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Title page :

**Une évaluation globale du style de vie:
Propriétés psychométriques du questionnaire général
sur le style de vie**

**A global lifestyle assessment:
Psychometric properties of the General Lifestyle Questionnaire**

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1 **Résumé:**

2 Le style de vie joue un rôle essentiel dans la santé physique et mentale et influence fortement
3 le sentiment de bien-être et la qualité de vie. Cependant, un outil d'évaluation du style de vie
4 complet et validé manque actuellement dans la littérature. Cette étude présente la création et
5 la validation du *General Lifestyle Questionnaire* (GLQ). À notre connaissance, le GLQ est le
6 premier questionnaire qui évalue simultanément les activités cognitives, physiques, sociales et
7 les autres activités de loisirs, ainsi que le sommeil, l'alimentation et la consommation de tabac
8 et d'alcool. Les résultats des tests réalisés pour évaluer les propriétés psychométriques du
9 GLQ font état d'un outil valide et fiable. Ce questionnaire offre de nouvelles perspectives sur
10 les plans de la pratique clinique et de la recherche impliquées dans la compréhension de la
11 façon dont le style de vie influence la santé, le bien-être et/ou la qualité de vie.

12 **Mots-clés:** Cognitif, social, physique, activités de loisirs, comportements de santé.

13

14

15 **Abstract:**

16 Lifestyle factors are essential moderators of physical and mental health, and highly influence
17 quality of life as well as well-being across the lifespan (WHO, 2009). As such, using an
18 appropriate and comprehensive assessment of lifestyle is therefore essential in order to detect
19 unhealthy behaviors and be able to prevent their consequences on physical, mental and/or
20 psychological health. A comprehensive and validated assessment of lifestyle adapted to
21 clinical and research settings is currently lacking. This article describes the development,
22 reliability and validity of the General Lifestyle Questionnaire (GLQ), a new tool designed to
23 assess general lifestyle. To our knowledge, the GLQ is the unique tool that simultaneously
24 measures cognitive, physical, social, and other leisure activities, as well as sleep, diet, and
25 substance use (alcohol and tobacco). The GLQ and sociodemographic data were collected

1 among 1043 participants, aged 18 to 84. The development, verification of the readability,
2 classification method and data collection are described along this article. Reliability was
3 assessed using Cronbach's alpha coefficient and Intra-Class Correlation coefficient. Validity
4 was tested using correlation coefficients and ANOVAs. Finally, floor and ceiling effects were
5 also verified. Classification of the items within dimensions followed the method proposed by
6 Sörman et al. (2014). Results of this study showed that the GLQ had satisfactory
7 psychometric properties. Cronbach's α revealed a weak to good internal consistency
8 (Cronbach's $\alpha = .31$ to $.75$). Temporal stability was very good for the general score (ICC =
9 $.86$) and good to very good for all the dimensions (ICC = $.72$ to $.87$). Furthermore, our
10 analyses demonstrated substantial construct validity of the GLQ with more than 75% of the
11 results that were in accordance with hypotheses tests. Finally, floor and ceiling effects also
12 meet satisfactory criteria (Terwee et al., 2007). Thus, the GLQ is a reliable and valid measure
13 for assessing human engagement in diverse behaviors. As such, this tool may serve as a useful
14 instrument in clinical practice and research involved in understanding how participation in
15 everyday activities influences health, well-being and/or quality of life.

16 **Keywords:** Cognitive, social, physical, leisure activities, health behaviors.

17

18 1. INTRODUCTION

19 The concept of lifestyle is a valuable analytic tool that consists of behaviors that are physically
20 observable or deducible from observation (Sobel, 2013). Lifestyle factors have been established as
21 an important moderator of health, well-being and/or quality of life across the lifespan (World
22 Health Organization, 2009). Over the last several decades, there has been an increase in awareness
23 of the impact of lifestyle on health promotion. Changes in lifestyle have consistently been
24 implicated in the prevention of disease and chronic health conditions, as well as associated with
25 healthy physical and cognitive aging (Kesse-Guyot, Andreeva, Lassale, Hercberg, & Galan, 2014;

1 Prakash, Voss, Erickson, & Kramer, 2015). Numerous studies have demonstrated the need to design
2 appropriate ways of promoting healthy behaviors (Bully, Sánchez, Zabaleta-del-Olmo, Pombo, &
3 Grandes, 2015), yet there is a lack of a universally applied method for assessing general lifestyle
4 factors.

5 Health promotion interventions would benefit from a reliable and valid measurement of lifestyle
6 factors (Jopp & Hertzog, 2010). Several lifestyle measures exist and typically fall into three
7 categories. First, the majority of validated questionnaires have been created in order to evaluate
8 lifestyle factors within a defined population, such as older adults (Lawton, Moss, Fulcomer, &
9 Kleban, 1982), or pediatric weight management (Wright et al., 2011). Secondly, several
10 questionnaires have focused on specific activity types, such as physical activities (e.g., Kriska,
11 1997) or cognitive activities (Wilson et al., 2005; Wilson, Barnes, & Bennett, 2003). Thirdly, a few
12 authors have gone beyond specific activities or populations and created general lifestyle
13 questionnaires. For example, Wilson and Ciliska (1984) created a measure called FANTASTIC that
14 encompasses the physical, emotional and social components of lifestyle. The FANTASTIC has
15 been revised several times. In the last version, authors mention that instructions to participants and
16 precision of the Likert scales need to be improved. In addition, the only method used to verify the
17 validity of the questionnaire was to compare correlations between the FANTASTIC scores and
18 doctor's and patient's assessment of their lifestyle. The authors concluded that the validity of the
19 FANTASTIC could not be confirmed (Kason & Ylanko, 1984). Other authors have also tried to
20 create a general lifestyle measure. Hultsch, Hammer and Small (1993) developed the Victoria
21 Longitudinal Study activity questionnaire and Jopp and Hertzog (2010) added 12 items in order to
22 assess a larger number of activities across the adult lifespan. The 82 items of this second tool were
23 divided in 11 subscales that generated scores that have moderate to good reliability (Cronbach's
24 alpha ranged from .43 to .79 and test-retest correlations ranged from .41 to .82). Nevertheless, the
25 questionnaire is lengthy, making it cumbersome in both clinical and research settings (Godwin,

1 Pike, Bethune, Kirby, & Pike, 2013). Additionally, this questionnaire does not query sleep habits,
2 diet or tobacco/alcohol use, which are essential aspects impacting health and health promotion.
3 Lastly, the validation study was limited by small samples size (Jopp & Hertzog, 2010). Besides,
4 other tools that do not aim to measure lifestyle also include daily activity items, in addition to other
5 questions, in order to measure other concepts. Thus, these questionnaires are not adapted to assess
6 proper lifestyle. For example, Kulbok, Carter, Baldwin, Gilmartin, and Kirkwood (1999) created a
7 questionnaire that includes 116 health and risk behaviors items. Questions are linked to
8 participation to activities (e.g., physical exercise, social activities), but also to health behaviors (e.g.,
9 checking blood pressure or cholesterol level) and safety behaviors (e.g., checking equipment or fire
10 detector). Thus, this questionnaire aims to measure multidimensional health behaviors but is not
11 focused on measuring general lifestyle. In addition, this questionnaire does not allow to measure
12 current frequent hobbies (e.g., using internet). More recently, Darviri et al. (2014) created a
13 questionnaire with 26 items that are also based on aspects of lifestyle. Actually, these items were
14 derived from the qualitative data of several stress management programs and the questionnaire aims
15 to assess the concept of empowerment (e.g., “Do you avoid eating when stressed or disappointed”)
16 and not proper lifestyle. Thus, according to the authors, “relevant aspects of daily living were not
17 included” (see Darviri et al., 2014, p.9), so this questionnaire cannot be considered as complete
18 enough to measure general lifestyle.

19 Despite several existing tools, some authors have opted for combining different questionnaires or
20 creating original questions for the needs of their study (e.g., Kesse-Guyot et al., 2014; Rouillard et
21 al., 2016; Sörman, Sundstrom, Ronnlund, Adolfsson, & Nilsson, 2014). This suggests that the field
22 is still attempting to close the gap between existing measures and the need to fully capture relevant
23 aspects of lifestyle. The gaps are illustrated in the following: 1) Most of the existing instruments are
24 designed for specific diseases and conditions so tools measuring both healthy and unhealthy
25 populations have to be developed and validated (Lara et al., 2013). 2) Many lifestyle questionnaires

1 focused only on narrow range of activities, but few tools go beyond specific activities in order to
2 assess general lifestyle (Jopp & Hertzog, 2007). 3) The rare general lifestyle questionnaires are long
3 and detailed (up to 80 items). However, what is preferred in both clinical and research settings is a
4 short and simple measure (Godwin et al., 2013). 4) Over time, habits and occupations evolve, and
5 the time dedicated to each activity changes. For example, the average time per day for playing
6 games and computer use for leisure has increased from 18 min in 2003 to 26 min in 2011 for all
7 ages. In 2014, individuals between 15 and 19 years old spent an average of 1.2 hours per weekend
8 day playing games or using a computer for leisure (Bureau of labor statistics, 2014). Evidently, an
9 increase in the time spent on new activities (e.g., games, networks use) is likely to decrease the time
10 spent on other activities (Kuo & Tang, 2014). With the advancement of new technologies and
11 subsequently new habits, new questionnaires are needed to account for the shift in the ways people
12 spend their time.

13 Because of the limitations of existing validated questionnaires and in order to meet the above-
14 mentioned needs, we developed and validated a new general lifestyle assessment (the General
15 Lifestyle Questionnaire - GLQ), taking into account different categories of behaviors that have the
16 greatest impact on health. According to the literature, five main dimensions influence health:
17 cognitive activities, social activities, physical activities, other leisure activities, and habits related to
18 food/substance consumption (alcohol and tobacco) and sleep. The strongest evidence is found for
19 the impact that cognitive activities (Salthouse, 2006; Small, Dixon, McArdle, & Grimm, 2012),
20 social activities (Seeman & Crimmins, 2001; Wang, Xu, & Pei, 2012) and regular physical
21 activities (Prakash et al., 2015; Steinmo, Hagger-Johnson, & Shahab, 2014) have on physical,
22 mental and/or cognitive health, even at advanced ages (Hertzog, Kramer, Wilson, & Lindenberger,
23 2008). Aside from these three well-known categories, other leisure activities, such as meditating
24 and listening to music have demonstrated a distinct impact on health and merit inclusion in a
25 lifestyle assessment (Kristeller & Hallett, 1999; MacDonald, Kreutz, & Mitchell, 2012).

1 Additionally, general healthy behaviors, such as, eating a well-balanced diet, not smoking, drinking
2 alcohol in moderation and adequate sleep have been consistently associated with the prevention of
3 numerous health conditions, such as cancer, osteoporosis, diabetes, and cardiovascular disease
4 (Alvarez & Ayas, 2004; Godwin et al., 2013; Kim, Popkin, Siega-Riz, Haines, & Arab, 2004). All
5 the above lifestyle factors were taken into account in order to capture a complete overview of
6 lifestyle.

7 Moreover, many studies have highlighted links between these lifestyle factors and age, gender,
8 Body Mass Index (BMI), socio-economic status or educational level. For instance, age is inversely
9 related to participation in social and physical activities (Krueger et al., 2009; Södergren, 2013).
10 Frequency of participation in social activities was not significantly different between men and
11 women (Koh, Jang, Paik, Kim, & Lim, 2014). However, men were more likely than women to be
12 current alcohol drinkers while women more frequently endorsed the presence of sleep disturbance
13 compared to men (Ma, Betts, & Hampl, 2000; Vitiello, Larsen, & Moe, 2004). BMI is negatively
14 correlated with frequency of physical activity (Wright, 2010). Regarding socio-economic status,
15 students' lifestyle can contribute to problems with improper poor dietary behaviors compared to the
16 rest of the population (Chock, 2011). Conversely, people who have retired will have greater
17 opportunity to engage in healthy behaviors, such as eating well and partaking in moderate alcohol
18 and tobacco consumption, compared to the rest of the population (Södergren et al., 2014). Lastly,
19 less educated individuals may have poorer health decision-making skills, in part because of limited
20 access to health information (Jaconelli, Stephan, & Chapman, 2012). All these findings from the
21 literature on lifestyle will serve to test the validity of the GLQ.

22 The aim of the present study was to develop and validate the GLQ, a tool that would provide a
23 comprehensive and simultaneous measurement of general lifestyle that is appropriate for a wide
24 range of adults.

2. METHODS

2.1. Development, readability, classification and data collection

The first step in developing the GLQ was to formulate items that assess the five main dimensions of lifestyle identified in the literature (e.g., physical, cognitive, social and other leisure activities, as well as sleep, food, tobacco and alcohol consumption). We first established all the activities that take part in general lifestyle questionnaires (e.g., Jopp & Hertzog, 2010; Wilson et al., 2003): physical activity, eating, sleeping, reading (as we can find in other questionnaires), but also activities that are more recent (linked to modern technological age) and, consequently, not appear in questionnaire that were evaluated several years ago. After establishing the items, we recruited three distinct samples of French speaking adults for validation of the GLQ, which we did in steps two to four. For each sample, inclusion criteria were the ability to read and write in French and being 18 years old or older.

The goal of step two was to evaluate the readability of the items, so that even participants that are not used to completing questionnaires would be able to understand the items. Sample 1 consisted of 32 individuals aged 18 to 68 years old ($M = 40.5$; $SD = 15.1$; see Table I). Sample 1 includes people from diverse educational and socio-professional levels and different age ranges. Exclusion criterion was to be used to answering questionnaires. For each item, participants have to indicate the frequency of practice of activity or behavior (on a 5-point Likert-scale scoring 1 = never, 2 = a few times in the last year, 3 = a few times per month, 4 = a few times per week, 5 = every day or almost every day) and to rate the clarity of the item on a 7-point Likert-scale (from 1 = not clear at all, to 7 = completely clear). Any item that received an average score of 4 or less would be removed in order to avoid misunderstandings.

The objective of step three was to classify the different behaviors into the five dimensions of lifestyle. The method that is commonly used to determine factors that share a common cause is factor analysis. Factors are defined as “an unobservable variable that influences more than one

1 observed measure and which accounts for the correlations among these observed measures”
2 (Brown, 2015). However, two behaviors might share a common cause without influencing each
3 other and factor analysis may not always be relevant in the specific domain of behavioral
4 observations (Floyd & Widaman, 1995). To avoid non-relevant statistical method, the authors opted
5 for the external classification. This method was proposed by Sörman et al. (2014) in order to limit
6 subjective classification. Thus, a second sample of participants was recruited to classify the items
7 along the main lifestyle dimensions identified in the literature (i.e., “cognitive activities”, “social
8 activities”, “physical activities”, “other leisure activities” and “sleep, food and substance
9 consumption”). Sample 2 consisted of 51 participants aged 22 to 47 years-old ($M = 29.23$; $SD =$
10 6.03). These participants rated each of the items along these five dimensions on a 10 point Likert-
11 scale (from 1 = the item does not belong at all to this dimension, to 10 = this item completely
12 belongs to this dimension).

13 Finally, the goal of step four was to evaluate the reliability and validity of the GLQ. For this,
14 participants were invited by email, social networks and within retiree communities to respond to a
15 survey about lifestyle. Participation was voluntary and all questionnaires with missing data were
16 excluded from the analyses. Thus, from 1,408 initial participants, 1,043 individuals completed the
17 survey and were included in data analyses. This sample size meet the criteria needed to validate a
18 questionnaire (Anthoine, Moret, Regnault, Sébille, & Hardouin, 2014). Participants were between
19 18 and 84 years-old ($M = 42.43$; $SD = 16.19$), 336 were men (32%) and 707 were women (68%).
20 This sample 3 was diverse in both socio-economic status (16.2% were students, 65% worked full or
21 part-time, 11.8% were retired and 7% were unemployed) and educational level (2.9% had 9 years of
22 education, 20.2% had between 10 and 12 years of formal schooling, 41.4% studied between 2 and 3
23 years at the university, 27.3% had obtained an university degree, which is 17 years of formal
24 schooling, and 8.4% a PhD). All participants were francophone. The majority of participants was
25 from France (91%), but also included participants from Belgium (4%), Switzerland (3%) and

1 Canada (2%). All the participants in sample 3 first completed the GLQ as well as demographic data
2 that was used to verify the validity of the GLQ (age, gender, BMI, smoking habits, educational
3 level, and professional status). Then, in order to assess test-retest reliability of the GLQ, one third of
4 participants from the sample 3 ($N = 361$) completed and returned the survey a second time ($M_{\text{age}} =$
5 40.95 ; $SD = 16.25$), from one to three weeks later. After approval of the local ethics committee, all
6 participants completed written informed consent.

7 Table I : *Samples Characteristics*

8 (Insert here table I)

9 **2.2.GLQ characteristics**

10 The GLQ was created to assess 48 types of behaviors and activities practiced in the last 12 months.
11 After analysis, 2 items were discarded (because rigorous classification could not be realized),
12 leaving a questionnaire composed by 46 items. The GLQ assesses five dimensions of lifestyle:
13 “physical,” “cognitive,” “social,” “other leisure activities” and “sleep and consumption (food,
14 tobacco and alcohol).” Physical activities include any bodily movements produced by skeletal
15 muscles that result in energy expenditure (Caspersen, Powell, & Christenson, 1985). The GLQ
16 includes leisure physical activities (e.g., bowling, fitness), competitive sports practices (e.g., tennis,
17 gymnastics), as well as daily living and energy consuming activities (e.g., climbing steps,
18 vacuuming). Cognitive activities include information processing as a central feature, and minimal
19 physical and social requirements (Wilson et al., 2003). The GLQ includes diverse cognitive
20 activities that engage one or more brain function(s), such as attention, memory and reasoning (e.g.,
21 reading). Social activities refer to the maintenance of social connections and participation in social
22 activities (Bassuk, Glass, & Berkman, 1999). The GLQ takes into account usual social activities
23 (e.g., spending time with relatives) as well as more recently developed social interactions types
24 (e.g., conversing by SMS, networks use). The dimension “other leisure activities” of the GLQ
25 includes activities that we practice principally for relaxing or personal enrichment (e.g., meditating).

1 In addition to these stimulating activities, the GLQ includes other behaviors that significantly
2 influence health (Alvarez & Ayas, 2004; Kim et al., 2004). This dimension provides information
3 about diet habits (e.g., eating between meals), alcohol consumption (e.g., wine and beer vs. whisky,
4 vodka, etc.), tobacco consumption (e.g., pipe, cigar) and quality of sleep (e.g., feeling rested while
5 waking up on both working days and days off).

6 The GLQ scores are calculated according to the frequency of practice of each activity or behavior
7 (e.g., Jopp & Hertzog, 2010; Wilson et al., 2003). For each item, participants indicated the
8 frequency on a 5-point Likert-scale scoring 1 = never, 2 = a few times in the last year, 3 = a few
9 times per month, 4 = a few times per week, 5 = every day or almost every day. Among the 46 items,
10 8 use inverse scoring. The GLQ delivers three useful levels of analysis. First, general lifestyle
11 information will be provided by the average of the scores of the 46 items. Second, more specific
12 information can be studied by the average of scores by each dimension (i.e., “physical”,
13 “cognitive”, “social”, “other leisure activities” and “sleep and consumption”). Lastly, an item
14 analysis can offer information about specific activity engagement.

15 **2.3. Statistical analysis**

16 Reliability and construct validity were tested to assess the psychometric properties of the
17 instrument. Cronbach’s alpha coefficient was used to measure the internal consistency (Cronbach,
18 1951). Intra-class Correlation Coefficient (ICC) assessed the test-retest reliability between GLQ
19 scores at test and retest, using analysis of variance (Shrout & Fleiss, 1979). In order to evaluate
20 construct validity of the GLQ, we focused on findings in previous studies of lifestyle, and observed
21 the associations between GLQ scores and other variables. We computed Pearson correlations
22 between the GLQ scores and BMI, smoking habits and educational level, and compared our
23 findings with analogous relationships from the literature (e.g., Jaconelli et al., 2012; Södergren,
24 2013; Wright, 2010). ANOVAs were used to measure the relationships between lifestyle

1 dimensions and gender and professional status (e.g., students, workers, pensioners) (e.g., Chock,
2 2011; Koh et al., 2014; Södergren et al., 2014).

3

4 **3. RESULTS**

5 **3.1. GLQ items comprehensibility, appropriateness and classification**

6 The clarity of the GLQ was good based on ratings by sample 1. Each item received an average
7 rating between 6 and 6.84 on a maximum of 7 ($M = 6.67$; $SD = 0.2$). At this step, none of the items
8 were removed. The classification of the items by dimensions by sample 2 resulted in removal of
9 two items. The items “I go to the theatre, to the opera or to see cultural shows” and “I play games
10 with other people” were highly classified (average more than 6 on 10) in both social and cognitive
11 dimensions and were therefore removed. We also noted that less than 15% of the respondents
12 achieved the highest or lowest possible scores (for the general score as well as for the 5
13 dimensions), satisfying the floor and ceiling effects criteria (Terwee et al., 2007). Finally, only 14
14 participants (1.34%) answered the question “Are there any activities not listed that you have
15 practiced in the last 12 months?” Participants wrote in the following items: singing in a choir, health
16 care, puppies training, business management, photography, and origami. Each of these items was
17 not repeated more than three times, thus the authors decided not to add them to the GLQ. The 46
18 final items were divided into five dimensions: physical (9 items), cognitive (8 items), social (10
19 items), other leisure activities (8 items) and sleep and consumption (diet, tobacco and alcohol) (11
20 items) (See appendix).

21 **3.2. GLQ’s reliability**

22 Overall, Cronbach’s alpha coefficients were satisfactory. General Cronbach’s alpha score was good
23 (.72) and scores by dimensions were generally moderate (.54 for sleep, diet and substance use) to
24 very good (.75 for physical activity), while “cognitive” and “other leisure” activities had lower
25 internal consistency (.46 and .31 respectively). High test-retest reliability was found. For the general

1 questionnaire score, ICC was .86; 95% confidence interval, .83-.89; $p < .001$. Dimensions scores
2 ranged from ICC = .72; 95% confidence interval, .66-.76; $p < .001$ (“other leisure activities”) to
3 ICC = .87; 95% confidence interval, .84-.89; $p < .001$ (“social activities”). Correlations between
4 dimensions of the General Lifestyle Questionnaire (Table II) were mostly significant (except
5 correlations between sleep, diet and substance use dimension and cognitive, physical and other
6 leisure dimensions). The correlations ranged from -.215 to .400.

7 **3.3.GLQ’s validity**

8 In order to evaluate construct validity of the GLQ, we performed separate statistical analyses
9 (Pearson correlation or Anova, according to the type of data) on each dimension. In addition, item-
10 level analyses were conducted either when the item approach provided relevant information or
11 when there were no previous results in the literature at the dimensional level.

12 *Physical activities dimension:* Participation in physical activity declined with age ($r = -.28, p <$
13 $.001$). BMI was negatively correlated with frequency of physical activity ($r = -.24, p < .001$).

14 *Cognitive activities dimension:* Participation in cognitive activities was positively related to years of
15 formal education ($r = .11, p = < .001$).

16 *Social activities dimension:* Participation in social activity was inversely related to age ($r = -.51, p <$
17 $.001$). Furthermore, frequency of participation in social activities was not significantly different
18 between men and women ($F(1, 1041) = 0.19, n.s.$). However, an item analysis established that
19 women were more likely to participate in religious activities compared to men ($F(1, 1041) = 4.40, p$
20 $< .05$).

21 *Other leisure activities dimension:* No general hypothesis was proposed since this construct has not
22 been studied extensively. Nevertheless, an item analysis showed that practicing relaxing activities
23 like meditation was negatively related to BMI ($r = -.08, p < .01$).

24 *Sleep, diet and substance use dimension:* There was a negative relationship between education and
25 smoking ($r = -.14, p < .001$). Likewise, men were more likely than women to be current alcohol

1 drinkers ($F(1, 1041) = 53.03, p < .001$). Daily smokers were more likely to report unhealthy dietary
2 habits and higher alcohol intake above the recommended limits compared to those who never
3 smoke ($F(1, 924) = 27.35, p < .001$). Compared to non-students, students reported eating between
4 meals and eating foods high in fat and sugar more frequently, but eating fewer portions of fruits and
5 vegetables ($F(1, 1041) = 34.63, p < .001$). Participants in retirement reported engaging in healthy
6 behaviors more frequently, such as eating well and consuming moderate amounts of alcohol and
7 tobacco, compared to the rest of the sample ($F(1, 1041) = 32.73, p < .001$). Furthermore, women
8 endorsed the presence of sleep disturbance more frequently than men ($F(1, 1041) = 4.87, p < .001$).
9 *General lifestyle score:* In addition to individual dimension analysis, a general lifestyle score
10 demonstrated that less educated individuals had poorer lifestyle than more educated individuals (r
11 $=.08, p < .01$). More than 75% of the results were in accordance with hypotheses tests, satisfying
12 the construct validity criteria (Terwee et al., 2007).

13

14 **4. DISCUSSION**

15 We developed an instrument to assess lifestyle, called the General Lifestyle Questionnaire
16 (GLQ). The main objective was to create a comprehensive instrument that measures five
17 dimensions proposed in the literature to be associated with better health outcomes. We
18 demonstrated that the GLQ has acceptable reliability and construct validity. The GLQ had good
19 internal consistency on general scores but a lower internal consistency on some of the five
20 dimensional scores. Test-retest reliability was high for the general score and all the dimensional
21 scores, showing very good to excellent temporal stability of the GLQ. The relationships obtained
22 between the proposed questionnaire and other variables (with which lifestyle should be linked) are
23 overall consistent with previous studies suggesting satisfactory construct validity of the GLQ in
24 both dimensional and general analysis.

1 This study has some strengths. The GLQ assessed five areas of lifestyle behaviors: physical
2 activities, social activities, cognitive activities, other leisure activities, and sleep, diet and substance
3 use. To our knowledge, this is the only validated survey for assessing these multiple measures
4 simultaneously. The physical dimension of the GLQ included intensity as well as both daily
5 activities and structured exercise training information, which are both relevant for understanding the
6 impact of physical activity on health (Kim et al., 2004; Prakash et al., 2015). This tool also takes
7 into account lifestyle changes in the last decade (Kuo & Tang, 2014) and included several items
8 reflecting technological advances, and other “new” habits in the social, cognitive and other leisure
9 activities dimensions. Moreover, the low number of responses to the open-ended question “Are
10 there any activities not listed that you have practiced in the last 12 months?” demonstrated that a
11 wide variety of lifestyle activities had been sampled and that the GLQ has a potentially wide-
12 ranging application. Additionally, the GLQ is easy-to-use and its assessment only takes 10 to 15
13 minutes. The survey was administrated to a large sample that allowed us to establish the reliability
14 and construct validity of the instrument. Participants’ characteristics included a wide age range, and
15 multiple educational levels and professional settings. These results provide evidence that the GLQ
16 may be used to assess lifestyle behaviors in diverse populations from young adults to older adults.

17 This general and multidimensional measure of lifestyle may be useful in further empirical work.
18 However, some limitations should be addressed in future research. First, even though all the others
19 dimensions had satisfactory internal consistency, “cognitive” and “other leisure” activities had
20 lower scores (.46 and .31 respectively), in part because these two dimensions offer a particularly
21 large range of activities that differ greatly. In comparison with the internal consistency of other
22 tools of life style, we find that the Cronbach alphas in this study are lower than those of tools
23 mainly centered on one dimension. For example, Darviri et al. (2014) have alphas between .63 and
24 .81, on a health habit questionnaire. Wilson et al. (2003; 2005) have alphas between .71 and .88 on
25 a cognitive questionnaire. However, if we compare our results with more general tools such as ours,

1 we see more similar trends. Internal consistency of the augmented Victoria Longitudinal Study
2 activity questionnaire (Jopp & Hertzog, 2010, concerning physical, crafts, games, TV, social private
3 and public, religious, travel...) are lower, with notably one dimension Cronbach Alpha at .43. The
4 leisure activity questionnaire of Sörman et al. (2014, concerning travel, exercises, read book,
5 watching TV, religious assembly...) has Cronbach' alphas of .49 for the social index, and .23 for
6 the mental index. Therefore, it seems that the more general tools have a lower internal consistency
7 on the dimensions. This limit is probably linked to the objective of being as complete as possible in
8 the evaluation of the lifestyle, through a wide variety of activities. Consequently, GLQ can be used
9 as a reliable general measure of lifestyle, but dimensional scores remain informative, with less
10 statistical confidence. In addition, these dimensions were not confirmed by factor analysis. Then,
11 the validity of the GLQ has been demonstrated with a general sample of French-speaking
12 participants without comprehensive knowledge of their medical conditions. As such, further testing
13 to determine the adaptability of the GLQ among English speakers and clinical populations is
14 recommended.

15

16 **5. CONCLUSION**

17 Lifestyle factors are essential moderators of physical and mental health, and highly influence
18 quality of life as well as well-being across the lifespan. However, an appropriate, complete and
19 validated assessment of lifestyle was lacking. The aim of this article was to develop and validate the
20 GLQ, the first questionnaire that simultaneously assesses cognitive, physical, social, and other
21 leisure activities, as well as sleep, diet, and substance use (alcohol and tobacco). This reliable and
22 valid tool will help clinicians and researchers to further understand the impact of both occupation
23 and leisure participation on health, well-being and/or quality of life.

24

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- 18

1 Table I. Samples Characteristics

2

Sample	N	Sex		Age	Years of education	Contribution to the validation
		Men N (%)	Women N (%)	M (SD)	M (SD)	
1	32	15 (47%)	17 (53%)	40.54 (15.11)	12.00 (3.82)	Readability
2	51	18 (35%)	33 (65%)	29.24 (6.03)	16.61 (2.89)	Classification
3	1043	336 (32%)	707 (68%)	42.43 (16.19)	14.76 (2.93)	Reliability and validity
3 (bis)	361	111 (31%)	250 (69%)	40.42 (16.00)	15.40 (2.53)	Test-retest reliability

3

4

5

Note. N = Number. M = Mean. SD = Standard Deviation.

1 Table II. Correlations between dimensions of the General Lifestyle Questionnaire and total score
 2

Dimensions	Cognitive	Physical	Social	Other leisure	SDS	Total
Cognitive	-	.246	.316	.400	.003	.614
Physical		-	.334	.350	.028	.755
Social			-	.307	-.215	.594
Other leisure				-	.031	.644
SDS					-	.295

SDS = Sleep, diet and substance use, bold typeface = p < .05

3
 4

1 Appendix. General Lifestyle Questionnaire items and dimensions

N° item	Dimension	Item
1	Activités sociales	Je vais au cinéma ou voir des spectacles divertissants (cirque, one man show, concerts, etc.)
2	Activités cognitives	Je visite des musées, des expositions, etc.
3	Activités sociales	Je sors en ville, au restaurant, dans un café...avec d'autres personnes
4	Activités sociales	Je sors dans les bars, pubs, boîtes de nuit...avec d'autres personnes
5	Activités sociales	Je participe à des actions bénévoles et/ou m'implique dans un club ou une association (sportif, scolaire, quartier, parti politique, etc.)
6	Activités cognitives	Je joue à des jeux de réflexion individuels (sudoku, mots fléchés, puzzle, casse-tête, quizz, etc) quel que soit le support (papier, ordinateur, téléphone portable ou console de jeux)
7	Autres activités de loisirs	Je lis à des fins de plaisir ou de détente des magazines people, journaux sportifs, bandes dessinées, etc.
8	Activités cognitives	Je lis à des fins privées ou professionnelles des articles "scientifiques", des journaux d'actualités, des romans, etc.
9	Activités cognitives	J'écris à la main (lettres, prise de notes, journal intime, etc.)
10	Activités cognitives	J'écris sur ordinateur (e-mail, rapport, compte-rendu, etc.)
11*	Autres activités de loisirs	Je regarde à la télévision (ou sur mon ordinateur) des émissions de divertissement, des événements sportifs, des films, des séries, des vidéos, etc.
12	Activités cognitives	Je regarde le journal télévisé, des documentaires, des magazines d'actualité, des programmes culturels, etc.
13	Autres activités de loisirs	Je flâne, médite, pratique des activités de détente, etc.
14	Autres activités de loisirs	Je m'occupe de mes collections (de timbres, de figurines, de voitures, etc), de mes fleurs, de classer mes photos, etc.
15	Activités sociales	J'assiste à des événements religieux (messe, cours de religion, cérémonies, etc.)
16	Activités cognitives	Je joue de la musique
17	Autres activités de loisirs	J'écoute de la musique
18	Activités cognitives	Je fais des activités créatives (je dessine, peins, sculpte, couds, tricote, etc.)
19	Activités sociales	Je partage du temps avec ma famille (repas de famille, visite chez mes enfants/parents/grands-parents, etc.)
20	Activités sociales	J'utilise les réseaux sociaux (Facebook, Twitter, WhatsApp, etc.)
21	Activités sociales	J'utilise des réseaux d'entraide proposés sur internet (couchsurfing, sites de co-voiturage, de location de voiture ou d'appartements entre particuliers, etc.)
22	Autres activités de loisirs	J'utilise internet à d'autres fins que le tchat, les jeux et les vidéos (recherches ou achats sur internet, création de site web ou blog, etc.)
23	Activités sociales	J'ai des conversations orales, que ce soit en face à face, par téléphone, via Skype, une webcam, etc.
24	Activités sociales	J'ai des conversations écrites, que ce soit par SMS, tchat, e-mails, etc.
25	Autres activités de loisirs	Je visite de nouveaux lieux (villes, villages, pays, etc.)
26	Autres activités de loisirs	Je cuisine pour le plaisir
27	Activités physiques	Je pratique pendant au moins 10 minutes d'affilées des sports, du fitness ou des activités de loisirs nécessitant : Un effort physique peu élevé. Mon rythme cardiaque augmente légèrement. Je peux parler sans être essoufflé(e) (marche tranquille, pétanque, pêche, etc.)
28	Activités physiques	Je pratique pendant au moins 10 minutes d'affilées des sports, du fitness ou des activités de loisirs nécessitant : Un effort physique modéré. Mon rythme cardiaque et ma respiration augmentent. Je suis essoufflé(e) mais peux continuer de parler (gymnastique aquatique, vélo ou natation plaisir, marche rapide, etc.)
29	Activités physiques	Je pratique pendant au moins 10 minutes d'affilées des sports, du fitness ou des activités de loisirs nécessitant : Un effort physique intense. Mon rythme cardiaque

		et ma respiration augmentent fortement. Parler devient difficile, voire impossible (jogging, tennis, natation sportive, VTT, etc.)
30	Activités physiques	Dans le cadre de mon travail et/ou de mes tâches quotidiennes, je réalise pendant au moins 10 minutes d'affilées : Un effort physique peu élevé. Mon rythme cardiaque augmente légèrement par rapport à d'habitude. Je peux parler sans être essoufflé(e) (passer l'aspirateur, marcher, etc.)
31	Activités physiques	Dans le cadre de mon travail et/ou de mes tâches quotidiennes, je réalise pendant au moins 10 minutes d'affilées : Un effort physique modéré. Mon rythme cardiaque et ma respiration augmentent. Je suis essoufflé(e) mais peux continuer de parler (soulever des charges légères, monter les escaliers, etc.)
32	Activités physiques	Dans le cadre de mon travail et/ou de mes tâches quotidiennes, je réalise pendant au moins 10 minutes d'affilées : Un effort physique intense. Mon rythme cardiaque et ma respiration augmentent de manière conséquente. Parler devient difficile, voire impossible (soulever des charges lourdes, bêcher le jardin, etc.)
33	Activités physiques	Je favorise une vie active (prendre les escaliers, se déplacer à pied, à vélo, en roller...) pour aller travailler, faire des courses, etc.
34	Activités physiques	J'entretiens mon logement (bricolage, jardinage, ménage, etc.)
35	Activités physiques	Je marche plus d'une heure par jour (temps cumulé)
36*	Autres comportements de santé	Je fume des cigarettes
37*	Autres comportements de santé	Je consomme du tabac sous d'autres formes (pipe, cigare, chicha, etc.)
38*	Autres comportements de santé	Je bois des boissons alcoolisées de type bière, vin ou champagne
39*	Autres comportements de santé	Je bois des alcools forts (rhum, Whisky, vodka, etc.)
40	Autres comportements de santé	Je mange au moins 5 portions fruits et légumes par jour
41*	Autres comportements de santé	Je mange des aliments gras (fritures, charcuterie, hamburger, etc.)
42*	Autres comportements de santé	Je consomme des chips et autres apéritifs (biscuits salés, cacahuètes, pistaches, etc.)
43*	Autres comportements de santé	Je consomme des pâtisseries et autres sucreries (friandises, bonbons, biscuits, chocolats, etc.)
44*	Autres comportements de santé	Je grignote entre les repas
45	Autres comportements de santé	En semaine ou lorsque je travaille, je me sens reposé(e) en me levant (impression d'avoir assez dormi)
46	Autres comportements de santé	En weekend et en congés, je me sens reposé(e) en me levant (impression d'avoir assez dormi)

1

2 * Inverse items

3

4

1 The calculation scores methods of the GLQ:

2 • Score by items based on answers¹:

3 The Likert-scale has been though in order to interpret that a high score reveals an active lifestyle and
4 healthy habits.

5 - 5 = every day or almost every day,

6 - 4 = a few times per week,

7 - 3 = a few times per month,

8 - 2 = a few times in the last year,

9 - 1 = never

10 ¹Excepted for items 36, 37, 38, 39, 41, 42, 43, 44 that present inversed scores (i.e., every day or
11 almost every day = 1, a few times per week = 2, etc.).

12

13 • Score by dimensions:

14 Score = average of items scores by dimension

15 - Cognitive activities: items 2, 6, 8, 9, 10, 12, 16, 18.

16 - Physical activities: items 27 to 35.

17 - Social activities: items 1, 3, 4, 5, 15, 19, 20, 21, 23.

18 - Other leisure activities: items 7, 11, 13, 14, 17, 22, 25, 26.

19 - Sleep, diet and substance use: items 36 to 46.

20

21 • General score:

22 Score = average of the 46 items scores (or 5 dimensions scores)