

## Original Research

# Quality of Life and Well-Being in Patients with Type I Diabetes Mellitus According to Treatment: MDI vs. CSII

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## Abstract

**Background:** The diagnosis of type 1 diabetes mellitus (T1DM) requires, in addition to insulin control, appropriate clinical management, and the maintenance of healthy lifestyle habits. There have been advances in treatment, from the traditional use of multiple doses of insulin (MDI) to, more recently, continuous subcutaneous insulin infusion (CSII). **Methods:** In order to understand the psychological adjustment of these patients, the clinical, health and psychological characteristics of MDI patients were compared with those of CSII patients. **Results:** Clinically, these latter had more diabetes education, more frequent consultations with endocrinologists and more adequate glycosylated hemoglobin values. There were no fundamental differences in health habits. In the psychological domain, CSII patients had better quality of life (greater self-care and less concern about the disease), more self-esteem, affective social support, happiness, life satisfaction; and better psychological well-being (environmental mastery, autonomy, self-acceptance, and positive relationships). **Conclusions:** The CSII type of treatment appears to be associated with greater psychological adjustment, through autonomy and a greater sense of control over the disease.

**Keywords:** type 1 diabetes mellitus; insulin infusion systems; quality of life; well-being

## Calidad de Vida y Bienestar en Pacientes con Diabetes Mellitus Tipo 1 Según el Tratamiento: MDI vs. ISCI

### Resumen

**Marco Teórico:** El diagnóstico de diabetes mellitus tipo 1 (DMt1), además del control de la insulina, requiere un adecuado control clínico y el mantenimiento de hábitos saludables. Se han producido avances en los tratamientos, desde el uso tradicional de múltiples dosis de insulina (MDI) hasta, la más actual, infusión subcutánea continua de insulina (ISCI). **Método:** Con el objetivo de conocer la adaptación psicológica de estos pacientes, se han contrastado las variables clínicas, de salud y psicológicas de pacientes con MDI frente a pacientes ISCI. **Resultados:** Estos últimos presentan a nivel clínico: mayor educación diabetológica, más frecuencia de consultas con endocrinología y mejores niveles de hemoglobina glicosilada. No se dieron diferencias fundamentales en hábitos de salud. Y en el ámbito psicológico, los pacientes ISCI muestran más calidad de vida (mayor autocuidado y menor preocupación por la enfermedad), más autoestima, apoyo social afectivo, felicidad, satisfacción vital; y más bienestar psicológico (dominio del entorno, autonomía, autoaceptación y relaciones positivas). **Conclusiones:** El tratamiento ISCI parece vincularse con una mayor adaptación psicológica, a través de la autonomía y mayor sensación de control sobre la enfermedad.

**Palabras Claves:** diabetes mellitus tipo 1; sistemas de infusión de insulina; calidad de vida; bienestar



## 1. Introduction

Type 1 diabetes mellitus (T1DM) is a chronic disease characterized by the presence of high blood glucose levels, due to the autoimmune destruction of pancreas beta cells. As the body does not produce the necessary hormone for this, known as insulin, exogenous administration to the patient is required (Gómez-Rico et al, 2015). In addition to insulin treatment, patients should follow a correct diet and practice physical exercise, all of which are determining factors for the management, self-care and control of T1DM (Katsarou et al, 2017).

According to the latest World Report on T1DM published by the World Health Organization (WHO) in 2016, its incidence has doubled, making it the most frequent metabolic disease. Although Europe does not have a high prevalence compared to other areas such as China, India or the USA, by 2025, new cases are estimated to have increased by around 5.4% compared to 1995, when there were 135 million people with T1DM. It is expected to increase further to around 7.7% in 2030. Furthermore, the increase in the number of T1DM diagnoses in developing countries (69% of new cases) will be greater than in developed countries, with an expected increase of 20% between 2010 and 2030 (WHO, 2016).

In the initial stage, after the debut with T1DM, patients must use a large number of resources, such as: self-analyses, drugs and outpatient care. It is a disease with short-term complications, but also long-term complications. This is because there is an asymptomatic period of hyperglycemia prior to diagnosis which, after diagnosis, often leads to complications, such as the development of other T1DM-related diseases. Hence, the importance of monitoring with the aim of delaying, and even preventing, the development of these diseases. Despite this important issue, patients with T1DM may not pay enough attention to it (Chong et al, 2019) in many cases due to this absence of symptoms. An inadequate management can affect patient development, increase comorbidities, increase the risk of related acute and chronic complications, and decrease life expectancy (Katsarou et al, 2017).

The specific negative effects of T1DM occur at different levels: metabolic, vascular and/or neurological. These can be acute: hypoglycemia, diabetic ketoacidosis, hyperglycemia, hyper- and hypo-glycemic diabetic coma, seizures or loss of consciousness, and infections. Chronic effects can also occur: cardiovascular disease, nephropathy, oral health problems, complications associated with pregnancy, neuropathy and diabetic foot, diabetic retinopathy, skin diseases and gastroparesis (Céspedes et al, 2018; Martínez et al, 2023; WHO, 2016).

In the long term, these negative effects represent a high cost for the healthcare system of any state, which, in Western European countries, usually ranges from 4% to 14% of overall healthcare expenditure. In other words, these patients consume between 2 and 6 times more health-

care resources than those suffering from other chronic diseases. Although the literature about the exact economic cost of diabetes is scarce, some authors have estimated that, in the time period 1997–2012, it amounted to around 5809 million euros. This cost would be limited with the application of more specific drugs and treatments, such as continuous subcutaneous insulin infusion (CSII) (Crespo et al, 2013; Giménez et al, 2017); which could result in savings of 9821 euros per patient with T1DM.

T1DM can develop at any age, however its onset is frequent in childhood, although its incidence is very low during the first months of life, and its maximum peak coincides with pubertal development. This fact requires patients to adapt, both physiologically and psycho-emotionally, from the moment they are diagnosed with T1DM (Pérez-Marín et al, 2015). Therefore, in addition to the fact that patients, in many cases, must keep the most accurate control possible of the disease. This means having to address, from an early age, aspects such as the adherence to treatment or the maintenance of healthy habits that result in a better quality of life and personal well-being (Orna et al, 2020). As reported by Gómez-Rico et al (2015), 36% of children and adolescents with T1DM will present some psychological problem during the first year of the disease, which can persist throughout adulthood, and may also affect the environment around them, such as family members (Plener et al, 2015). The diagnosis is associated with psychosocial problems, such as anxiety, decreased self-care, impaired metabolic control and behavioral disorders. Therefore, it is important to have a multidisciplinary team to be able to address all the difficulties that patients may present, from the first moment of T1DM diagnosis, with the aim of achieving an emotional and psychological balance (Henríquez-Tejo and Cartes-Velásquez, 2018).

The presence of psychological symptomatology, such as anxiety and depression, is related to the patient's adaptation to the disease and treatment. This is generally the case in chronic diseases, through their relationship with the patients' own self-concept and, in general, with their quality of life (Riverón et al, 2003). The adaptation of patients to the diagnosis of T1DM and the changes produced by the disease may have negative effects on self-esteem. An adequate level of self-esteem constitutes a protective barrier that helps adaptation to the disease, reducing suffering and the appearance of complications (González-Alonso and Malillos-Manso, 2022).

People with chronic diseases may be dependent on their environment and therefore require a greater social support network so that the disease does not have a negative impact on adequate functioning in their daily lives. Patients with T1DM, compared to those with type 2 diabetes mellitus (T2DM), tend to be more pessimistic and less trusting of others, so they may have more problems in establishing and maintaining social relationships, hence the importance of strengthening social support networks and an adequate

social representation of the disease (Espinosa and Suárez, 2022; García-Ortiz et al, 2020). This may be linked to fear of rejection due to the diagnosis and insecurity of not being accepted or directly excluded from activities among their peers (Espinosa and Suárez, 2022).

The quality of life of patients with diabetes, both physical and psychological, is usually lower than that of the population without diabetes, even affecting family members involved in their care, among other issues, due to aspects related to the fear of hypoglycemia (Beléndez Vázquez et al, 2015). In general, a decrease in quality of life is observed as the number of complications arising from the disease and their degree of severity increases (Machado-Romero et al, 2010); and as inadequate control of the disease is perceived (Rodríguez-Almagro et al, 2018). This may result in patients deliberately failing to comply with the prescribed medical treatment, which can lead to poor metabolic control (Orna et al, 2020).

In addition to the quality of life of patients, it is of great interest to deepen their personal well-being. This is an objective to be achieved, since it can promote the acceptance of the diagnosis of the disease, its limitations, as well as maintaining positive attitudes, and can become an indicator linked to the control of diabetes (Roldan, 2015). Subjective well-being, which includes emotional aspects such as affection, happiness, and cognitive aspects such as life satisfaction, is linked to certain demographic and health variables of the patients (García-Vigara, 2015). Psychological well-being in adult patients with chronic diseases is favored by self-knowledge, an active life and self-acceptance (Fernández-Laguna, 2019).

In terms of different therapeutic approaches, there have been several advances in treatments, which are increasingly individualized and specific to ensure effective disease control. An example of this is the use of CSII and continuous glucose monitoring (CGM) compared to previous less sophisticated treatments (González-Fernández, 2020).

Research on the psychological consequences of T1DM, as well as on adaptive variables of quality of life and well-being, has been limited when it comes to contrasting the most commonly used types of treatment: multiple doses of insulin (MDI) and continuous subcutaneous insulin infusion (CSII). However, CSII treatment has been found to result in improved glycemic control and a long-term decrease in the negative consequences of the disease (Ruiz de Adana, 2015). Some studies have found that after 10 years of follow-up with CSII and CGM treatment, not only glycemic control improves, but also patients' depressive symptoms decrease, as well as their quality of life indexes increase (Ruiz de Adana, 2015; Sastre et al, 2022). Both types of personal well-being, especially psychological well-being, are linked to better daily control of T1DM among patients with CSII (Chao et al, 2019).

Despite these findings, we consider that further studies are needed to overcome some limitations in the knowledge of the differences between the two types of patients. This has led us to further investigate these factors associated with each of the treatments for T1DM.

The main objective will be to analyze the clinical variables related to disease control (frequency of endocrinologist consultations, more diabetes education, number of daily capillary blood controls, blood glucose levels and glycosylated hemoglobin value) and health habits (physical exercise practice, presence of high-fat diet, consumption of sugary drinks, alcohol and tobacco), as well as the adaptive psychological profile (quality of life, self-esteem, social support and personal well-being) associated with each of the T1DM treatments (MDI vs. CSII).

It is hypothesized that patients with CSII treatment will have better clinical indicators and healthier habits, as well as a more adaptive psychological profile than those receiving MDI therapy. If CSII treatment is linked to better health habits, greater personal well-being and quality of life, this could result in fewer health problems in patients with T1DM, as well as better psychological adjustment.

## 2. Method

### 2.1 Participants

A total of 155 patients with T1DM (78.7% female) aged 18–65 years ( $M = 40.37$ ,  $SD = 12.21$ ) were included in the study. A percentage of 41.3% were single; and 47.7% were in full-time employment. The educational levels of Bachelor's Degree and Vocational Training were the most numerous, coinciding in incidence percentages (30.3%), followed by High School (14.8%). There were 92 (59.35%) patients receiving MDI treatment and 63 (40.65%) CSII. A 63.9% attended endocrinology consultations for their diabetes control every 6 months, and 45.2% attended diabetes education with the same frequency. A 49% had occasional low blood glucose levels and 52.9% had high levels. This is related to glycosylated hemoglobin (HbA1c) values, with 49% of the sample showed levels between 6% and 7% (135 mg/dL–170 mg/dL). A 24.5% of the patients had more than 5 capillary controls per day ( $M = 3.67$ ,  $SD = 1.75$ ).

In terms of health habits, 83.9% of the sample avoided a high-fat diet, 78.7% did not consume sugary drinks, 84.5% did not use tobacco, although 51.6% consumed alcohol with some frequency. A 22.6% exercised more than 3 times a week. There were 38.1% of patients with a family history, mainly of T2DM and 69.7% of other diseases (cardiovascular, renal, glaucoma, asthma, osteoporosis).

### 2.2 Instruments

(a) Life with Type 1 Diabetes Questionnaire (ViDa1; Alvarado-Martel et al, 2017). The ViDa1 assesses the fluctuations and the impact the disease may pose for patients through 34 items grouped into 4 dimensions: inter-

ference with life, self-care, well-being, and concern about the disease. It has a 5-alternative Likert-type scales as response format (from 1 = “strongly disagree” to 5 = “strongly agree”). A total score is obtained for each of the four subscales by summing the direct responses to the items it contains, after recoding the meaning of those reversed items. Interference with life includes items 1 to 11 directly and 12 in reverse order. Self-care includes items 13 to 22 directly and 23 recoded. Well-being includes items 24 to 29 and item 27 recoded. Finally, concern about illness subscale consists of items 30 to 34, all direct. The higher the score on each subscale, the higher the degree of interference with life, self-care, well-being or concern about illness. Cronbach’s Alpha indices of internal consistency were: interference with life ( $\alpha = 0.89$ ), self-care ( $\alpha = 0.88$ ), well-being ( $\alpha = 0.77$ ) and concern about the disease ( $\alpha = 0.81$ ).

(b) Rosenberg Self-Esteem Scale (RSE; [Rosenberg, 1965](#)), Spanish version by [Atienza et al \(2000\)](#). The RSE measures general self-esteem, including positive and negative feelings about the self, allowing to know the respect and self-acceptance of the person. It consists of 10 items: 5 are positively and 5 negatively stated. It uses a Likert-type scale with 4 response alternatives (from 1 = “strongly disagree” to 4 = “strongly agree”). The total score is obtained by adding the responses to the 10 items, after reversing the negatively formulated items (2, 5, 8, 9, and 10). The higher the score obtained, the higher the level of general self-esteem perceived by the person. The internal consistency was 0.85.

(c) Duke Functional Social Support Scale (UNC-11; [Broadhead et al, 1988](#)), adaptation to Spanish population by [Bellón Saameño et al \(1996\)](#). The UNC-11 is a brief, multidimensional 11-item questionnaire that assesses the degree of communication with others (confidential support) and the level of affection, empathy and caring (affective support). It is administered on a 5-point Likert-type scale (from 1 = “much less than I would like” to 5 = “as much as I would like”). Two scores are obtained by adding the direct responses to the items in each dimension: confidential support, with items: 1, 2, 6, 7, 8, 9, and 10; and affective support, with items: 3, 4, 5, and 11. The higher the score in each of these dimensions, the higher the perceived functional social support in that dimension. Cronbach’s Alpha values were: confidential support ( $\alpha = 0.88$ ) and affective support ( $\alpha = 0.84$ ).

(d) Subjective Happiness Scale (SHS; [Lyubomirsky and Lepper, 1999](#)), Spanish adaptation by [Extremepacheco and Fernández-Berrocal \(2014\)](#). The SHS consists of 4 items with a 7-point response format (from 1 = “not happy at all” to 7 = “very happy”). It is a subjective global measure, that considers the definition of happiness from an individual’s own perspective. The total score is obtained by adding the responses to the four items, the last of which is recoded because it has the opposite meaning to that measured by the questionnaire. The higher the score, the higher

the individual’s subjective perception of happiness. This scale is not divided into subscales, and it has an internal consistency of 0.85.

(e) Satisfaction with Life Scale (SWLS; [Diener et al, 1985](#)), Spanish adaptation by [Vázquez et al \(2013\)](#). The SWLS was used, which consists of 5 items that assess the individuals’ cognitive judgment of their overall life satisfaction, comparing their life circumstances with a particular standard. Each item is answered on a scale ranging from 1 (“not at all satisfied”) to 7 (“very satisfied”). This questionnaire contains a single scale, which is obtained by adding up the direct responses to the five items it includes. The higher the score, the higher the overall satisfaction with life perceived by the person. Cronbach’s Alpha value was 0.88.

(f) Psychological Well-Being Scales (PWBS; [Ryff, 1989](#)), Spanish adaptation and validation by [Díaz et al \(2006\)](#). The PWBS measures the Ryff six scales of psychological well-being. The Spanish version has 29-item and has a response format with a 6-point Likert-type scale (from 1 = “strongly disagree” to 6 = “strongly agree”). A total score is obtained for each of the six dimensions of psychological well-being. Environmental mastery includes items: 10, 14, 29 (directly coded); 5 and 19 (recoded). Personal growth includes items 21, 27 and 28; and 26 (recoded). Purpose in life includes items 6, 11, 15 and 16. Autonomy includes items 3 and 18 in a direct sense and items 4, 9, 13 and 23 (recoded). Self-acceptance includes items 1, 7, 17 and 24, all directly coded. Finally, Positive Relations with others subscale is obtained by adding the responses to items 12 and 25, directly coded, and items 2, 8 and 22, recoded. The higher the score on each subscale, the higher the level of psychological well-being in that particular area. The internal consistency scores for each of the 6 scales were: environmental mastery ( $\alpha = 0.64$ ), personal growth ( $\alpha = 0.71$ ), purpose in life ( $\alpha = 0.82$ ), autonomy ( $\alpha = 0.66$ ), self-acceptance ( $\alpha = 0.87$ ) and positive relationships with others ( $\alpha = 0.81$ ).

### 2.3 Procedure

An ex post facto cross-sectional design and a convenience sample of participants were adopted. Diabetes associations, audiovisual portals, and professional associations collaborated in the dissemination of the study among patients. Participation was anonymous and voluntary and participants gave their informed consent to use the data for research purposes.

The assessment battery, administered online through a Google Forms questionnaire, took approximately 20 minutes to be completed. This consisted of a semi-structured interview with sociodemographic data, clinical characteristics of the disease and the previously mentioned psychological variables.

**Table 1. Mean differences (Student's *t* test) in clinical variables and health habits between the sample of patients with CSII treatment (N = 63) and the sample with MDI treatment (N = 92).**

| Clinical variables and health habits     | Patients with CSII treatment (N = 63) |      | Patients with MDI treatment (N = 92) |      | <i>t</i> | <i>p</i> | Cohen's <i>d</i> |
|------------------------------------------|---------------------------------------|------|--------------------------------------|------|----------|----------|------------------|
|                                          | M                                     | SD   | M                                    | SD   |          |          |                  |
| Clinical Variables                       |                                       |      |                                      |      |          |          |                  |
| Last diabetes education                  | 3.03                                  | 1.29 | 2.50                                 | 1.35 | 2.44     | 0.016    | 0.40             |
| Frequency of endocrinology consultations | 3.57                                  | 0.56 | 3.09                                 | 0.81 | 4.13     | 0.000    | 0.69             |
| Number of daily capillary blood controls | 3.49                                  | 1.54 | 3.79                                 | 1.88 | −1.09    | 0.277    | −0.17            |
| Low blood glucose levels                 | 2.87                                  | 0.66 | 2.72                                 | 0.76 | 1.35     | 0.178    | 0.21             |
| High blood glucose levels                | 3.03                                  | 0.65 | 2.96                                 | 0.74 | 0.65     | 0.514    | 0.10             |
| Glycosylated hemoglobin value            | 4.02                                  | 1.13 | 3.58                                 | 1.46 | 2.11     | 0.037    | 0.34             |
| Health Habits                            |                                       |      |                                      |      |          |          |                  |
| Practice of physical exercise            | 3.16                                  | 1.39 | 2.91                                 | 1.59 | 1.02     | 0.311    | 0.17             |
| High fat diet                            | 1.14                                  | 0.35 | 1.17                                 | 0.38 | −0.51    | 0.608    | −0.08            |
| Consume sugary drinks                    | 1.22                                  | 0.42 | 1.22                                 | 0.44 | 0.07     | 0.946    | 0.00             |
| Alcohol consumption                      | 1.57                                  | 0.50 | 1.57                                 | 0.58 | 0.07     | 0.943    | 0.00             |
| Tobacco consumption                      | 1.11                                  | 0.41 | 1.37                                 | 0.79 | −2.65    | 0.009    | −0.41            |

CSII, continuous subcutaneous insulin infusion; MDI, multiple dose insulin; N, number; M, mean; SD, standard deviation.

## 2.4 Data Analysis

The information was computerized in the IBM SPSS Statistics v. 25.0 (IBM Corp., Chicago, IL, USA) database to perform the following statistical analyses: (I) Contingency analyses to determine the degree of independence between socio-demographic variables (age, sex, marital status, occupation, educational level) and clinical variables (frequency of consultation with the endocrinologist specialist and diabetes education, number of daily capillary controls, blood glucose levels and glycosylated hemoglobin value). (II) Contrasts of means with Student's *t*-test to analyze the differences between patients with T1DM receiving MDI treatment and those receiving CSII treatment, in the following variables: health habits (practice of physical exercise, presence of high-fat diet, consumption of sugary drinks, alcohol and tobacco); clinical characteristics (frequency of consultations with endocrinology and diabetes education professionals, number of daily capillary controls, glycaemia levels and glycosylated hemoglobin value); and, finally: psychological variables (quality of life, self-esteem, social support and personal well-being).

## 3. Results

Contingency analyses showed the independence between socio-demographic variables and the treatment received: CSII vs. MDI. Thus, the type of treatment did not present significant relationships with gender ( $\chi^2 = 1.07$ ,  $p = 0.301$ ), age ( $\chi^2 = 42.50$ ,  $p = 0.493$ ), place of residence ( $\chi^2 = 6.28$ ,  $p = 0.099$ ), marital status ( $\chi^2 = 4.00$ ,  $p = 0.406$ ), number of children ( $\chi^2 = 0.94$ ,  $p = 0.857$ ), educational level ( $\chi^2 = 6.18$ ,  $p = 0.626$ ), nor with occupation ( $\chi^2 = 7.25$ ,  $p = 0.202$ ).

In addition, analyses of mean differences between both types of treatment were performed for clinical variables and health habits (Table 1). Significant differences were observed between patients in both treatments in the following variables: the latest diabetes education ( $t = 2.44$ ,  $p = 0.016$ ), the frequency of consultations with endocrinology ( $t = 4.13$ ,  $p = 0.000$ ), and HbA1c value ( $t = 2.11$ ,  $p = 0.037$ ). Regarding health habits, significant differences were only found in tobacco consumption ( $t = -2.65$ ,  $p = 0.009$ ), with lower consumption among patients with CSII treatment. These results were supported by moderate effect sizes. In summary, patients receiving CSII treatment, had more frequent diabetes education and endocrinology consultations, more adequate HbA1c values; and they were less tobacco consumers.

Mean differences analyses between patients with both types of treatment (CSII vs. MDI), for the psychological variables, are shown in Table 2. There were significant differences between both groups of patients according to their treatment in quality of life: self-care ( $t = 3.19$ ,  $p = 0.002$ ) and concern about the disease ( $t = -2.66$ ,  $p = 0.009$ ). Also, in self-esteem ( $t = 2.59$ ,  $p = 0.010$ ), and in affective social support ( $t = 2.45$ ,  $p = 0.016$ ).

The contrasts also showed significant differences in subjective well-being [both happiness ( $t = 2.30$ ,  $p = 0.023$ ) and life satisfaction ( $t = 2.66$ ,  $p = 0.009$ )]. Additionally, in psychological well-being [(environmental mastery ( $t = 2.41$ ,  $p = 0.017$ ), autonomy ( $t = 2.97$ ,  $p = 0.003$ ), self-acceptance ( $t = 2.25$ ,  $p = 0.026$ ) and positive relationships with others ( $t = 2.73$ ,  $p = 0.007$ )]. In psychological well-being, there were marginally significant differences in personal growth ( $t = 1.81$ ,  $p = 0.072$ ) and purpose in life ( $t = 1.61$ ,  $p = 0.109$ ).

**Table 2. Mean differences (Student's *t* test) in psychological variables between the sample of patients with CSII treatment (N = 63) and the sample with MDI treatment (N = 92).**

| Psychological variables        | Patients with CSII treatment (N = 63) |       | Patients with MDI treatment (N = 92) |       | <i>t</i> | <i>p</i> | Cohen's <i>d</i> |
|--------------------------------|---------------------------------------|-------|--------------------------------------|-------|----------|----------|------------------|
|                                | M                                     | SD    | M                                    | SD    |          |          |                  |
| Quality of life                |                                       |       |                                      |       |          |          |                  |
| Interference with life         | 29.92                                 | 10.94 | 30.96                                | 10.67 | −0.58    | 0.558    | −0.10            |
| Self-care                      | 45.89                                 | 6.46  | 41.90                                | 9.10  | 3.19     | 0.002    | 0.50             |
| Well-being                     | 20.05                                 | 5.41  | 19.34                                | 5.39  | 0.80     | 0.422    | 0.02             |
| Concern about illness          | 17.94                                 | 4.76  | 19.95                                | 4.52  | −2.66    | 0.009    | −0.43            |
| Self-esteem                    | 33.40                                 | 5.13  | 30.97                                | 6.11  | 2.59     | 0.010    | 0.43             |
| Social support                 |                                       |       |                                      |       |          |          |                  |
| Confidential                   | 25.87                                 | 6.91  | 24.35                                | 6.67  | 1.38     | 0.170    | 0.22             |
| Affective                      | 16.52                                 | 3.55  | 14.97                                | 4.11  | 2.45     | 0.016    | 0.40             |
| Happiness                      | 19.87                                 | 4.89  | 17.96                                | 5.22  | 2.30     | 0.023    | 0.38             |
| Life satisfaction              | 23.54                                 | 6.39  | 20.61                                | 6.96  | 2.66     | 0.009    | 0.44             |
| Psychological well-being       |                                       |       |                                      |       |          |          |                  |
| Environmental mastery          | 22.21                                 | 4.11  | 20.45                                | 4.69  | 2.41     | 0.017    | 0.40             |
| Personal growth                | 20.32                                 | 3.56  | 19.26                                | 3.57  | 1.81     | 0.072    | 0.30             |
| Purpose in life                | 17.86                                 | 4.18  | 16.73                                | 4.35  | 1.61     | 0.109    | 0.26             |
| Autonomy                       | 26.89                                 | 5.13  | 24.36                                | 5.26  | 2.97     | 0.003    | 0.49             |
| Self-acceptance                | 17.89                                 | 4.29  | 16.28                                | 4.43  | 2.25     | 0.026    | 0.37             |
| Positive relations with others | 23.13                                 | 5.87  | 20.50                                | 5.90  | 2.73     | 0.007    | 0.45             |

CSII, continuous subcutaneous insulin infusion; MDI, multiple dose insulin; N, number; M, mean; SD, standard deviation.

Patients receiving CSII treatment vs. MDI patients showed greater self-care and less concern about the disease; they reported higher self-esteem and received more affective social support. They also had higher subjective well-being: life satisfaction and happiness; and psychological well-being: environmental mastery, autonomy, self-acceptance and positive relationships with others. Cohen's *d* statistics confirmed these differences with adequate effect sizes.

## 4. Discussion

Type 1 diabetes mellitus is a chronic disease that significantly affects patients' quality of life, both physically and psychologically. This usually manifests itself with psychosocial problems from a very early age, such as lower interpersonal confidence, greater pessimism, deterioration of social relationships, and low levels of happiness, symptomatology that appears mainly during the course of chronic complications of the disease itself (Martínez, 2020). For all these reasons, it is essential to address, not only the implications for good disease control, but also the clinical and emotional effects derived (Cedeño-Mendoza, 2019). Thus, appropriate psychological care for each problem would help to prevent future complications and improve personal well-being (Inga-Llanéz, 2021).

The results of the present investigation showed significant differences between patients receiving CSII treatment and those receiving MDI, both in clinical and psycho-

logical variables. It should be considered that preliminary Chi-square analyses reflect independence between the variables, so that the differences found between both types of treatment were not due to sociodemographic contingencies of the patients. In addition, the bivariate contrasts showing significant differences between the groups were ratified by adequate values of the effect sizes through Cohen's *d* statistic. Therefore, the hypothesis proposed seems to be fulfilled.

At the clinical level, it is observed that patients with CSII treatment present a higher frequency of attendance to endocrinology consultations and diabetic education sessions. This could be related to their HbA1c levels, which have shown to be adequate (Ruiz de Adana, 2015). However, the number of daily capillary controls, as well as the presence of hypo or hyperglycemia did not establish differences between both types of treatment. In terms of health habits (physical exercise and control of excessive consumption of fats, sugars and alcohol), there were no significant differences, showing adequate habits in both groups, with the exception of tobacco consumption, which is lower among CSII patients.

In the psychological domain, CSII patients have a higher quality of life, involving greater self-care and less concern about the disease. This finding is consistent with the fact that CSII treatment seems to improve glycemic oscillations and HbA1c lowering. Thus, maintaining more stable blood glucose levels and decreasing the persistence of hypoglycemia, as well as being more effective

together with the combination with CGM (Domínguez-López, 2015).

An adequate level of self-esteem is essential for patients with T1DM, as it can be a protective factor for adjustment to the disease. This may reduce possible more severe complications, both physiological and emotional, as is mainly the case with depression (Flores-Bello et al, 2018). In our study, this does not seem to occur among the CSII patients, given their significantly more adaptive scores than those of the MDI, which confirms part of the hypothesis put forward.

Social support is another health protective factor for patients with T1DM, through both instrumental and emotional support (Espinosa and Suárez, 2022). These results indicate greater affective social support among CSII patients, compared to MDI patients, which seems to confirm its relevance and is related to their tendency to resort to this type of emotional support. In addition, together with an adequate level of self-esteem, this could result in greater adherence to treatment and clinical recommendations for adequate disease control (Lacomba-Trejo et al, 2019). These findings could be linked to greater well-being and a better quality of life (Ruiz de Adana, 2015).

The present findings reported greater personal well-being among patients receiving CSII. An investigation with CSII treatment users report that improved HbA1c levels and achievement of longer periods of in-range glucose levels are related to greater happiness (Herrera-Bethencourt, 2019). In the present work, not only happiness, but also life satisfaction is higher in CSII patients. Alongside these two measures of subjective well-being, psychological well-being variables are also higher among patients with CSII treatment, namely environmental mastery, autonomy, self-acceptance and positive relationships with other people. This result may be partly consistent with other study in which the use of CSII is associated with a decrease in emotional worry and fear of hypoglycemia, with these effects being reduced after an average of 12 months on this treatment (Shaban et al, 2017). In addition, emotional well-being may provide adequate stress management and better metabolic control in patients (Rodríguez-Almagro et al, 2018).

The results of this research are conclusive in indicating that CSII treatment for T1DM is linked to greater autonomy and a sense of control over the disease. This could be associated with the higher quality of life and personal well-being reported by patients receiving this intervention. However, the study is not free of certain limitations: (i) the imbalance in the sample size, both in terms of sex and type of treatment received for diabetes; (ii) the cross-sectional nature of the study, which prevents establishing causal relationships based on the findings obtained; (iii) the possible influence of certain complications of the disease (both acute and chronic) on the manifestation of the psychological state of the patients, that has not been analyzed.

This research perpetuates certain findings on the effects of applying different therapeutic approaches for T1DM; which can affect both the clinical aspects and the psychological sphere of patients. In addition, as a study shows (Gil-Ibáñez and Aispuru, 2020), it may ultimately have positive economic repercussions for the healthcare systems of any state.

## 5. Conclusions

The findings showed a better adjustment among patients receiving CSII treatment, both in clinical and psychological variables. At a clinical level, patients with CSII treatment present a higher frequency of attendance to endocrinology consultations and diabetic education sessions. Psychologically, CSII patients showed a higher quality of life, involving greater self-care and less concern about the disease. Also, self-esteem and affective social support were higher than in MDI patients. Additionally, well-being was better among CSII patients, not only subjective (happiness and life satisfaction), but also psychological (autonomy, positive relations, environmental mastery, and self-acceptance).

## Availability of Data and Materials

The data sets generated and analyzed during the present study are available in the Google Drive repository, [https://drive.google.com/file/d/1\\_4sNuObgpGJO54oM6OgJOxojgG7KKznx/view?usp=sharing](https://drive.google.com/file/d/1_4sNuObgpGJO54oM6OgJOxojgG7KKznx/view?usp=sharing). All data points generated or analyzed during this study are included in this article and no other underlying data are necessary to reproduce the results.

## Author Contributions

BMC and MCA designed and performed the research study. MCA analysed the data. BMC was responsible for drafting the results. Both authors contributed to editorial changes in the manuscript. Both authors read and approved the final manuscript. Both authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

## Ethics Approval and Consent to Participate

All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of the University Hospital Complex of the Canary Islands (approval number: CHUC-2023-22).

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## Conflict of Interest

The authors declare no conflict of interest.

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