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ORIGINAL ARTICLE

Validation of the "Good2Go": the first French-language transition readiness questionnaire

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Abstract

The use of transition readiness questionnaires is strongly recommended in adolescents with chronic conditions. The aim of our study was to validate "Good2Go," the first French-language transition readiness questionnaire. We analyzed the data from 2 multicentric studies (Canada and France) involving adolescents with chronic conditions (type 1 diabetes, inflammatory bowel disease, cystic fibrosis, epilepsy, juvenile idiopathic arthritis). Content and construct validity were examined using factorial and Rasch analysis (structural validity), Spearman's correlation, and Mann-Whitney test (external validity). Cronbach's α and intra-class correlation coefficients explored reliability. Cognitive interviews assessed wording comprehension and item appropriateness. Good2Go was completed by 321 participants (boys = 51%; mean age = 16.4 years (standard deviation = 1.5; min = 14.0; max = 18.0); Canada = 51.1%). Factor analysis identified 3 domains: "health self-advocacy," "knowledge about chronic conditions," and "self-management skills." The 3-domain structure showed a satisfying Rasch fit, internal consistency, and test-retest reliability. Good2Go domain scores were significantly higher in participants over 17 years of age, indicating satisfactory external validity.

Conclusion: Good2Go is a valid 20-item questionnaire to assess transition readiness in adolescents with chronic conditions and may be useful in routine care to propose individually tailored preparation for their transfer to adult healthcare. Further research is now needed to analyze correlation between domain scores and success of transition.

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What is Known:
- *In adolescents with chronic conditions, the use of transition readiness questionnaires is recommended to propose individually tailored preparation for their transfer to adult healthcare.*
- *However, no French-language questionnaire has been so far validated.*

What is New:
- *Based on a complete validation methodology, this study highlights that the French-language 20-items Good2Go questionnaire has good psychometric properties.*
- *It explores all transition key points though 3 scored domains: "health self-advocacy", "knowledge about chronic disease" and "self-management skills".*

Keywords Chronic condition · Chronic disease · Adolescent · Tools validation · Psychometric proprieties · Patient-reported outcomes

Abbreviations
RMEF Réseau Mère-Enfant de la Francophonie

Introduction

As teenagers, young people with a chronic condition face a double challenge: first, the developmental tasks of adolescence [26], which may potentially be impaired by illness or disability, and second, the transition from pediatric to adult healthcare. Many studies, focusing on different chronic conditions, have shown that transition was associated with an over-risk of acute complications and death [1, 4, 14, 33]. To enhance the chances of successful transition, international recommendations [2, 3, 11, 28] agree that the transition process must involve both the patient and his/her parents, with a view to the patient's empowerment and early preparation (from 12 to 13 years) around personalized objectives. These objectives concern the patient's knowledge and skills related to the chronic conditions, psychosocial skills, and the quality of the available social support. Finally, the role of caregivers is to encourage the adolescent's global maturation so that he/she feels ready to move to adult healthcare.

Transition readiness assessment tools help to establish a personal transition plan, by highlighting the key-points to work on during transition preparation [3, 21, 31]. Several generic tools have already been evaluated and published in English [27, 30, 36](TRAQ [35], TRANSITION-Q [12], Am I ON TRAC [22], Self-Management Skills Assessment Guide [34], UNC TRxANSITION scale [8], and STARx questionnaire [9]) but none in French and extensive data about their psychometric validation are lacking. Apart from the aforementioned generic tools, a 26-item questionnaire was generated at the Hospital for Sick Children in Toronto, Canada, then finalized after an analysis of interviews with patients and caregivers, and included in the "Good2Go" complete program of transition preparation [32]. The developers focused item content on a global approach to the key aspects of transition, from practical aspects of self-management to the subjective experience of transition preparation, at any stage of adolescence, even if autonomy was still limited.

Because of its wide approach, this questionnaire is used worldwide but without any psychometric validation. Our aim was to assess the psychometric proprieties of the French Good2Go questionnaire, using a combination of classical test theory and item response theory.

Materials and methods

French version of the Good2Go questionnaire

The aim of the translation process was to achieve conceptual item equivalence, and semantic equivalence [6]. The translation process was conducted between May and December 2011. The Good2Go was cross-culturally adapted from the English version (26 items; Online Resource 1—Table 1), into French according to guidelines [7] by an expert committee of the "Réseau Mère-Enfant de la Francophonie" group (RMEF), including 8 bilingual physicians, which produced four translations of the Good2Go questionnaire (one for each of 4 French-speaking country: Canada, France, Switzerland, and Morocco). During a first harmonization meeting, the expert committee agreed by consensus on a preliminary version, which was validated by the developers. Next, this preliminary version was discussed within 4 focus groups (2 in France; 1 in Switzerland; 1 in Quebec) of 5 to 6 adolescents (14–18 years) with chronic disease (type 1 diabetes, epilepsy, cystic fibrosis, juvenile idiopathic arthritis, or inflammatory bowel disease). Considering patients' recommendations, a new phone meeting of the expert committee resulted in a new version of the translated Good2Go. After this meeting, a consensus on a 25-item version (1 item eliminated; Online Resource 1-Table 1) was obtained, and was approved by the developers of the Good2Go.

The initial French version contained 21 Likert items (scored from 1 = low readiness to 5 = high readiness) and 4 additional (non-scored) items on social support (Table 1).

Table 1 Initial and final French versions of the Good2Go questionnaire

Type of item	No. of item	Item of the initial French version	Number of responses available	Item of the final French version
Scored items*	1	Je sais expliquer aux autres ma maladie et les besoins qui y sont associés.	318	Je sais expliquer aux autres ma maladie et les besoins qui y sont associés.
	2	Je prépare et prends / fais mes médicaments/traitements de moi-même.	307	Je prépare et prends / fais mes médicaments/traitements de moi-même.
	3	Je participe activement (pose et répond aux questions) pendant les consultations/rendez-vous que j'ai avec les soignants.	315	Je participe activement (pose et répond aux questions) pendant les consultations/rendez-vous que j'ai avec les soignants.
	4	*Je prends soins de ma santé: activité physique, alimentation, hygiène de sommeil.*	319	*Excluded*[a]
	5	J'organize moi-même les soins qui sont nécessaires à ma santé (ex.: prendre un rendez-vous/convocations, acheter/renouveler les traitements, prendre note/conserver des résultats d'examens).	317	J'organize moi-même les soins qui sont nécessaires à ma santé (ex.: prendre un rendez-vous/convocations, acheter/renouveler les traitements, prendre note/conserver des résultats d'examens).
	6	Durant une consultation/rendez-vous, j'exprime mon point de vue et explique ce dont je crois avoir besoin.	318	Durant une consultation/rendez-vous, j'exprime mon point de vue et explique ce dont je crois avoir besoin.
	7	Je peux me rendre seul(e) aux consultations/rendez-vous médicaux.	309	Je peux me rendre seul(e) aux consultations/rendez-vous médicaux.
	8	À chaque rendez-vous/consultations, je passe un moment seul avec les soignants	309	À chaque rendez-vous/consultations, je passe un moment seul avec les soignants
	9	Avec les soignants, je suis capable de parler de sexualité et de l'impact qu'a ma maladie sur elle (ex.: fonctionnement, contraception, protection contre les infections).	282	Avec les soignants, je suis capable de parler de sexualité et de l'impact qu'a ma maladie sur elle (ex.: fonctionnement, contraception, protection contre les infections).
	10	Je discute avec les soignants de l'impact qu'a le tabac, l'alcool et les drogues sur ma santé.	274	Je discute avec les soignants de l'impact qu'a le tabac, l'alcool et les drogues sur ma santé.
	11	Je suis capable de discuter avec les soignants de comment faire face à mon stress / mes inquiétudes.	300	Je suis capable de discuter avec les soignants de comment faire face à mon stress / mes inquiétudes.
	12	Je discute avec les soignants de l'impact qu'a ma maladie sur ma vie.	313	Je discute avec les soignants de l'impact qu'ont ma maladie sur ma vie.
	13	Je connais les noms de mes médicaments et/ou de mes traitements.	317	Je connais les noms de mes médicaments et/ou de mes traitements.
	14	Je sais à quoi servent chacun de mes médicaments et/ou de mes traitements.	316	Je sais à quoi servent chacun de mes médicaments et/ou de mes traitements.
	15	Je sais comment mes médicaments sont payés/remboursés.	308	Je sais comment mes médicaments sont payés/remboursés.
	16	Je connais les conséquences qu'aura ma maladie sur ma santé au cours des prochaines années.	311	Je connais les conséquences qu'aura ma maladie sur ma santé au cours des prochaines années.
	17	Je comprends l'impact qu'a/a eu ma maladie sur ma puberté et ses changements.	287	Je comprends l'impact qu'a/a eu ma maladie sur ma puberté et ses changements.
	18	Je sais que j'ai le droit d'être informé sur ma maladie.	314	Je sais que j'ai le droit d'être informé sur ma maladie.
	19	Je sais quels soignants j'aurai à rencontrer comme adulte.	307	Je sais quels types de soignants j'aurai à rencontrer comme adulte.
	20	Quand ma maladie pose problème, je sais comment aller chercher de l'aide.	307	Quand ma maladie pose problème, je sais comment aller chercher de l'aide.
	21	Je sais comment prendre un rendez-vous avec un soignant.	312	Je sais comment prendre un rendez-vous avec un soignant.
Additional items**	/	Je suis soutenu par mon entourage (par exemple, ma famille, mes amis) pour prendre en charge ma maladie.		Je suis soutenu par mon entourage (par exemple, ma famille, mes amis) pour prendre en charge ma maladie.
(Non-scored)	/	J'ai des amis qui me soutiennent lors de moments difficiles.		J'ai des amis qui me soutiennent lors de moments difficiles.
	/	Je participe à des clubs, des groupes, des équipes sportives ou des activités que j'aime.		Je participe à des clubs, des groupes, des équipes sportives ou des activités que j'aime.
	/	Je vais régulièrement à l'école ou j'ai un travail.		Je vais régulièrement à l'école ou j'ai un travail.
	/			*Added* [a]*: Je prends soins de ma santé: activité physique, alimentation, hygiène de sommeil.*

In italics: items excluded or added in the final version. *Items 1 to 21: scored from 1 to 5: 1 = "Je ne fais jamais cela (quelqu'un le fait pour moi)"; 2 = "Je fais rarement cela (mais je tente parfois)"; 3 = "Parfois je fais cela, parfois non"; 4 = "Je fais cela souvent"; 5 = "Je fais toujours cela"; NA = "Cela ne s'applique pas à ma situation". **Additional items: not included in scoring, with 3 answer modalities: "Non," "Parfois," "Oui"

[a] In the final version, item 4 was excluded from the scored items and added to additional items

Data

For this study, we analyzed data from French language clinical studies. The "RMEF study" [13] (2013–2015) included 223 adolescents (14–18 years) with type 1 diabetes, epilepsy, cystic fibrosis, juvenile idiopathic arthritis, or inflammatory bowel disease from 3 centers in Canada (Montreal, Quebec, Sherbrooke) and 1 in France (R. Debré Hospital, Paris). The questionnaire was filled in twice (at baseline and 15 days later), face-to-face in paper version during a routine appointment with a healthcare professional. The "Pass'Age study" [10] (2014–2016) included 98 adolescents (16–21 years) with type 1 diabetes from 9 centers in the Paris area (France). The Good2Go was administrated at baseline in paper version during an appointment with their referring endocrinologist. Non-inclusion criteria were the same for the 2 studies: developmental delay, non-understanding of the French language, or patient or parents declining participation. The ethical committees of CHU Montreal, CHU Saint Justine, and CHU Sherbrooke approved the protocol for their respective centers, and the Groupe Nantais d'éthique approved it for R. Debré hospital. R. Debré hospital ethical committee approved the Pass'Age study protocol. Data of the two studies were stored in online-protected databases, conforming to good practices. RMEF and Pass'Age studies' data were stored in secured online datasets in accordance with the respective institutional standards. For the purpose of this analysis, an anonymized dataset (SAS format) protected with a password was provided to the methodologist (H. Devilliers).

Statistical analysis

We used international terminology and taxonomy of measurement properties [20]. SAS software (version 9.4-SAS institute, Inc., Cary, NC) was used for classical test theory analysis and Winsteps (version 3.60-Winsteps, Chicago, IL) for item response theory analysis.

Construct validity

To identify concepts underlying transition readiness in Good2Go, items representing the same concept had to be grouped into domains to which corresponded a numerical value. It consisted in an exploratory factor analysis, a statistical technique aimed at reducing item information to a smaller set of summary variables (factors). The number of factors to be kept was determined according to clinical expertise and statistical criteria. All factors explaining more information (variance) than one single item (in statistical terms: with an eigenvalue > 1) were kept. For this analysis only, a multiple imputation of missing data and specific value to "non-applicable" items ("0" = lowest value) were applied. To ensure factorial structure stability, sensitivity analyses were conducted on complete data, using various imputation methods and different values given to "non-applicable" items (0/1/multiple imputation).

To further analyze the structure of Good2Go, an item response theory analysis was conducted using a rating scale model. Based on response to items, this approach allows one to estimate for a given domain each patient's ability and each item's difficulty level on the same linear scale expressed in log-odds units (logits). Bad fit of items to item response theory models assumption may indicate bad wording or violation of unidimensionality (i.e., item not related to the dimension concept) or item redundancy (i.e., local dependence). Items fit were assessed using the infit and outfit statistics, for each item (acceptable ranges; 0.3–0.7). The residual is the amount of information not explained by the model. Residual dimensional structure and correlation matrix were examined to ensure unidimensionality and local independence of items. To determine the best dimensional structure, item response theory analysis was conducted twice on each domain, separately: first, using the dimensionality suggested by factor analysis; and second, on domains after moving 3 items clinically expected to load on a different domain. (for further details, see Online Resource 2).

Good2Go scoring

For each domain, when at least 50% of items were answered, a domain score was calculated using the mean score of answered items (for each domain: sum of answered items scores divided by the number of answered items). Mean domain scores were then multiplied by 20 to obtain final scores from 0 (poorest transition readiness) to 100 (best transition readiness). "Non-applicable" responses were treated as unanswered (missing).

External validity

We compared domain scores between groups expected to have different transition readiness using Mann-Whitney non-parametric tests (divergent validity). In line with other transition readiness questionnaire validation studies [8, 12, 22, 34, 35], and hypothesizing that scores would be significantly different depending of the participant characteristics, Spearman's correlations explored correlation between domain scores and age, gender, type, and duration of chronic condition.

Reliability

Cronbach's α coefficient explored internal consistency for each domain ($\alpha \geq 0.7$: satisfactory value). Comparing domain scores between baseline and 15 days later, intra-class coefficients analyzed test-retest reliability (intra-class coefficient $\geq$ 0.7: satisfactory value).

Face validity

Conforming to ISPOR guidelines concerning the assessment of respondent understanding [23], one of us (P. Jacquin) performed individual cognitive semi-structured interviews (think aloud approach) in 5 adolescents (13–16 years) with chronic condition who were asked if items were understandable and adequately referred to relevant aspects of transition, and, if necessary, to suggest new wordings.

Results

A total of 321 adolescents completed the questionnaire (characteristics detailed in Table 2).

Construct validity

Exploratory factor analysis (Table 3) resulted in 3 factors (eigenvalue > 1) explaining more than 90% of item variance. Factorial structure was consistent among analyses with various imputation methods. Items' standardized loading were ≥ 0.44 on domain 1 ("health self-advocacy") for items 1, 3, 6, 9, 10, 11, 12, and 17; ≥ 0.34 on domain 2 ("knowledge about chronic condition") for items 13, 14, 15, 16, 18, and 20; and ≥ 0.52 on domain 3 ("self-management skills") for items 5, 7, 8, and 21.

Concerning item 4 (taking care of their own health needs), results indicated low loading on each domain (0.14, 0.03, and 0.02 in domains 1, 2, and 3, respectively), and, after including it in any domain, decreased Cronbach's coefficient and poorer fit with the item response theory model. Moreover, cognitive interviews showed that the wording "own health needs" created confusion between the concepts of personal well-being and compliance with medical prescription. Based on statistical and clinical considerations, we thus eliminated item 4 from further analyses.

Item 19 (knowing the kinds of health-care providers they will need to see as an adult) had a moderate loading on domains 1 and 2 (0.28 and 0.24, respectively) but cognitive interviews found it was more related to the topic of domain 2 ("knowledge about chronic condition"). Similarly, item 2 (preparing and taking the medications and/or treatments on their own) had a higher loading on domain 2 (0.27) but it was clinically more related to domain 3 ("self-management skills"), according to clinicians and the adolescents in cognitive interviews.

Considering the discrepancy between statistical and clinical considerations, item response theory analysis was conducted separately on each domain, based on two options (Table 4): in option 1, items were grouped according to their higher loading in exploratory factor analysis (item 19 in domain 1; item 2 in domain 2); in option 2, items 19 and 2 were classified according clinical pertinence (item 19 in domain 2; item 2 in

Table 2 Characteristics of the 321 study participants

	RMEF study $N = 223$	Pass'Age study $N = 98$	Total $N = 321$
Gender: Boys—*n* (%)	112 (50)	53 (54)	165 (51)
Age at questionnaire completion, in years—mean (SD)	16 (1.4)	17.3 (1.2)	16.4 (1.5)
Time since diagnosis (years)—mean (SD)	7.5 (5.4)	9.5 (4.6)	8.1 (5.2)
Chronic condition—*n* (%)			
Type 1 diabetes	78 (35)	98 (100)	176 (55)
Inflammatory bowel disease	56 (25)	–	56 (18)
Cystic fibrosis	47 (21)	–	47 (15)
Epilepsy	34 (15)	–	34 (10)
Juvenile idiopathic arthritis	8 (4)	–	8 (2)
Place of residence—*n* (%)			
Canada	164	–	164 (51)
France	59	98	157 (49)
Quality of questionnaire completion—*n* (%)			
Complete questionnaire	119 (53)	81 (83)	200 (62)
1 missing value	43 (19)	13 (13)	56 (17)
2 missing values	33 (15)	1 (1)	34 (11)
≥ 3 missing values	28 (13)	3 (3)	31 (9)
Second completion at 15 days—*n* (%)	–	94 (96)	94 (29)

Quantitative variables are expressed as means (SD) or median (quartiles), depending on the distribution, and qualitative variables are expressed as frequencies (percentages)

Table 3 Exploratory factor analysis of Good2Go items

No. of item	Item wording	Factor 1	Factor 2	Factor 3
11	I talk to my health-care provider about ways to manage stress.	*0.88*	0.04	−0.09
12	I talk to my health-care provider about how my health condition affects my life.	*0.77*	0.09	−0.14
9	I talk to my health-care provider about the impact of my condition on my sexual functioning and health (for example, sexually transmitted infections, protection).	*0.62*	−0.29	0.40
10	I talk to my health-care provider about how my condition is affected by the use of tobacco, alcohol and drugs.	*0.62*	−0.12	0.28
3	I take part in health-care discussions about me.	*0.49*	0.25	0.04
1	I can describe my condition and explain my special health-care needs to others.	*0.47*	0.22	−0.07
17	I understand how my condition will affect the way I develop through puberty.	*0.45*	0.35	−0.08
6	I speak up for myself and tell others what I need during health-care visits.	*0.44*	0.19	0.16
19	I know the kinds of health-care providers I will need to see as an adult.	0.28	0.24	0.11
4	I plan how to take care of my own health needs.	0.14	0.03	0.02
13	I know the names of my medications and/or treatments.	−0.03	*0.67*	−0.02
14	I know what my medications and/or treatments are for.	0.12	*0.55*	0.04
16	I know what my health condition may bring in the future.	0.24	*0.46*	0.07
15	I know how my medications and/or treatments are paid for.	−0.08	*0.44*	0.30
20	When I get sick, I know how to get the help I need.	0.15	*0.36*	0.18
18	I know I have the right to get information about my health.	0.27	*0.34*	0.00
2	I am in charge of preparing and taking my medications and/or treatments on my own.	0.06	0.27	0.16
7	I can get myself to health-care appointments.	−0.01	0.02	*0.73*
21	I know how to schedule a health-care appointment.	−0.10	0.32	*0.66*
5	I organize and keep track of my health information (for example, appointments, medications, test results).	−0.04	0.11	*0.64*
8	I spend time alone with my health-care provider at each visit.	0.16	0.06	*0.52*

Principal factor analysis after promax rotation. Item information was summarized in 3 factors: health self-advocacy (factor 1), knowledge about chronic condition (factor 2), and self-management skills (factor 3). Values are standardized factor loading: a higher value indicates a strong correlation with the corresponding factor. Values above 0.30 are in italics

domain 3). No unidimensionality violation was observed in any of the three domains for either of the analyses. The first eigenvalue for principal component analysis of the residual was < 2 in all analyses. No local dependencies were observed, except for items 9 and 10 in option 1 (r for residual = 0.33). In option 1, items 19 and 2 had underfit in domains 1 and 2, respectively. Conversely, infit and outfit statistics were acceptable for items 19 and 2 being entered in domains 2 and 3, respectively (option 2). The only remaining overfit in option 2 was for item 6 in domain 1. For the remaining analyses, we thus kept the structure of option 2 (Table 3). Category probability curves demonstrated a disordered threshold in the 3 domains, suggesting a need to decrease the number of response categories to 4 (Online Resource 3—Fig. 1).

Reliability

Cronbach's α was 0.85, 0.72, and 0.77 in domains 1, 2, and 3, respectively. Intra-class coefficients between the two completions demonstrated test-retest reliability at 0.76, 0.70, and 0.80 for domains 1, 2, and 3, respectively.

Readiness assessment and external validity

Mean scores (SD) were 65 (19), 79 (14), and 64 (21) in domains 1, 2, and 3, respectively. No floor effect was observed. A ceiling effect was observed in less than 6% of adolescents (Table 5). All domain scores were significantly higher in participants aged over 17 years ($p < 0.01$ for all domains; Table 6). Correlation with age was 0.26, 0.27, and 0.63 for domains 1, 2, and 3, respectively. No significant difference was observed according to gender or disease duration. Nonetheless, a trend toward a better "self-management skills" score was observed in girls (68 vs. 60 in boys; $p = 0.08$). Having type 1 diabetes was significantly associated with higher domain 2 scores, and having juvenile idiopathic arthritis was significantly associated with lower domain 3 scores.

Discussion

This study provides evidence that the Good2Go French version is valid to assess transition readiness in young people with a chronic condition. It is the first validated French-

Table 4 Item response theory analysis of Good2Go items

No. of item	Option 1[a]					Option 2[b]				
	Domain	Infit	Outfit	Fit	Local dependence	Domain	Infit	Outfit	Fit	Local dependence
11	1	0.67	0.64	Overfit	–	1	0.68	0.66	Overfit	–
12	1	0.86	0.82	Good	–	1	0.94	0.94	Good	–
9	1	1.12	1.07	Good	Item 10	1	1.17	1.12	Good	–
10	1	1.08	1.03	Good	Item 9	1	1.15	1.08	Good	–
03	1	0.72	0.7	Good	–	1	0.78	0.78	Good	–
01	1	0.9	1.07	Good	–	1	0.97	1.21	Good	–
17	1	1.2	1.23	Good	–	1	1.37	1.39	Underfit	–
6	1	0.87	0.92	Good	–	1	0.96	0.99	Good	–
19*	1	1.55	1.68	Underfit	–	2	1.29	1.29	Good	–
13	2	0.96	0.92	Good	–	2	1.05	1.14	Good	–
14	2	0.85	0.71	Good	–	2	0.92	0.8	Good	–
16	2	0.86	0.89	Good	–	2	0.82	0.87	Good	–
15	2	1.12	1.07	Good	–	2	1.12	1.13	Good	–
20	2	1.03	0.99	Good	–	2	0.9	0.85	Good	–
18	2	1.19	1.04	Good	–	2	1.15	0.95	Good	–
2**	2	1.46	1.35	Underfit	–	2	1.18	1.29	Good	–
7	2	0.89	0.8	Good	–	3	0.91	0.8	Good	–
21	3	0.97	0.88	Good	–	3	0.95	0.88	Good	–
5	3	1.08	1.1	Good	–	3	0.97	0.96	Good	–
8	3	1.15	1.08	Good	–	3	1.11	1.05	Good	–

All three domains in each option were separately analyzed using a partial credit model. Mean square infit and outfit were used to study item fit to the model. These statistics represent the amount of information not explained by the model. Infit/outfit indicates an overfit if < 0.7 (i.e., items with too predictable an answer) and an underfit if > 1.3 (i.e., items with answer not well predicted by the model because not well formulated, for example). A local dependence (indicating item redundancy) is defined by a residual correlation > 0.3 for two items. [a] Option 1: items grouped according to their higher loading in exploratory factor analysis, with item 19 being analyzed with domain 1 and item 2 with domain 2. [b] Option 2: item 19 kept in domain 2 and item 2 in domain 3. *Item 19 had a higher loading on domain 1 but was clinically related to domain 2. **Item 2 had a higher loading on domain 2 but was clinically related to domain 3. Domain 1: Health self-advocacy. Domain 2: Knowledge about chronic condition. Domain 3: Self-management skills

language transition readiness questionnaire and this study now allows its large dissemination throughout French-speaking countries.

This questionnaire adopts a multidimensional approach and explores several crucial aspects of transition readiness, categorized in three scored complementary domains. Firstly, domain 1 "health self-advocacy" analyzes the experience of speaking with caregivers and decision-making in the care relationship (items 1, 3, 6, 9–12, and 17). It reflects adolescents' maturity in adolescent–provider communication and counseling, and their capability to express their own viewpoint and negotiate, which are predictive elements of treatment adherence and healthcare use [15, 18, 21]. In this domain, only item 17 (understanding how the condition will affect puberty) had a slight underfit; this item is likely to be barely understandable for post-pubertal adolescents, as pointed out in cognitive interviews. Overall, not only objective but also subjective experience about transition preparation is explored in domain 1,

Table 5 Descriptive analysis of the Good2Go domain scores

Good2Go domain	Missing*	Median (Q1-Q3)	Mean (SD)	Min score**	Max score**
Health self-advocacy	3	65 (54–80)	65 (19)	0 (0%)	16 (5%)
Knowledge about chronic condition	4	80 (69–89)	79 (14)	0 (0%)	20 (6%)
Self-management skills	2	64 (48–80)	64 (21)	0 (0%)	20 (6%)

*Data were missing for all items in 1 patient. According to scoring instructions, a domain can be scored if at least one half of the items are answered. **Number (percent) patients with minimum domain score (minimum score is 0) or maximum domain score (maximum score is 100). The domain score represents the transition readiness in a given domain from 0 (lowest readiness) to 100 (best readiness)

Table 6 External validity of the Good2Go scores

		Domain scores*—median (Q1-Q3)					
		Health self-advocacy	*p* value**	Knowledge about chronic condition	*p* value**	Self-management skills	*p* value**
Age	< 17 years	63 (53–74)	< 0.01	74 (66–86)	< 0.01	48 (40–64)	< 0.01
	≥ 17 years	68 (55–83)		83 (73–91)		76 (60–90)	
	Correlation†	0.26		0.27		0.63	
Disease duration	< 8 years	65 (53–80)	0.74	79 (67–91)	0.26	60 (44–76)	0.32
	≥ 8 years	65 (55–80)		80 (71–89)		65 (48–84)	
	Correlation†	− 0.02		0.06		0.03	
Gender	Boys	63 (53–78)	0.22	80 (69–89)	0.84	60 (45–76)	0.08
	Girls	65 (55–81)		80 (69–89)		68 (48–84)	
Chronic condition	Type 1 diabetes	65 (54–80)	0.67	86 (74–91)	< 0.01	68 (52–88)	< 0.01
	Inflammatory bowel disease	65 (56–80)		74 (66–89)		64 (44–76)	
	Cystic fibrosis	63 (55–78)		77 (71–83)		50 (40–64)	
	Epilepsy	68 (53–80)		72 (60–89)		58 (40–65)	
	Juvenile idiopathic arthritis	56 (40–74)		69 (56–80)		44 (36–80)	

*The domain score represents the transition readiness in a given domain from 0 (lowest readiness) to 100 (best readiness). Q1: first quartile, Q3: third quartile. **Mann–Whitney non-parametric test. † Spearman's correlation coefficient

because effective transition preparation consists of specific interactions with healthcare providers [25]. Domain 2 "knowledge about chronic condition", in addition to items strictly related to therapeutic education (items 13, 14, 16, and 20), evaluates knowledge about social insurance (item 15) and rights (item 18), infrequently investigated key elements of self-care management in adolescents. Another crucial point in transition readiness assessment, item 19 checks that adolescents know what kind of health caregivers they will meet in adult healthcare. Finally, domain 3 "self-management skills" (items 2, 5, 7, 8, and 21) explores the feelings of having already performed the most basic tasks in chronic condition self-management, to easily identify practical objectives to be attained by young people during transition preparation. Social support and participation, potentially impacting transition success [24, 31], and the social participation of people with chronic condition in adulthood [5, 16, 17, 29], are also explored through the four additional items. The concepts of social well-being and participation they explore are not directly linked to readiness but remain relevant for evaluating adolescents with chronic conditions. Furthermore, it should be noted that, although score calculation may be useful to assess and follow-up transition readiness, Good2Go can also be used as a springboard for a discussion to explore willingness to be transferred or intimate aspects, such as risk-taking behaviors or sexuality, in adolescents with chronic conditions. In that perspective, it can also facilitate caregiver training [19].

Not surprisingly, participants aged over 17 years had higher mean domain scores than younger participants, confirming the pertinence of using the Good2Go to follow the evolution of transition readiness in its 3 domains, especially in transition preparation programs. Interestingly, no effect of disease duration or gender was observed on scores, except a non-significant higher score for self-management skills in girls, often more encouraged than boys to perform practical tasks in that age range. Inversely, mean domain scores were different depending on the chronic condition. Higher domain 2 scores in adolescents with type 1 diabetes might reflect the strong culture of therapeutic education in this chronic condition, whereas lower domain 3 scores in teens affected by juvenile arthritis might reflect their physical impairment, which limits autonomy in technical aspects of chronic condition self-management.

Several strengths must be underlined. This study was based on a large population, with great variability in terms of age, gender, chronic condition, and culture, thus enhancing external validity. It also highlights the crucial importance of adopting a dual approach including classical test theory and item response theory combined with cognitive interviews to validate tools in the field of transition. Specifically, this complete methodology made it possible to address some of the challenges of cross-cultural adaptation. Item 19 for example was shortened during translation into French ("kinds of healthcare providers" translated as *soignants*). However, misunderstanding identified by cognitive interviews prompted a return to the initial, more precise wording. Furthermore, interviews confirmed that the wording of items was understandable across different education levels or age groups, implying that Good2Go is highly suitable for young people whose transfer to adult services is not yet imminent and/or whose

autonomy is still limited. Consequently, this tool can be used at least from 14 to 18 years, which allows a longitudinal follow-up of an adolescent's maturation.

Our study also has some limitations. As long-term outcomes concerning transition success were not yet available, the correlation with Good2Go scores could not be analyzed. However, the "Pass'Age" study long-term data will allow pertinent cutoffs in decision-making to be determined. Additionally, none of the target chronic conditions included mental disability, despite its significant impact on adolescent–healthcare provider interactions and acquisition of knowledge about the chronic condition and skills in self-care management. We observed notable amounts of missing data but the sensitivity analysis confirmed that they did not impact the questionnaire structure validity and globally the number of missing items per participant was low. The lack of an external measure of transition readiness, which might be seen as a limitation, is explained by the absence of a "gold standard" for transition readiness questionnaire measurement. Future studies with a longitudinal follow-up evaluating the transition success will be able to fully demonstrate the external validity of Good2Go.

Conclusion

The final French version of Good2Go is a reliable and valid questionnaire of 20 items to assess adolescents' transition readiness regardless of their chronic condition. This questionnaire will be useful for professionals to systematically explore adolescents' level of self-management and willingness to transfer to adult services.

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Authors' Contributions Dr. Mellerio conceptualized and designed the study, drafted the initial manuscript, and reviewed and revised the manuscript.

Dr. Jacquin conceptualized and designed the study, collected data, conducted the cognitive interviews and reviewed and revised the manuscript.

Dr. Trelles conceptualized and designed the study, carried out the statistical analyses, and critically reviewed the manuscript.

Prof. Alberti, and Drs. Guilmin-Crépon, Le Roux, Tubiana-Rufi conceptualized and designed the study and critically reviewed the manuscript.

Dr. Belanger and Dr. Stheneur coordinated and supervised data collection, and critically reviewed the manuscript.

Dr. Devilliers conceptualized and designed the study, carried out the statistical analyses, drafted the initial manuscript, and reviewed and revised the manuscript.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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Compliance with ethical standards

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