
Comorbid chronic physical illnesses in type 1 diabetes adolescents: Personal, caregiver, and family functioning

Enfermedades físicas crónicas comórbidas en adolescentes con diabetes tipo 1: Funcionamiento personal, de la persona cuidadora y de la familia

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Abstract

Having diabetes and comorbid chronic physical illnesses (CCPIs) suggests a higher risk for depression and lower health-related quality of life and treatment adherence. Caring for these patients is often overwhelming. Although CCPIs affect youths with type 1 diabetes (T1D), no study has examined the psychosocial or health-related impact of CCPIs in this population. We examined individual, caregiver, and family functioning differences among T1D adolescents with (G1; $n = 25$) and without (G2; $n = 26$) CCPIs. Participants were 51 youth (aged 12-17 years) enrolled in a depression treatment study. We administered diagnostic interviews and rating scales to assess each domain of interest. Using MANOVA, followed by individual univariate analyses, and Chi-square tests, we compared groups in continuous and categorical variables, respectively. MANOVA results were significant, $F(4, 46) = 2.62, p = .047$. Participants from G1 obtained lower global functioning scores compared to G2. Caregivers whose offspring had CCPIs were more depressed and reported higher burden but lower family functioning scores than their counterparts did. A higher percent of youths with CCPIs needed reminders about insulin use and met the criteria for major depression, but a lower proportion had access to insulin pumps. Taking care of youths from G1 was associated with a lifetime history of depressive disorder or suicidality. Our findings support the existence of individual, caregiver, and family functioning differences between T1D adolescents with vs. without CCPIs. Psychosocial interventions should consider the incremental burden that CCPIs may pose over these youth and their families.

Keywords: adolescents, chronic physical illness, comorbidity, Hispanics, type 1 diabetes

Resumen

Tener diabetes y enfermedades físicas crónicas comórbidas (EFCCs) sugiere mayor riesgo de depresión, menor calidad de vida relacionada con la salud y menos adherencia al tratamiento. Cuidar tales pacientes suele ser agobiante. Aunque las EFCCs afectan a jóvenes con diabetes tipo 1 (DT1), no existen estudios sobre su impacto psicosocial o en la salud en esta población. Examinamos diferencias en funcionamiento individual, familiar y entre personas cuidadoras de 51 adolescentes (12–17 años) que presentaban DT1 con (G1; $n = 25$) y sin (G2; $n = 26$) EFCCs y participaron en un estudio de tratamiento para la depresión. Administramos entrevistas diagnósticas y cuestionarios para evaluar cada dominio de interés. Utilizando MANOVA, seguido de análisis univariados, y el Chi-cuadrado, comparamos los grupos en variables continuas y categóricas. El MANOVA fue significativo, $F(4, 46) = 2.62, p = .047$. El G1 mostró un funcionamiento global menor que el G2. Quienes cuidaban adolescentes del G1 reportaron más sintomatología depresiva, una carga parental mayor y un funcionamiento familiar menor que sus contrapartes. Un porcentaje mayor de jóvenes con EFCCs necesitó recordatorios para usar insulina y cumplió criterios de depresión mayor, pero una proporción menor accedió a bombas de insulina. Cuidar adolescentes del G1 se asoció con presentar un trastorno depresivo o tendencias suicidas alguna vez. Nuestros hallazgos respaldan que existen diferencias en funcionamiento individual, familiar y de personas cuidadoras de adolescentes con DT1 con y sin EFCCs. Las intervenciones psicosociales deben considerar la carga incremental que las EFCCs representan para tales jóvenes y familias.

Palabras Claves: adolescentes, enfermedad física crónica, comorbilidad, origen hispano, diabetes tipo 1

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Diabetes is a chronic illness that requires ongoing medical attention and the use of diverse self-management strategies to prevent and reduce the risk of acute and long-term complications (American Diabetes Association [ADA], 2021). The total direct and indirect estimated costs of diagnosed diabetes in the United States (U.S.) in 2017 were \$327 billion (ADA, 2018). By 2019, the crude prevalence of diabetes for people aged 18 and older in Puerto Rico was 16.7%, and the age-adjusted prevalence was 14.4%, both of which were significantly higher than the median rates of 10.7% (crude) and 9.4% (age-adjusted) for the U.S., including the 50 states and Washington DC (Centers for Disease Control and Prevention [CDC], 2021a). Most recent data for the U.S. (CDC, 2020) show a prevalence rate (0.25%) for pediatric diabetes that is considerably lower than rates historically reported for youths in Puerto Rico (Haddock & de Conty, 1991; Puerto Rico Department of Health [PRDH], 2016).

Most adult patients with diabetes have at least one comorbid physical illness, which is often chronic (ADA, 2021). In a study conducted with adults (mean age = 70.3 years) from Catalonia (Spain), 82% of patients with type 2 diabetes (T2D) showed 2 or more comorbidities and 31% exhibited 4 or more comorbidities (Mata-Cases et al., 2019). In a clinical sample of Hispanic adults with diabetes (Ell et al., 2009), rates for CCPIs were as follows: gastrointestinal disease (14.0%), eye disease (15.2%), arthritis (36.2%), and chronic pain (32.6%). Data for 2012 showed that, among adults from Puerto Rico with diabetes, 49.5% presented arthritis, 20.0% had a coronary disease, 12.7% suffered a heart attack, 11.7% had comorbid asthma, 6.7% had concurrent cancer, and both kidney disease and stroke occurred in 5.4% of the cases (PRDH, 2014). About 69.5% of the patients

had at least one CCPI. On the other hand, data for 2013 reflected that 33.82% of Puerto Rican adults with diabetes aged 18 to 64 years presented two or more comorbidities (PRDH, 2016). More recently, age-adjusted data from 2019 revealed that, among adults 18 years old and above diagnosed with diabetes in Puerto Rico, 65.7% presented hypertension and 52.1% had dyslipidemia (CDC, 2021b). However, the rates of CCPIs among Hispanic youths with diabetes living in Puerto Rico are unknown.

Compared to those who only have diabetes, adults with diabetes comorbid with Major Depressive Disorder (MDD) are significantly more likely to be diagnosed with CCPIs and to have a higher number of these comorbidities (Fugger et al., 2019; Novak et al., 2016). Among adults with diabetes, the odds for MDD are higher in the presence of coexisting chronic conditions (Egede, 2005; Lankarani & Assari, 2015). In another study, patients with coexisting medical complications living in the Caribbean islands of Trinidad and Tobago had higher levels of depressive symptoms than those with diabetes alone (Frederick & Maharajh, 2013). Among low-income Hispanics with diabetes and MDD living in California, depression severity was significantly associated with diabetes complications and medical comorbidity (Ell et al., 2009).

Patients with CCPIs have to adhere to multiple treatment regimens, which may reduce their ability to sustain their compliance with all treatments for long periods (An & Nichol, 2013) and the time and energy left for diabetes care (Piette & Kerr, 2006). In such conditions, they may present more psychiatric complications, a lower level of global functioning, increased treatment costs, a higher caregiver's burden, and more challenges for successful

diabetes management and for obtaining benefits from treatment (Huang et al., 2008; Reeves et al., 2015; Roy et al., 2016; Suh et al., 2008). In a study conducted in South Korea, among patients with depression and diabetes, the incidence of serious psychiatric outcomes (e. g., psychiatric hospitalization and suicide attempts) was lower in patients without diabetes complications than among their counterparts (Kim et al., 2015). In a longitudinal study of patients with T2D aged 65 years and above, greater improvement in glycemic control rates was evident in those without comorbidities (Suh et al., 2008). On the other hand, in a group of adults with T2D treated with Cognitive-Behavioral Therapy (CBT), the presence of diabetes complications was a significant independent predictor of diminished response to depression treatment (Lustman et al., 1998).

Patients with diabetes and CCPIs experience a lower health-related quality of life (HRQOL) than those with no chronic disease or only one chronic disease (Bowker et al., 2006). Nguyen et al. (2019) reported similar results among elder patients with T2D in Vietnam. However, among a sample of predominantly obese youth with T2D (39.6% Hispanic), a significant correspondence between impaired HRQOL and the number of comorbidities was noted only when the presence of clinically significant depressive symptoms was included among the comorbidities examined (Larkin et al., 2015). The presence of hypertension, dyslipidemia, and micro-albuminuria (alone or in combination) did not relate with HRQOL.

Type 1 diabetes (T1D) is one of the most economically and behaviorally demanding chronic illnesses because of its rigorous treatment regimen (ADA, 2021; Silverstein et al., 2005). People with T1D diabetes

have to regularly deal with self-care behaviors, which include daily insulin use, frequent blood sugar monitoring, following a healthy meal plan, and an exercise routine. This condition accounts for between 89% and 95% of diabetes cases in children and adolescents (ADA, 2021; CDC, 2020). In the U.S., the average cost per person with diabetes in people younger than 18 years old is higher than those of any other age group, except for people aged 65 years or older (ADA, 2018). CCPIs pose a particular burden for people with diabetes and their families by significantly increasing their costs of care (Cortaredona & Ventelou, 2017).

As argued by Dabalea et al. (2017), the prevalence of complications and comorbidities in children and adolescents is higher among those with T2D diabetes compared with T1D cases. Still, according to these authors, 32% of young patients with T1D develop a comorbid condition or complication early after diagnosis. T1D during puberty is an accelerator of risk for diabetic complications (Cho et al., 2014). CCPIs in T1D youth may include thyroid disorders, celiac disease, gastrointestinal problems, cardiovascular disorders, pulmonary disease, anemia, migraine, hypertension, dyslipidemia, nephropathy, retinopathy, and neuropathy, among others (ADA, 2021; Dabalea et al., 2017; Fazeli-Farsani et al., 2015; Silverstein et al., 2005). Children with T1D generally need assistance from their family, particularly their caregivers, to manage the routine care of their condition (Naughton et al., 2014). Given the additional treatment demands imposed by CCPIs on patients, youth with T1D and comorbid CCPIs (compared to their counterparts with no CCPIs) may experience even more difficulties to maintain optimal functioning without requiring additional assistance from their caregivers.

The requirement of additional assistance from parents and other family members during adolescence is inconsistent with developmental expectations for increased responsibility and independence of diabetes care and the usual desire for autonomy experienced by most youth during this period (ADA, 2021; Chen et al., 2017). Such inconsistency may elicit conflict among T1D adolescents and their main caregivers (Matos-Melo & Cumba-Avilés, 2018). Under these circumstances, their caregivers and families might also experience a higher caregiver burden and a lower family functioning, respectively, given the overwhelming experience of increased care demands (Whittemore et al., 2012). Feelings of overwhelm and overburden might be higher among caregivers and families of T1D youth with CCPIs as compared with their counterparts without CCPIs. Although CCPIs are thought to be prevalent among T1D youths (Silverstein et al., 2005), no published study has examined its psychosocial or health-related impact among this population, their caregivers, and their families as compared with youth who only present T1D.

In this study, we aimed to examine if individual, caregiver, and family functioning differences exist among T1D youths with (Group 1 [G1] $n = 25$) vs. without (Group 2 [G2] $n = 26$) CCPIs. We hypothesized that adolescents with CCPIs would show lower global functioning than youths from G2, and that caregivers from G1 would report higher depressive symptoms and parental burden, as well as lower family functioning scores, than caregivers of youths without CCPIs. We also expected that a higher percentage of youths in G1 would need insulin reminders and meet the criteria for MDD, but a lower proportion would be using an insulin pump at study enrollment. Finally, we supposed that a higher percent of caregivers from G1

would report a history of any depressive disorder or suicidality when compared to caregivers from G2.

Methods

Participants

Participants were 51 T1D Hispanic youth (29 women) aged 12-17 years old ($M = 15.26$) recruited during a CBT for depression study held at the University of Puerto Rico, Río Piedras Campus. Youths attended public (66.67%) and private schools in Puerto Rico. About 43.14% lived in a Metropolitan area. About 45.10% (23) belonged to homes in which both parents lived together. Their mean score in the Children's Depression Inventory (CDI) was 19.53. Adolescents' most recent glycosylated hemoglobin test (as reported by their private laboratory) before study enrollment yielded a mean of 9.14 (range from 5.76 - 17.70). Their mean T1D duration was 6.12 years ($SD = 3.88$). The mean family household size was 4.02 members ($SD = 0.95$; range: 2 to 7). About 86.27% of caregivers (aged 32 to 58 years old) were women. The mean caregivers' age was 43.45 years ($SD = 6.59$) and their mean education was of 14.63 years ($SD = 2.47$). As reported by primary caregivers, most of their families (72.55%) were from low/medium-low socioeconomic status. Mean annual family income (in U.S. dollars) was \$37,024.42 ($SD = 3,837.64$). About 39.2% (20) of the families lived under U.S. poverty levels.

For inclusion in the main study, T1D youths must be 12 to 17 years old, obtain a CDI score ≥ 13 or a score ≥ 44 in the Children's Depression Rating Scale-Revised, and be willing to participate in weekly group sessions if eligible. Psychotic symptoms, bipolar or schizoaffective disorder, last-year substance dependence or abuse, current treatment for depression, current child maltreatment, imminent

suicide risk, a cognitive deficit that may limit participation, and having a mental disorder (other than depressive disorder) that was the primary need for intervention, were among exclusion criteria (Cumba-Avilés & Sáez-Santiago, 2016).

Measures

Socio-Demographic Data Form

We collected data about youths' sex, age, employment status, ethnicity, grade, and type of school attended. Caregivers provided much the same information (the first four items), as well as details regarding their specific job and their level of education. In addition, we asked about annual family income, perceived socioeconomic status, and the number of lifetime diabetes-related hospitalizations. Primary caregivers provided the latter information.

Diagnostic Interview Schedule for Children-IV (DISC-IV) – Spanish Version

This structured interview assesses DSM diagnostic criteria for several mental disorders in youths. Its Spanish version has shown adequate reliability in community samples of Hispanic caregivers and youth from Puerto Rico (Bravo et al., 2001) and has been successfully used in clinical samples with parents of Puerto Rican school-age children (Cumba-Avilés et al., 2002), as well as with depressed adolescents and their caregivers (Bernal et al., 2019). Caregivers and adolescents in the current study completed the Major Depression module at the screening interview. Although designed to yield a DSM-IV diagnosis, we asked additional questions (when needed) to ensure compatibility with DSM-5 criteria, including probes about exclusion criteria and any data needed to make a differential diagnosis.

MINI International Neuropsychiatric Interview-Spanish Version 6.0

This diagnostic interview assesses criteria for most common mental disorders in adults (Pettersson et al., 2018). For this study, we used Major Depression, Dysthymia, and Suicidality modules to identify a history of depression and/or suicidality (e.g., morbid/suicide thoughts or suicide behaviors) among caregivers. Although designed for assessing DSM-IV criteria, we adapted its diagnostic algorithm to ensure compatibility with DSM-5 criteria.

MINI International Neuropsychiatric Interview-Spanish Kid Version 6.0

This diagnostic interview assesses criteria for most common mental disorders in children (Sheehan et al., 2010). For this study, we used the Major Depression module and other relevant information needed to make a differential diagnosis. Although designed for assessing DSM-IV criteria, we adapted its diagnostic algorithm to ensure compatibility with DSM-5 criteria.

Children's Global Assessment Scale (C-GAS)

It consists of a single score that ranges from 1 (most impaired) to 100 (healthiest). Psychology graduate students rated youths considering their worst level of functioning in the previous month. The C-GAS has shown good inter-rater reliability (.83 to .91) as well as concurrent and discriminant validity in Puerto Rico (Bird et al., 1987).

Family Environment Scale-Family Relationship Index (FES-FRI)

This is a 27-item self-report measure of the quality of family relationships (Moos & Moos, 1994). We scored its items using an

ordinal format that ranged from 0 to 3. The internal reliability of its Total score among caregivers in this sample was .88 (Matos-Melo et al., 2015).

Burden Assessment Scale (BAS)

This 26-item scale assesses the burden related to caring for a person with mental health symptoms (Matías-Carrello et al., 2003). The alpha coefficient of the BAS among caregivers of the current sample was .90 (Rodríguez-Beato et al., 2018).

Beck Depression Inventory-II (BDI-II)

This 21-item scale assesses depressive symptomatology in adults during the past 2 weeks (Beck et al., 1996). The reliability and validity of the BDI-II have been well documented internationally. Its internal reliability in the current sample was .91 (Matos-Melo et al., 2016).

Kovacs-Diabetes Management Information Sheet (K-DMIS)

Using the K-DMIS, we obtained T1D-related information from parents, including youth T1D adherence and access to an insulin pump (Kovacs et al., 1986). We used an adapted version.

Procedures

We shared information about the main study via T1D clinics, local media, and printed materials. We recruited participants through summer camps, educational/recreational activities, and referrals from endocrinologists, school personnel, and other participants. Caregivers completed requests for participation forms via phone calls. We invited youth and one parent each to an in-person screening if they meet initial eligibility criteria. After obtaining consent/assent, they completed measures at this visit and a diagnostic

evaluation that was scheduled within two weeks. We classified 25 participants who presented with at least one CCPI into Group 1 (G1) and defined as Group 2 (G2) the 26 youth who did not present any CCPI. Institutional review boards from the University of Puerto Rico (UPR) Río Piedras Campus (Approval number 1112-005) and the UPR Medical Sciences Campus (Approval number A9530112) approved the study.

Data Analysis

We used SPSS 24.0 for all statistical analyses. We computed descriptive statistics for sample characterization. After classifying the sample between T1D youths with vs. without CCPIs, we used Chi-square and Student *t*-tests for comparing groups in categorical and continuous socio-demographic variables. Then, we conducted a multivariate analysis of variance (MANOVA), followed by individual analyses of variance (ANOVAs) to compare group means on the continuous dependent variables considering their CCPI status. For comparing groups in categorical dependent variables, we used Chi-square tests. We assessed all comparisons using the significance criterion of $p \leq .05$. We used the Partial Eta Squared (η_p^2) indicator provided in the MANOVA/ANOVA analyses, and calculated Cohen's *d*, to estimate the effect size of mean differences in continuous variables. To estimate the effect size of differences among groups in categorical variables, we estimated Cohen's *d* based on a Chi-square transformation (for a 2 x 2 crosstab), following the formula provided by DeFife (2009) in his statistical program.

Results

Comorbid Chronic Physical Illnesses Among Participants in Group 1

We obtained data on the presence of CCPIs through caregivers' reports of any physician diagnosis provided for youths before the eligibility assessment. We considered a physical illness as chronic if its duration was at least 6 months. Among the most common CCPI's presented by members of G1 were asthma (48%), chronic migraines (24%), digestive system diseases (16%), hypothyroidism (16%), skin diseases (12%), urologic/genital illnesses (12%), and chronic pneumonia (8%). Only one participant each presented the following: heart arrhythmia, renal cysts, ovarian cysts, cataracts, chronic bronchitis, chronic throat infections, Guillain-Barré syndrome, and lumbar tumor.

Group Comparison on Socio-demographic Variables

Groups defined by their CCPI status did not differ significantly in any categorical or continuous sociodemographic variable (see Table 1). Because of this, it was unnecessary to control for any of these variables in subsequent analyses.

Analysis of Continuous Dependent Variables

The MANOVA to examine continuous variables was significant, $F(4, 46) = 2.62$, $p = .047$, Multivariate Effect Size = .185

Table 1
Socio-Demographic Variables by Comorbid Chronic Physical Illness Status

Variables	Any CCPI (<i>n</i> = 25)	No CCPI (<i>n</i> = 26)	χ^2 / t	<i>d</i>
<i>Categorical Variables</i>				
Adolescent's Sex (Girls)	52.00% (13)	61.54% (16)	0.47	0.19
School Attended (Public)	76.00% (19)	57.69% (15)	1.92	0.40
Rural vs. Urban (Rural)	32.00% (8)	34.72% (9)	0.04	0.06
SES (Middle-low/Low)	76.00% (19)	69.23% (18)	0.29	0.15
Two-parents' Homes (Yes)	40.00% (10)	50.00% (13)	0.51	0.20
<i>Continuous Variables</i>				
Adolescent's Age	15.53 (1.76)	14.99 (1.42)	1.21	0.34
T1D Duration	6.60 (3.61)	5.65 (4.14)	0.87	0.24
Caregiver's Age	43.80 (7.01)	43.12 (6.28)	0.37	0.10
Caregiver's Education	14.68 (1.91)	14.58 (2.96)	0.15	0.04
Annual Family Income	\$30,868.34 (19,132.37)	\$42,943.72 (32,809.40)	-1.60	0.45
Household Size	3.88 (0.97)	4.15 (0.92)	-1.03	0.29

Note. CCPI = Comorbid chronic physical illness; T1D = Type 1 diabetes; SES = Perceived socioeconomic status.

Table 2
Comparison in Continuous Outcome Variables by Comorbid Chronic Physical Illness Status

Variable	Any CCPI (<i>n</i> = 25)	No CCPI (<i>n</i> = 26)	<i>F</i>	η_p^2	<i>d</i>
Global Functioning	53.36 (6.83)	58.08 (8.71)	4.61*	0.09	0.60
Caregiver's Burden	59.80 (12.64)	51.96 (14.14)	4.35*	0.08	0.58
Caregiver's Depression	13.28 (7.52)	8.46 (8.22)	4.76*	0.09	0.61
Family Functioning	76.52 (12.31)	83.46 (8.78)	5.41*	0.10	0.65

Note. CCPI = Comorbid chronic physical illness.

* $p \leq .05$.

As expected, comparisons made through individual one-way ANOVAs showed that youths with CCPIs had significantly lower global functioning than their counterparts did (see Table 2). On their behalf, caregivers of youth with CCPIs reported greater parental burden, more depressive symptomatology, and significantly lower quality in family relationships. The effect sizes of these differences were medium.

In an additional exploratory analysis, we compared groups to examine their mean number of lifetime diabetes-related hospitalizations. Using the Welch Robust Test of Equality of Means, which corrects for differences in variance among groups, we found that, compared to youth from G2 ($M = 2.38$; $SD = 2.12$), adolescents from G1 ($M = 5.24$; $SD = 6.68$) were reported by their parents to have been hospitalized more frequently [$F(1, 28.61) = 4.17, p = .05; d = .58$].

Analysis of Categorical Dependent Variables

When comparing groups in the categorical variables related to T1D, we observed that a significantly higher percentage of adolescents with CCPIs needed their parents to remind them to use insulin (Table 3). In addition, we found that a significantly lower proportion of these adolescents had access to an insulin pump. The effect sizes (using Cohen's d) of these differences were medium.

Regarding the categorical variables related to mental health, a significantly higher percentage of youth with CCPIs (G1) met the criteria for MDD at some point in the previous year. On the other hand, a significantly higher proportion of the caregivers of these adolescents presented a lifetime history of any depressive disorder or any mental disorder.

Table 3

Comparison on Categorical Outcome Variables by Comorbid Chronic Physical Illness Status

Variables	Any CCPI ($n = 25$)	No CCPI ($n = 26$)	χ^2	d
Need to be Reminded About Insulin	84.00% (21)	57.69% (15)	4.25*	0.60
Access to Insulin Pump Treatment	8.00% (2)	30.77% (8)	4.19*	0.60
MDD-Adolescent (Last-year)	88.00% (22)	61.54% (16)	4.70*	0.64
Parental Hx of Depressive Disorder	80.00% (20)	42.31% (11)	7.60**	0.84
Parental Hx of Suicidality	36.00% (9)	11.54% (3)	4.24*	0.60
Parental Hx of Any Disorder	88.00 (22)	57.69% (15)	5.88*	0.72

Note. MDD = Major Depressive Disorder; Hx = History; T1D = Type 1 diabetes. * $p \leq .05$; ** $p \leq .01$.

Moreover, a significantly higher percentage of caregivers from G1 reported having experienced any suicidality (ranging from death thoughts to a suicide attempt) at some point in their lives. The effect size was large for the caretakers' history of depression and medium for the other variables.

Discussion

As expected, our findings provide initial evidence supporting our hypothesis about

the existence of individual, caregiver, and family functioning differences between T1D adolescents with (G1) vs. without (G2) CCPIs. Youth with T1D and CCPIs were outperformed by their counterparts on measures of global functioning, adherence to insulin treatment, and access to insulin pumps. They also were more prone to meet MDD criteria in the previous year and presented a higher mean of lifetime diabetes-related hospitalizations.

Some of our findings may be interconnected. For example, having a CCPI supposes higher treatment costs for families, and this might be associated with lower access to resources such as insulin pumps. As adhering to multiple treatment regimens may reduce patients ability to sustain their compliance with all treatments for long periods (An & Nichol, 2013), it is not surprising that the more complicated treatment regimen for T1D adolescents with additional chronic illnesses may facilitate their forgetfulness regarding the specific logistic details needed for adequate compliance with insulin treatment. On the other hand, T1D youths with CCPIs may feel overwhelmed with higher treatment demands to the point of developing depressive symptoms (such as feelings of sadness or negative thoughts about their future) or meeting criteria for a depressive disorder, as has been found among adults with diabetes (Fugger et al., 2019; Novak et al., 2016). In addition, our finding of a higher mean number of hospitalizations among adolescents in G1 is also consistent with results from studies conducted with adults (Reeves et al., 2015; Wielgosz et al., 2018). Even at a younger age, adolescents with T1D seem to be at higher risk for hospitalizations when CCPIs are present than when they are not. Along with a lower access to insulin pumps, the frequency of diabetes-related hospitalizations is another health indicator that may suggest increased treatment costs for this subgroup of patients.

Meanwhile, caregivers of adolescents with T1D and other chronic illnesses showed a higher lifetime prevalence of depressive disorders, any mental disorder, and suicidality, as well as more severe current depressive symptoms and parental burden than caregivers of adolescents from G2. This should be expected given that treatment demands related to chronic illness are known to affect not only patients but also their caregivers, particularly when multiple chronic diseases or complications

are present (Buckloh et al., 2008; Whittemore et al., 2012). The burden experienced for caring for a child with a chronic illness might increase if that child is also dealing with significant depressive symptoms (Rodríguez-Beato et al., 2018). Caregivers' burden could escalate to levels that might put parents at risk for experiencing symptoms of emotional disorders or meeting criteria for one or more of those disorders (Flynn, 2013). The possibility of losing their children due to diabetes, its comorbid illnesses, or its complications may also make caregivers more prone to feelings of helplessness as well as thoughts of death and suicide.

The lower functioning found among families in G1 suggests that disease-related burden may negatively affect their interactions as the amount and difficulty of treatment regimens for physical illnesses increases. As mentioned earlier, the requirement of additional assistance from parents and other family members during adolescence is inconsistent with developmental expectations for increased responsibility and independence of diabetes care. The quality of family interactions may also affect emotional functioning in both youth and caregivers (Matos-Melo & Cumba-Avilés, 2018). Interventions that help families to improve communication skills, reduce diabetes-related conflict, and increase cohesion and mutual support may serve to provide a better environment that contributes to reducing the impact of T1D and CCPIs on family life (Cumba-Avilés & Sáez-Santiago, 2016).

Our study has several limitations. First, our sample size was small which precluded the analysis of the role of particular CCPIs in affecting personal, caregiver, and family functioning. Second, although it would be desirable to compare the mean treatment costs between the groups of interest, that information was not collected in the main study. Further studies should assess treatment costs and recruit larger samples

that allow the analysis of groups defined by the presence of different categories of CCPIs, or even the incremental impact of having one, two, or more than two CCPIs. Third, our study was based only on quantitative data. Future studies might use in-depth interviews or focus groups with adolescents and their caregivers to further explore the particular experiences of adolescents with CCPIs and their families and provide insight into specific areas of intervention to improve their quality of life.

One of the most important implications of our findings relates to the pertinence of appropriate screening for the presence of CCPIs among patients with diabetes referred for mental health services. For example, compared to no treatment, treatment of newly diagnosed depression among adult patients with T2D and CCPIs has been related to a reduction of total health care expenditures of 16% for antidepressant treatment, 22% for psychotherapy, and 28% for both therapy types in combination (Bhattacharya et al., 2016). Studies with adults presenting MDD have shown that a higher number of comorbid illnesses predicted higher increases in depressive symptoms at the continuation phase of treatment (Iosefescu et al., 2004). In addition, among adults with diabetes treated with CBT, the presence of diabetes complications significantly predicted a diminished response to depression treatment (Lustman et al., 1998). Taken together, and extrapolating from their results, these studies suggest that early screening for CCPIs among T1D youth may also result in the reduction of treatment costs and would allow service providers to anticipate the need for adjustments in their treatment plan to accommodate the needs of this particular population. Such adjustments may include providing additional psychotherapy sessions, addressing issues related to comorbid diseases in sessions, extending the period of prophylactic pharmacotherapy, and continuous monitoring of the progression of CCPIs for

preventing relapse of depression during the maintenance phase of treatment.

More research is needed on the prevalence of CCPIs in children and adolescents with T1D and its potential impact on the individual, caregivers, and family functioning. Our study targeted a particular group of T1D youths, specifically Hispanic adolescents who also presented significant depressive symptoms. It is unknown whether the prevalence of CCPIs in T1D children or adolescents with depressive symptoms is higher than among non-depressed T1D youth, as is the case among adults with diabetes, or if we would find the incremental impact of CCPIs observed in our sample among a sample of T1D adolescents without depressive symptoms. In the context of previous research results, further studies should examine the role that CCPIs may have in predicting response after both psychosocial and pharmacological treatments for depression among T1D adolescents. Our findings do suggest the importance of examining the potential impact of CCPIs as a moderator of treatment outcomes in depressed T1D adolescents of Hispanic origin and the need to tailor psychosocial interventions considering the incremental burden that CCPIs may pose over these youths and their families.

Compliance with Research Ethics Standards

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