to fulfill the cultural mandate of control, and especially when intertwined with the rejection of vulnerability implicitly contained on maternal avoidant attachment.

*** DO will be used to refer to the HbA1c and D-QoL indicators indistinctly, both as 'Diabetes Outcomes' proxy variables.

Maternalavoidant pattern in boys, on the one hand, seems to result in non-controlled diabetes, but in girls, on the other hand, seems to strengthen the idea of taking care of themselves. However, this efficient strategy for achieving positive DO (in the short term) is likely to fail in the long term due to its high psychosocial and metabolic cost (dysregulation). For instance, girls who had good control in childhood (short-term) have developed eating disorders (ED) in adolescence (long-term).

The rigorous control of food involved in the treatment of diabetes has been identified as the main risk factor for ED in the population with T1D[40]. In addition, women are at risk of developing ED twice than men. Our results support the idea that, in the context of insecure attachment, an effective strategy for diabetes control in the short term can share the root with mental disorders in the long term.

This is also in line with our results on stress. Highest maternal stress was associated with unfavorable DO in boys, while in girls, we observed the opposite pattern: the higher the maternal stress, the more favorable the DO. This demonstrates the fundamental role of maternal stress in the development of child self-care. Childhood stress, in contrast, showed no significant associations with attachment or diabetes.

The discussion on sex differences should be approached with caution. It is possible that the sex variable plays an important role, especially considering the differences in male and female pubertal development; however, our design does not allow us to delve into this point. Future studies should consider including an assessment of participants' stage of puberty using the Tanner Scale.

Regarding the third hypothesis -the mediating role of stress- there were no significant results. This may be explained in part by the limitations of this study, explained below.

The observational, cross-sectional, and self-reporting design does not allow us to extract causal relationships from our results. Future research should consider longitudinal designs to unravel the effectiveness of long-term strategies. In addition, future studies would benefit from using experimental procedures and biological stress measurements. Another important limitation of our study is the lack of distinction in HbA1c measurement techniques that could affect the results. Although it is likely that most participants have used the DCA 2000+ method for capillary HbA1c (since it is the most used in Chile) we cannot state this with certainty. Future studies should clearly establish this distinction and consider it in the analyses.

Finally, our results reflect that the different ways of interpersonal bonding in care relationships are important in health; both in considering the mother (and her

own subjectivity) in pediatric treatments and in the relevance of the patient-physician relationship.

Ethical Responsibilities

Human Beings and animals protection: Disclosure the authors state that the procedures were followed according to the Declaration of Helsinki and the World Medical Association regarding human experimentation developed for the medical community.

Data confidentiality: The authors state that they have followed the protocols of their Center and Local regulations on the publication of patient data.

Rights to privacy and informed consent: The authors have obtained the informed consent of the patients and/or subjects referred to in the article. This document is in the possession of the correspondence author.

Conflicts of Interest

Authors declare no conflict of interest regarding the present study.

Financial Disclosure

Authors state that no economic support has been associated with the present study.

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