Psychometric analysis of the Spanish and Catalan versions of a questionnaire for hypoglycemia awareness

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ABSTRACT

Background and objective: Intensive insulin therapy with multiple insulin doses in subjects with type 1 diabetes mellitus (T1D) is associated with a higher risk of hypoglycaemic episodes. Repeated hypoglycaemia results in a reduced ability/failure to recognise hypoglycaemia symptoms and predisposes to severe episodes. In this context, it is crucial to work with specific questionnaires to diagnose and address this burden. Our study aimed to perform the psychometric analysis of Spanish and Catalan versions of Clarke et al. questionnaire for hypoglycemia awareness.

Patients and method: Psychometric analysis in patients with T1D of Spanish and Catalan versions of Clarke et al. questionnaire in three phases: (1) translation, back-translation and cultural adaptation of the English version; (2) analysis of internal, external and test–retest validity, and (3) assessing sensitivity to change in hypoglycaemia perception.

Results: One-hundred and forty-four subjects with T1D answered the Clarke et al. questionnaire (mean age [SD] 36 [18] years, 46\% men). We observed a Cronbach’s $\alpha$ coefficient for internal validity of 0.75, a correlation coefficient for test–retest reliability of $r=0.81$ and a correlation of the questionnaire score with the frequency of severe and no severe hypoglycaemia events of $r=0.47$ and $r=0.77$, respectively. The analysis of 20 patients with T1D 24 months after the initiation of continuous subcutaneous insulin infusion showed a decrease in the frequency of non-severe hypoglycaemia/week (from 5.40 [2.09] to 2.75 [1.74]) and in the number of severe hypoglycaemic episodes/year (1.25 [0.44] to 0.05 [0.22]). This was associated with a decrease in scores in the translated versions of Clarke et al. questionnaire (from 5.45 [1.19] to 1.60 [2.03]).

Conclusions: Spanish and Catalan versions of Clarke et al. questionnaire display good psychometric properties and both could be considered a useful tool for evaluating hypoglycaemia awareness in patients with T1D from our area.

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Análisis psicométrico de las versiones en lengua castellana y catalana de un cuestionario de percepción de la hipoglucemia

R E S U M E N

Fundamento y objetivo: El tratamiento intensivo con múltiples dosis de insulina de los pacientes con diabetes mellitus tipo 1 (DT1) se asocia con la aparición de hipoglucemias. Su recurrencia condiciona la pérdida progresiva de los síntomas asociados a las mismas y predispone a la aparición de episodios graves. Es importante disponer de cuestionarios específicos y validados para identificar a los pacientes con este problema. Con este objetivo se realizó el análisis psicométrico de las versiones castellana y catalana del cuestionario de Clarke et al. destinado a valorar la percepción de hipoglucemias.
Patients and method: Analysis psychometric in patients with DT1 of the versions in castellano and catalan del cuestionario de Clarke et al. in 3 phases: 1) traduction, retrotraduction and adaptation cultural of the version in inglés; 2) analysis of the consistencia interna, validez de constructo and test-retest of the same, and 3) analysis of the sensibility al cambio en the percepción de hipoglucemias.

Resultados: Ciento cuarenta y cuatro pacientes with DT1 contestaron los cuestionarios en lengua castellana or catalana, according preferences (edad media [DE] de 36 [18] años, 46% varones). Se obtuvo un coeficiente α de Cronbach para the consistencia interna de 0,75, un coeficiente de correlación para la fiabilidad test-retest de r = 0,81 y una correlación de the puntuación del cuestionario con the frecuencia de hipoglucemias no graves and graves de r = 0,47 and r = 0,77, respectively. El análisis de 20 pacientes with DT1 durante 24 meses tras the inicio of infusion subcutánea continua of insulin mostró una disminución de the frecuencia de hipoglucemias no graves/semana (de una media de 5.40 [2.09] a 2.75 [1.74]), así como del número of episodios of hipoglucemia grave/año (de una media of 1.25 [0.44] a 0.05 [0.22]). Esta reducción se asoció with una mejora in the percepción de the hipoglucemia, con una disminución of the puntuación del the cuestionario of Clarke et al. [de 5.45 [1.19] a 1.60 [2.03]].

Conclusiones: Las versiones en lengua castellana and catalana del cuestionario of Clarke et al. tienen buenas características psicométricas and pueden be an instrument útil for evaluate the presencia of hipoglucemia desapercibida in patients with DT1 of nuestro entorno.

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within a maximum of one week. Both questionnaires had the same alphanumeric code so that they could be merged in the statistical analyses. When the second questionnaire had been returned, we checked to determine whether or not it was within the stipulated period. If the deadline had already passed, the data was excluded.

Stage 3. Sensitivity to change. This stage involved patients with T1D (≥18 years old) who had started CSII treatment at the Diabetes Unit of the Endocrinology and Nutrition Service at the Hospital Clínícal Universitari de Barcelona between 2006 and 2008, as a consequence of high incidence of non-serious and serious episodes of hypoglycaemia. As in stage 2, sociodemographic and clinical data were collected. Awareness of hypoglycaemia was evaluated using the Spanish and Catalan versions of the Clarke et al. questionnaire at the beginning of the study and at 6, 12 and 24 months after initiating CSII treatment.

Statistical analysis

Data are expressed as mean [SD]. Means were compared using the Student’s t-test. The correlation between variables was calculated with Pearson’s correlation coefficient. Cronbach’s α coefficient was used to assess the internal consistency of the questionnaire. We considered $p < 0.05$ to be significant. Statistical analysis was with SPSS® 17.0 (SPSS Inc., Chicago, IL, USA). The study sample size was not determined.

Results

Stage 1. After translating the questionnaires from English into Spanish and Catalan, and the subsequent back-translation into English, 16 words were modified in the Spanish version and 20 in the Catalan version. Two other words and a verb tense were changed after their cultural adaptation by patients. The final Spanish and Catalan versions were produced using all available observations (Tables 1–3).

Stage 2. Of the total number of patients invited to participate, 30 were excluded (new readers, language barrier, type 2 diabetes, unwillingness to participate). In total, 144 patients completed the questionnaire in Spanish or Catalan, as they preferred (mean age [SD] 36 [18] years; 46% men; level of education: primary 18%, secondary 37%, university 45%; 41% received CSII and the rest, MDI; mean HbA1c was 7.5% [1.4%]). Cronbach’s α coefficient for internal consistency was 0.75. Test–retest reliability showed a correlation coefficient of $r = 0.81$; $p < 0.001$. The correlation between the questionnaire score (R) and the frequency of non-serious episodes of hypoglycaemia was $r = 0.47$ ($p < 0.05$); and the frequency of serious episodes of hypoglycaemia was $r = 0.77$ ($p < 0.001$) (construct validity).

Stage 3. Twenty patients with T1D (mean age 34.0 [7.5] years; 12 women; mean disease progression 16.2 [6.6] years; mean HbA1c 6.7% [1.1%]) were assessed. Before initiating treatment with CSII, 19 of the 20 patients were classified as having an abnormal perception of a situation of hypoglycaemia (mean score 5.45 [1.19]). The remaining patient was classified as having an indeterminate perception.

The use of CSII was associated with a fall in the number of non-serious episodes of hypoglycaemia per week (mean between 5.40 [2.09] and 4.60 [2.33], 3.07 [1.39] and 2.75 [1.74] at 6, 12 and 24 months, respectively; $p < 0.001$). Similarly, the number of episodes of serious hypoglycaemia decreased from 1.25 [0.44] per patient/year to 0.05 [0.22] at the end of the study ($p < 0.001$). We observed a progressive reduction in the questionnaire score, indicating a progressive improvement in perception of hypoglycaemia (mean score 3.7 [1.65], 2.74 [1.06] and 1.60 [2.03] at 6, 12 and 24 months, respectively). After 24 months, only 3 of the 20 patients were still classified as having an abnormal perception of a situation of hypoglycaemia.

Discussion

Psychometric analysis of English into Spanish and English into Catalan translations of a hypoglycaemia awareness questionnaire shows that this instrument could be useful in the detection of patients with T1D and unnoticed hypoglycaemia, in our context. Without doubt, the occurrence of repeated episodes of hypoglycaemia is currently one of the most substantial obstacles to

<table>
<thead>
<tr>
<th>Table 1</th>
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<tbody>
<tr>
<td><strong>Spanish language version of the questionnaire Clarke.</strong></td>
</tr>
<tr>
<td>1. ¿Escoja la categoría que mejor le describe (solo una)</td>
</tr>
<tr>
<td>a) Siempre tengo síntomas cuando mi azúcar en sangre está bajo</td>
</tr>
<tr>
<td>b) Algunas veces tengo síntomas cuando mi azúcar en sangre está bajo</td>
</tr>
<tr>
<td>c) Ya no tengo síntomas cuando mi azúcar en sangre está bajo</td>
</tr>
<tr>
<td>2. ¿Ha perdido alguno de los síntomas que solía presentar ante una bajada de azúcar (hipoglucemia)?</td>
</tr>
<tr>
<td>a) Sí</td>
</tr>
<tr>
<td>b) No</td>
</tr>
<tr>
<td>3. En los últimos 6 meses, ¿con qué frecuencia ha tenido episodios de HIPoglUCeMIA GRAVe SIN PÉRDIDA De CONOCIMIENTO? (episodios en los que se ha sentido confundido, desorientado, cansado y sin posibilidad de tratar usted mismo la situación de hipoglucemia)</td>
</tr>
<tr>
<td>a) Nunca</td>
</tr>
<tr>
<td>b) Una/2 veces</td>
</tr>
<tr>
<td>c) Una vez cada 2 meses</td>
</tr>
<tr>
<td>d) Una vez al mes</td>
</tr>
<tr>
<td>e) Más de una vez al mes</td>
</tr>
<tr>
<td>4. En el último año, ¿con qué frecuencia ha tenido episodios de HIPoglUCeMIA GRAVe CON PÉRDIDA De CONOCIMIENTO? (episodios acompañados de pérdida de conciencia o convulsiones que hayan requerido la administración de glucagón o glucosa intravenosa)</td>
</tr>
<tr>
<td>a) Nunca</td>
</tr>
<tr>
<td>b) De una a 3 veces</td>
</tr>
<tr>
<td>c) 2 a 3 veces/semana</td>
</tr>
<tr>
<td>d) 4 o 5 veces/semana</td>
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<tr>
<td>e) Casi cada día</td>
</tr>
<tr>
<td>5. En el último mes, ¿con qué frecuencia ha tenido lecturas inferiores a 70 mg/dl con síntomas?</td>
</tr>
<tr>
<td>a) Nunca</td>
</tr>
<tr>
<td>b) De una a 3 veces</td>
</tr>
<tr>
<td>c) 2 a 3 veces/semana</td>
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<tr>
<td>d) 4 o 5 veces/semana</td>
</tr>
<tr>
<td>e) Casi cada día</td>
</tr>
<tr>
<td>6. En el último mes, ¿con qué frecuencia ha tenido lecturas inferiores a 70 mg/dl sin síntomas?</td>
</tr>
<tr>
<td>a) Nunca</td>
</tr>
<tr>
<td>b) De una a 3 veces</td>
</tr>
<tr>
<td>c) 2 a 3 veces/semana</td>
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<tr>
<td>d) 4 o 5 veces/semana</td>
</tr>
<tr>
<td>e) Casi cada día</td>
</tr>
<tr>
<td>7. ¿Hasta cuándo ha de bajar su azúcar en sangre para notar síntomas?</td>
</tr>
<tr>
<td>a) 60-69 mg/dl</td>
</tr>
<tr>
<td>b) 50-59 mg/dl</td>
</tr>
<tr>
<td>c) 40-49 mg/dl</td>
</tr>
<tr>
<td>d) Inferior a 40 mg/dl</td>
</tr>
<tr>
<td>8. ¿Hasta qué punto puede decir por sus síntomas que su azúcar en sangre es bajo?</td>
</tr>
<tr>
<td>a) Nunca</td>
</tr>
<tr>
<td>b) Casi nunca</td>
</tr>
<tr>
<td>c) Algunas veces</td>
</tr>
<tr>
<td>d) Casi siempre</td>
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<tr>
<td>e) Siempre</td>
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</table>
To summarise, the results of our study show that the Spanish and Catalan versions of the Clarke et al. questionnaire can be a useful instrument in assessing the presence of unnoticed hypoglycaemia in patients with T1D in our context. Using the questionnaire is the step prior to any intervention targeted at detecting, preventing and improving the treatment of existing cases of hypoglycaemia, with the overall aim of eradicating the occurrence of episodes of hypoglycaemia, if possible.

**Funding**

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Table 2

Catalan version of the questionnaire Clarke.

1. Escull la categoria que millor descriu (només una):
   a) Sempre tinc símptomes quan el meu sucre en sang està baix
   b) A vegades tinc símptomes quan el meu sucre en sang està baix
   c) Ja no tinc símptomes quan el meu sucre en sang està baix

2. Ha perdut algun dels símptomes que solia presentar davant una bajada de sucre?
   a) Sí
   b) No

3. En els últims 6 mesos, amb quina freqüència ha tingut episodis d'HIPoglucèmia GREU SENSE PÈRDUA DE CONEXEMET? (episodis en els que s'ha sentit confus, desorientat, cansat i sense possibilitat de tractar vostè mateix la situació d'hipoglucèmia)
   a) Mai
   b) Una/2 vegades
   c) Una vegada cada 2 mesos
   d) Una vegada al mes
   e) Més d'una vegada al mes

4. Al darrer any, amb quina freqüència ha tingut episodis d'HIPoglucèmia GREU AMB PÈRDUA DE CONEXEMET? (episodis acompanyats de pèrdua de conciència o convulsions i que varen requerir l'administració de glucagó o glucosa intravenosa)
   a) Mai
   b) Una vegada
   c) 2 vegades
   d) 3 vegades
   e) 5 vegades
   f) 6 vegades
   g) 7 vegades
   h) 8 vegades
   i) 9 vegades
   j) 10 vegades
   k) 11 vegades
   l) 12 vegades o més

5. A l'últim mes, amb quina freqüència ha tingut lectures inferiors a 70 mg/dl amb símptomes?
   a) Mai
   b) Entre una i 3 vegades
   c) Una vegada/setmana
   d) De 2 a 3 vegades/setmana
   e) De 4 a 5 vegades/setmana
   f) Gairebé cada dia

6. A l'últim mes, amb quina freqüència ha tingut lectures inferiors a 70 mg/dl sense cap símptoma?
   a) Mai
   b) Entre una i 3 vegades
   c) Una vegada/setmana
   d) De 2 a 3 vegades/setmana
   e) De 4 a 5 vegades/setmana
   f) Gairebé cada dia

7. Fins a quant ha de baixar el seu nivel de sucre a la sang, abans de notar símptomes?
   a) 60-69 mg/dl
   b) 50-59 mg/dl
   c) 40-49 mg/dl
   d) Inferior a 40 mg/dl

8. Fins a quin punt pot dir, pels seus símptomes, que el nivell de sucre en sang és baix?
   a) Mai
   b) Gairebé mai
   c) Algunes vegades
   d) Gairebé sempre
   e) Sempre

---

Table 3

Score calculation.

<table>
<thead>
<tr>
<th>Question 1, b or c = R</th>
<th>Question 2, a = R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 3, b, c, d, e (any of them) = R</td>
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<tr>
<td>Question 4, b, c, d, e, f, g, h, i, j, k, (any of them) = R</td>
<td></td>
</tr>
<tr>
<td>Questions 5 and 6, answer to question 5 &lt; answer to question 6 = R</td>
<td></td>
</tr>
<tr>
<td>Question 7, c or d = R</td>
<td></td>
</tr>
<tr>
<td>Question 8, a, b or c = R</td>
<td></td>
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</tbody>
</table>

The total sum of R responses determines the level of the patient’s awareness of hypoglycaemia:

1–2R = normal perception
3R = indeterminate perception
>3R = abnormal perception of an episode of hypoglycaemia (unnoticed hypoglycaemia)

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Improving blood sugar level control in patients with T1D, using conventional and non-conventional insulin-intensified treatment. The repetition of episodes leads to a progressive loss of the symptoms of a normal response to hypoglycaemia in up to 20% of patients. This loss of warning symptoms in response to hypoglycaemia (unnoticed hypoglycaemia) leads to repeated non-serious episodes and, particularly, to serious episodes, thus increasing the patient’s vulnerability and significantly diminishing their quality of life. In this context, and if improved hypoglycaemia awareness and the prevention of serious hypoglycaemia episodes are our targets, then it is undoubtedly essential we have access to a questionnaire in the patients’ mother tongue. In addition to the original study by Clarke et al., we have previously demonstrated the questionnaire’s capacity to identify patients with unnoticed hypoglycaemia. To do so, we compared the results obtained with the questionnaire with the gold standard, defined as the achievement of symptoms triggered by an episode of controlled-induced hypoglycaemia. Our comparison with the percentage increase in the symptoms score (Edinburgh’s scale) between hypoglycaemia and euglycaemia demonstrated that using the questionnaire enables us to identify patients with high sensitivity. Moreover, we found a negative correlation between the increased symptoms score and the score obtained in the Clarke et al. questionnaire. Additionally, we were able to prove that the questionnaire score was higher in patients with a higher percentage of interstitial glucose: <70 mg/dl obtained by continuous monitoring.

As we see it, the results pertaining to the questionnaire’s capacity to detect changes are especially interesting. As the stage 3 patients had a decreasing number of episodes of non-serious and serious hypoglycaemia, the questionnaire score fell concurrently, i.e. their perception of hypoglycaemia gradually improved. That is to say, the questionnaire can detect changes associated with an intervention procedure aimed at avoiding hypoglycaemia and thus improving perception of it.

However, our study and its results are not without their limitations. The validation can only be considered partial: internal consistency, test–retest reliability of the instrument, construct validity and sensitivity to change have been established. There is also an arbitrary cut-off point that classifies patients and compares the questionnaire with a diagnostic test, although its final objectives are exclusively targeted at identifying those patients at highest risk of future serious episodes of hypoglycaemia. We should also bear in mind that the sample used for sensitivity-to-change analysis could be considered small, although the specific characteristics of the patients actually included reflect the difficulties entailed in the selection process.
Conflicts of interest

The authors declare that there are no conflicts of interest.

Acknowledgements

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Appendix.

Tables 1-2 English version of the Clarke questionnaire.

1. Choose the category that better describes you (only one)
   a) I always have symptoms when my blood sugar levels are low
   b) I sometimes have symptoms when my blood sugar levels are low
   c) I do not have symptoms any more when my blood sugar levels are low

2. Have you lost any of the symptoms you usually had in case of low blood sugar levels (hypoglycaemia)?
   a) Yes
   b) No

3. During the last 6 months, with what frequency have you experienced episodes of SERIOUS HYPOGLYCAEMIA WITHOUT LOSS OF CONSCIOUSNESS? (episodes where you were confused, disoriented, tired and without the ability to treat the episode of hypoglycaemia by yourself)
   a) Never
   b) Once/twice
   c) Once every 2 months
   d) Once a month
   e) More than once a month

4. During the last year, with what frequency have you experienced episodes of SERIOUS HYPOGLYCAEMIA WITH LOSS OF CONSCIOUSNESS? (episodes accompanied by loss of consciousness or seizures that have required the administration of intravenous glucose or glucose)
   a) Never
   b) Once
   c) Twice
   d) 3 times
   e) 5 times
   f) 6 times
   g) 7 times
   h) 8 times
   i) 9 times
   j) 10 times
   k) 11 times
   l) 12 times or more

5. During the last month, with what frequency have you had levels lower than 70 mg/dl with symptoms?
   a) Never
   b) 1 to 3 times
   c) 2 or 3 times a week
   d) 4 or 5 times a week
   e) Almost every day

References