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Adherence to healthy diet and physical activity in clinical patients

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Abstract

Background: The aim of this study is to explore the psychometric properties of the Motiva.Diaf questionnaire, which assesses the adherence to healthy diet and physical activity in clinical patients. **Method:** Participants were 230 patients, who attended hospital services, with a mean age of 49.28 years (SD = 12.34). Women constituted 55.7% of the patients. Two weeks after initial administration, 40 participants, from those who had another hospital appointment scheduled, were selected at random to complete again the questionnaire in order to assess test–retest reliability. **Results:** the accuracy of the scores is adequate both in terms of internal consistency (α = .802; Ω = .776) and temporal stability (r =.786). The test's structure is essentially one-dimensional, and the scores in this dimension converge with other necessary basic psychological measurements (r_{Diet} = .294; $r_{Physical\ Activity}$ = .359) and perceived health (r = .266). In addition, a relatively moderate relationship was found with the Body Mass Index (r = - .129). **Conclusions:** The test has shown adequate reliability and validity for evaluating adherence to healthy habits. The availability of an instrument with these characteristics has significant implications for evaluating behaviour, designing and implementing behavioural interventions.

Keywords: Dietary habits, physical activity, psychometrics, motivation.

Resumen

Adherencia a la dieta saludable y a la realización de actividad física en pacientes. **Antecedentes:** el objetivo de este estudio ha sido explorar las propiedades psicométricas del cuestionario Motiva.Diaf, diseñado para medir la adherencia a las características de la dieta saludable y realización de actividad física en personas enfermas. **Método:** participaron 230 pacientes, que asistieron a consultas hospitalarias, con una edad media de 49,28 años (SD = 12,34), siendo un 55,7 % mujeres. Dos semanas tras la administración inicial, se seleccionaron al azar 40 participantes, de los que tenían otra cita hospitalaria, para completar nuevamente el cuestionario con el fin de evaluar la fiabilidad test-retest. **Resultados:** la precisión de las puntuaciones es adecuada en términos de consistencia interna (α = .802; Ω = .776) y de estabilidad temporal (r =.786). La estructura del test es esencialmente unidimensional y las puntuaciones en esta dimensión convergen con las medidas de necesidades psicológicas básicas (r_{Diet} = .294; $r_{Physical\ Activity}$ = .359) y salud percibida (r = .266). También se encontró una relación moderada con IMC (r = - .129). **Conclusiones:** Motiva.Diaf ha demostrado una fiabilidad y validez. La disponibilidad de un instrumento de estas características tiene implicaciones significativas en la evaluación de las conductas, diseño e implementación de intervenciones conductuales.

Palabras clave: hábitos dietéticos, actividad física, psicometría, motivación.

Ample evidence suggests that diet and physical activity (PA) play a major role in preventing and developing many conditions including cancer, diabetes, and cardiovascular disease (McKenzie et al., 2016; Tilman & Clark, 2014). Deciding whether or not a person follows a healthy diet is not an easy task, mainly because there is no clear conceptual definition of what a "healthy" diet is. However, using theoretical frameworks, one can determine whether or not a population follows established dietary recommendations and identify adherence to their healthy characteristics (Castro-Quezada, Román-Viñas, & Serra-Majem, 2014; La Vecchia & Serra-Majem, 2015). On the other hand, and despite the fact that there are various methods to evaluate a person's level of activity, one of the simplest (although unspecific) is to evaluate their adherence to recommendations given by experts (Dutton, Bauman, Dennis, Zwar, & Harris, 2016). There is no apparent controversy in the existing literature regarding physical activity (Crespo-Salgado, Delgado-Martín, Blanco-Iglesias, & Aldecoa-Landesa, 2015). The World Health Organization recommends that adults aged 18-64 do at least 150 minutes of moderate exercise or 75 minutes of vigorous aerobic exercise weekly, in which aerobic exercise should be performed in intervals of at least 10 minutes (World Health Organisation, 2010).

Identifying unhealthy behaviours is essential to specifically orient promotional activities and promote healthy lifestyles. In order to achieve this objective, understanding people's motivation to follow healthy habits and the factors that determine such behaviours are of great interest. Motivation is a very important variable when evaluating health promotion and the resulting change in habits (Kelly, Zyzanski, & Alemagno, 1991). The self-determination theory (SDT) is a theory of human motivation that has been applied to health-relevant changes (Deci & Ryan, 2012)

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frequently used to understand and promote motivation to adopt and maintain healthy lifestyles (Ng et al., 2012). SDT is a general theory of human motivation that facilitates understanding both adherence to health behaviours as well as motivation, by means of analysing a person's degree of will power to perform different actions (Deci & Ryan 1985; Ryan & Deci, 2000).

One of the central ideas of this theory is that adaptive self-regulation of healthy behaviours follows from the provision of greater self-support for three basic needs (BN): autonomy, competence, and relatedness to others (Deci & Ryan, 2012). Autonomy is defined as being the origin of behaviours themselves, competence is feeling capable of carrying out certain behaviours, and relatedness is feeling supported and accepted by others (Ng et al., 2012). Williams et al. (2006) conclude that placing patients' needs for autonomy and competence at the centre of therapeutic interventions could improve health outcomes, and Ryan and Deci (2008) add that other aspects can also be improved, such as quality of life. In this sense, Ryan and Deci (2000) indicated that a self-supportive health care environment facilitates satisfaction of all three BN.

Another central idea to this theory is the existence of various types of motivation or behaviour regulators: autonomous self-regulation or intrinsic motivation and controlled regulation or extrinsic motivation, which is composed of four different types of regulation (external, interjected, identified and integrated) and demotivation (Deci & Ryan, 1985; Ryan & Deci, 2000). The different forms of motivation are represented in a continuum that goes from non-self-determined behaviour, which corresponds with lack of motivation to perform an action, to self-determined motivation, which simultaneously corresponds with extrinsic and intrinsic motivation, the latter corresponding to a higher degree of self-determination (Deci & Ryan, 1985). The lack of motivation corresponds with the absence of action, and therefore impedes the development of healthy behaviours. Extrinsic motivation is based on the fact that factors that generate a behaviour are based on the consequences of an action. Finally, intrinsic motivation arises from the inherent enjoyment derived from the behaviour itself (García del Castillo, García del Castillo-López, López-Sánchez, & Días, 2015). It has been observed that BN can be understood as psychological mediators that influence the different types of motivation and thus, the execution of healthy behaviours. The healthy development of people and their well-being is directly related to the satisfaction of these needs (Ryan & Deci, 2000).

In recent years, a growing body of research has tested the applicability of SDT in health contexts including the healthcare environment, health behaviour changes, and interventions (Ryan, Patrick, Deci, & Williams, 2008). Ng et al. (2012) suggest that SDT can become a foundation for the development of interventions within health promotion in a variety of physical health outcomes, for example physical activity (Gourlan, Trouilloud, & Boiché, 2015; Teixeira, Carraça, Markland, Silva, & Ryan, 2012) and dietary habits (Kopp & Zimmer-Gembeck, 2011; Leblanc et al., 2014; Mask, Blanchard, & Baker, 2014). Although there are many methods for assessing people's diet and PA, measuring what people eat and the activity they carry out, no method has been found which includes both behaviours and that is based on SDT. Several instruments are currently available that measure the behaviours explained in this document, many focusing on biomedical models with analytical representation of the results. However, after a thorough search of existing literature, there are no instruments in Spanish that combine adherence to both behaviours in a brief format, while also evaluating the motivation and needs of the population to adhere to and maintain healthy habits. These qualities, could guide healthcare professionals in the development of efficient educational interventions.

The aim of this study is to explore the connection between adherence to healthy behaviours and basic psychological needs related to diet and physical activity as well as to several biochemical markers. For this purpose, a new measurement instrument for assessing compliance with healthy diet and physical activity is developed. There are several major novelties of this research. Firstly, this new instrument will fill the gap in the scientific literature and will provide a new measure for assessing adherence to healthy behaviours in adults. Secondly, the target population is mostly clinical patients who attend hospital services. The use of this sample substantially increases the potential benefit and practical implications of this research, as they can improve their wellbeing to a greater extent than the general healthy population. Thirdly, this research includes both psychological and biochemical markers. The use of both kinds of measures provides a more comprehensive and realistic understanding of the situation and at the same time increases the validity of evidence that the research provides in addition to the information in the self-report.

Method

Participants

The sample was recruited when patients went to the Asturias University Central Hospital for routine blood tests. A total of 230 patients voluntarily agreed to participate in the study. The average age of the participants was 49.28 years (SD = 12.34) and age ranged between 18 and 77 years. Women accounted for 55.7%. Regarding civil status, 20% of the patients were single, 13.5% were separated, divorced or widowed, and 66.5% were married or in a relationship. Regarding education, 0.9% had no formal education, 15.7% had completed only primary school, 40% had completed only secondary school, and 43.5% had studied at the university level. A random subsample of 40 participants was selected, from those who had another hospital appointment scheduled, to fill in the questionnaire again two weeks after the initial administration in order to assess the test–retest reliability. Table 1 outlines the distribution of symptoms experienced by the participants.

Instruments

A three-part survey was used to collect the data: biological markers (cholesterol, triglycerides, baseline glucose, and anthropometric measurements of Body Mass Index - BMI); the survey question taken from the Spanish Health Survey, "subjective perception of health status (ratings were given using a 5-point Likert scale where 0 indicated *very bad* , 1 *bad* , 2 *regular* , 3 *good* and 4 *very good*); (Instituto Nacional de Estadística, 2014); and the Motiva.Diaf questionnaire.

The Motiva.Diaf questionnaire is composed of social-demographic questions (age, gender, education level, and civil status), questions that describe adherence and motivation for each behaviour related to diet and physical activity (15 items) and questions related to fulfilment of basic psychological needs (6 items), separated into categories of diet and physical activity.

Table 1
Clinical diagnosis of patients

Illness	Percentage	(N)
None	8.3	*(19)*
Renal	4.4	*(10)*
Dyslipidaemia	6.6	*(15)*
Diabetes	7.4	*(17)*
Obesity	.9	*(2)*
Hypertension	5.7	*(13)*
Dermatological	2.6	*(6)*
Cancer	18.8	*(43)*
Transplant	11.4	*(26)*
Vascular	1.3	*(3)*
Digestive	11.4	*(26)*
Psychological	1.3	*(3)*
Hormonal	3.1	*(7)*
Rare disease	3.5	*(8)*
Hepatitis c	2.2	*(5)*
HIV	2.6	*(6)*
Nervous system	1.3	*(3)*
Cardiology	1.3	*(3)*
Traumatology	1.7	*(4)*
Rheumatoid	.9	*(2)*
Cirrhosis	2.2	*(5)*
Sclerosis	.4	*(1)*
Fibromyalgia	.4	*(1)*
Haematology	.4	*(1)*

The questionnaire on adherence to healthy behaviour was made up of 15 items to assess adherence to dietary recommendations and adherence to physical activity in adults without dietary or physical restrictions (Table 2). Each dietary item assessed compliance with recommendations on the consumption of each food group (bread, pasta, grains and potatoes; fruits; vegetables; milk and dairy products; fish; meat; eggs; legumes; dried fruit and nuts), which contribute to a healthy adult diet. The items were developed based on the recommendations made by the Spanish Societies of Community Nutrition and Family and Community Medicine (Dapcich et al., 2007) and validated in content by nutrition experts. The recommendations for physical activity were developed based on the recommendations of previous literature (Crespo-Salgado et al., 2015) and the World Health Organisation (WHO, 2010). The dietary items were formulated as statements with the structure, "A healthy diet includes… the (weekly or daily) consumption of (the appropriate number of) servings of (a kind of food group). "Do you tend to follow this advice?" The items on physical activity were formulated with the structure: "Healthy advice includes… type of activity (and time when performed). "Do you tend to follow this advice?" All the items were given a dichotomous rating of "Yes" or "No". In addition, a list of 10 response options was provided related to the reasons for certain behaviours on which the participants had to indicate the option they identified with the most. The first four options corresponded with the reasons why they did not follow healthy guidelines (unmotivated) "No, because I did not know this information; because I do not find it useful; because it would be a great effort for me; for other reasons ...". The next four questions corresponded with following healthy guidelines in accordance with intrinsic regulation, "Yes, because my family/doctor makes me," "Yes, because I feel bad if I don't," "Yes, because I know it's good for my health," "Yes, because I have always followed these habits." The last two responses corresponded with habits associated with intrinsic regulation, "Yes, because I enjoy them" or "Yes, because it makes me feel good."

Table 2
Items included in the questionnaire

1. A healthy diet includes a daily consumption of 4-6 servings of the following foods: bread, grains, pasta, rice, and potatoes. A service of pasta or rice is generally a plate, a serving of grains is generally a bowl, a serving of pan is generally 3 or 4 slices or a role (40- 60 grams) and a serving of potatoes is generally 1 large or 2 small potatoes (150- 200 grams).
2. A healthy diet includes the daily consumption of 3 or more servings of fresh fruit. An example of a serving would be a medium piece, a cup of cherries, two slices of melon... (A serving equals 120 - 200 grams).
3. A healthy diet includes the daily consumption of 2 or more servings of vegetables, raw or cooked without fat. A serving of these foods would be, for example: a plate of salad, a plate of cooked vegetables, 1 large tomato, 2 carrots... (A serving equals 150- 200 grams).
4. A healthy diet includes the daily consumption of 2 to 4 servings of milk and dairy products. A serving is considered to be, a glass of milk (200-250 ml), 2 yogurts (200-250 grams), or 3 slices of cheese (40-60 grams of cured chees or 80-125 grams of fresh cheese).
5. A healthy diet includes weekly consumption of 3 to 4 servings of fish, or the equivalent of one individual fillet (125-150 grams).
6. A healthy diet includes the weekly consumption of 3 to 4 servings of meat low in fat, with no visible fat, and with no skin on fowl. A serving is a small fillet, or a quarter chicken or rabbit (125- 150 grams).
7. A healthy diet includes a weekly consumption of 3 to 4 eggs.
8. A healthy diet consists of a weekly consumption of 2 to 4 servings of legumes (chickpeas, lentils...), in other words, the equivalent to a plate of legumes (60-80 grams raw).
9. A healthy diet consists of a weekly consumption of 3 to 7 servings of nuts. One serving equals a handful (20-30 grams).
10. A healthy diet consists of a daily consumption of 1.5 to 2 litres of water.
11. Walking at least 30 minutes per day is considered healthy physical activity.
12. Using the stairs instead of the elevator or escalator is considered healthy physical activity.
13. Walking instead of using transport methods for short distances is considered healthy physical activity.
14. Lightly moving (taking a stroll for example…) after eating instead of resting (for example, sitting or lying down...) is considered healthy physical activity.
15. Moving (for example, getting up and walking or getting up and stretching for 2 to 3 minutes) every 30 minutes while being sedentary (for example, watching TV or working...) is considered healthy physical activity.

To evaluate basic psychological needs (BN), two indicators composed of 6 items each were developed. Each indicator was composed of 2 affirmations for autonomy, two for competence, and two for relatedness to others. Needs were evaluated by each habit separately (BN for dietary habits and BN for physical activity). Ratings were given on a 5-point Likert scale ranging from 0 (*never*) to 4 (*always*). The scores for each item were added together to yield an average score ranging from 0 to 4 (from null to full adherence with basic psychological needs).

An inter-judge analysis was carried out by experts (ten in nutrition, ten in physical activity and five in SDT) in order to assess the appropriateness of the content of the items. The selection of the experts was based following two criteria: (1) more than 5 years of experience in the field and (2) scientific production related to the field. The results have shown that experts considered the items appropriate for assessing adherence to healthy behaviour.

Procedure

Eligible participants included people over 18 years old (adults) without dietary or physical activity restrictions, permanent residents in Spain, and able to correctly understand Spanish. A collaborating nurse explained the purpose of the study and provided the informed consent. Patients who voluntarily decided to participate and signed the informed consent received the self-administrated questionnaire. In addition, patients who had another hospital appointment scheduled were invited to complete the questionnaire again two weeks later. In order to maintain anonymity, an alphanumeric code composed of three letters and six digits was assigned to each participant. On both occasions, the questionnaire was returned to a ballot collection box located in the hospital. All cases with missing data were deleted. Prior to data collection, ethical approval was obtained from a local research ethics committee in January 2016.

Data analysis

A descriptive analysis was first completed to outline the participants' motivations for following dietetic advice. Various exploratory factor analyses were subsequently completed using the unweighted least squares estimation method and the polychoric correlation matrix as the starting matrix. Determining the number of factors was completed using parallel analysis, an optimal implementation method, with 5000 resamples (Timmerman & Lorenzo-Seva, 2011) and in accordance with the fit indices using the Goodness of Fit Index (GFI > .90) and the Root Mean Square of Residuals (RMSR < .08). All items with factorial weight under .20 were eliminated. The reliability coefficient was estimated using Cronbach's alpha for ordinal information, McDonald's omega and the test-retest correlation. The test scores were correlated with the scores measuring basic psychological needs related to diet and physical activity, the participant's perceived health as well as different biomedical markers: cholesterol, glucose, BMI, Triglycerides, High density lipoprotein (HDL) and Light density lipoprotein (LDL).

Results

Descriptive analysis of items

Table 3 shows the percentage of participants that are motivated to follow dietary recommendations. More than 30% of the participants were observed to have intrinsic motivation to follow advice related to the consumption of milk and dairy products (recommendation 4) and eggs (recommendation 5), while more than 50% declared that they are unmotivated to follow advice related to physical activity (recommendation 14 and 15).

Dimensions of adherence to healthy habits

The Kaiser-Meyer-Olkin index (KMO = 0.672) and the Bartlett statistic (p<.001) showed that the data matrix was adequate for factoring. Given the presence of kurtosis in several of the items (9, 10, 14, and 15), a polychoric correlation matrix was used as the starting matrix. Items 7, 8, and 10 were eliminated given the low factorial weight. Table 4 shows that after iterative elimination of the previously mentioned items, all factorial weight was greater

Table 3
Percentage of participants who are motivated to follow dietary recommendations

Items	Un	(N)	Ex	(N)	Int	(N)	Id	(N)	Ing	(N)	Intr	(N)
1.	21.3	*(49)*	3.9	*(9)*	1.3	*(3)*	28.3	*(65)*	20.4	*(47)*	24.8	*(57)*
2.	26.1	*(60)*	3.5	*(8)*	2.6	*(6)*	23.9	*(55)*	15.7	*(36)*	28.3	*(65)*
3.	17.0	*(39)*	3.5	*(8)*	3.5	*(8)*	31.3	*(72)*	17.0	*(39)*	27.8	*(64)*
4.	16.1	*(37)*	2.6	*(6)*	.9	*(2)*	21.3	*(49)*	27.0	*(62)*	32.2	*(74)*
5.	25.2	*(58)*	4.8	*(11)*	.9	*(2)*	27.8	*(64)*	16.5	*(38)*	24.8	*(57)*
6.	13.5	*(31)*	3.9	*(9)*	0.0	*(0)*	30.0	*(69)*	25.7	*(59)*	27.0	*(62)*
7.	15.7	*(36)*	3.5	*(8)*	.4	*(1)*	19.1	*(44)*	27.0	*(62)*	34.3	*(79)*
8.	12.2	*(28)*	3.9	*(9)*	2.2	*(5)*	18.7	*(43)*	38.3	*(88)*	24.8	*(57)*
9.	50.9	*(117)*	1.3	*(3)*	.4	*(1)*	23.5	*(54)*	3.9	*(9)*	20.0	*(46)*
10.	24.3	*(56)*	5.7	*(13)*	7.0	*(16)*	36.1	*(83)*	16.1	*(37)*	10.9	*(25)*
11.	23.9	*(55)*	3.0	*(7)*	7.4	*(17)*	30.4	*(70)*	9.1	*(21)*	26.1	*(60)*
12.	48.7	*(112)*	3.0	*(7)*	3.5	*(8)*	26.5	*(61)*	8.3	*(19)*	10.0	*(23)*
13.	18.3	*(141)*	3.0	*(2)*	6.1	*(11)*	35.7	*(32)*	12.2	*(15)*	24.8	*(28)*
14.	61.6	*(124)*	.9	*(3)*	4.8	*(14)*	14.0	*(41)*	6.6	*(19)*	12.2	*(28)*
15.	54.1	*(49)*	1.3	*(9)*	6.1	*(3)*	17.9	*(65)*	8.3	*(47)*	12.2	*(57)*

Note: Un = Unmotivated Ex = External; In = Interjected; Id = Identified; Integ = Integrated; Intrin = Intrinsic

than .20. The parallel analysis method with 5000 resamples recommends extracting only one factor. Fit indices showed that the data had reasonably satisfactory fit for a one-dimensional structure (GFI .93; RMSR = 0.106). The first factor explained 29.04% of the total variance.

Reliability of adherence scores for healthy habits

Cronbach's alpha for ordinal data was .802 and McDonald's omega was .776. In addition, a re-test was conducted in a subsample of 40 participants, and the correlation of the Pearson test-retest was .780. These results showed that adherence scores for healthy behaviour had adequate reliability in terms of internal consistency as well as temporal stability.

Validity evidence related to other variables

Basic psychological needs and perceived health

The dimension of basic psychological needs related to diet showed adequate reliability of the scores (alpha = .842; McDonald's omega = .789; Pearson test-retest = .780) as well as adequate fit to a one-dimensional structure (GFI = .96; RMSR = 0.133) and the first factor explained 54.48% of the total variance. The dimension of basic psychological needs related to physical activity also showed adequate reliability of the scores (alpha = .867; McDonald's omega = .803; Pearson test-retest = .633) and adequate construct validity (GFI = .93; RMSR = 0.169; Variance explained = 50.98%). As seen in Table 5, correlations between adherence to healthy behaviour, basic psychological needs (diet and physical activity), and perceived health are statically significant and positive. These results are as expected and show adequate convergent validity of the instrument.

Medical biomarkers

Table 6 shows the correlations between adherence scores to healthy behaviour and medical biomarkers. As observed, the only biomarker that has a statistically significant correlation to adherence is BMI (r = - .129). Upon interpreting these results, it should be taken into account that the participants are patients who have medical appointments in the hospital and who show clinical diagnoses that may interfere with the association between adherence and healthy habits and the improvement of biochemical markers. For example, 18.8% of the participants have cancer, 11.4% have digestive problems, 7.4% are diabetic, while only 8.3% were not affected by any illness (see Table 1). On the other hand, the highest correlations between biochemical markers were found between cholesterol and LDL (r = .919), BMI and HDL (r = .590), and between HDL and triglycerides (r = -.467).

Table 4
Psychometric properties of the adherence scale for healthy behaviour

Adherence items*	Factorial weights
1	.441
2	.395
3	.431
4	.393
5	.264
6	.222
9	.559
11	.634
12	.446
13	.675
14	.612
15	.473
Adjustment indices	GFI = .93; RMSR = 0.106
Percentage of variance explained	29.04%
Score reliability	α = .802; Ω = .776; Test-retest =.786

* The complete report of the items can be seen in table 3.
* Items 7, 8, and 10 were eliminated for having factorial weight < .20

Table 5
Matrix of correlations between adherence to healthy behaviour, basic psychological necessities and perceived health

	Adherence (1)	2	3
Basic Needs – Diet (2)	.306*		
Basic Needs– Physical Activity (3)	.342*	.265*	
Perceived health (4)	.273*	.230*	.260*

* Correlation is significant at the 0.01 level (2-tailed)

Table 6
Matrix of correlations between adherence to healthy behaviour and medical biomarkers

	Adherence (1)	2	3	4	5	6
BMI (2)	-.158*					
Glucose (3)	.016	.095				
Cholesterol (4)	.071	-.07	.01			
HDL (5)	.084	-.500**	-.288**	.284**		
LDL (6)	.085	0	-.122	.902**	.034	
Triglycerides (7)	-.061	.285**	.435**	.305**	-.386**	.089

*. Correlation is significant at the 0.05 level (2-tailed).**. Correlation is significant at the 0.01 level (2-tailed)
HDL= High Density Lipoprotein
LDL= Light Density Lipoprotein

Discussion

The self-determination theory (SDT) enables understanding both adherence to health behaviours as well as motivation by analysing the person's degree of will power to perform different actions (Deci & Ryan 1985; Ryan & Deci, 2000). The SDT is widely used to understand the reasons behind certain behaviours related to health and why or how they may be changed within a healthy adult population (Teixeira et al., 2012), those with acute illnesses (Fortier, Duda, Guerin, & Teixeira, 2012; Hurkmans et al., 2010; Rutten et al., 2014), or chronic diseases (Peddle, Plotnikoff, Wild, Au, & Courneya, 2008; Shigaki et al., 2010; Teixeira et al., 2012). There are previous studies have that have used this model and have used more than one questionnaire to collect information underlying behaviour and motivation (Rutten et al., 2014; Leong, Madden, Gray, & Horwath, 2012) or that measured only one behaviour (Fortier et al., 2012; Leblanc et al., 2014; Leblanc et al., 2015). On another hand, there is currently no validated

questionnaire in Spanish based on the SDT model implementing the Motiva.Diaf characteristics. Therefore, a new instrument for measuring compliance with healthy diet and physical activity in clinical patients has been developed. It presents the opportunity to study the relationship between adherence to healthy behaviours and the BN related to healthy behaviours.

The results showed that the designed instrument has adequate psychometric properties. The score reliability is adequate in terms of internal consistency ($\alpha = .802; \Omega = .776$) and temporal consistency ($r = .786$). The test structure is essentially one-dimensional and the scores on this dimension converge with other measurements of basic psychological needs ($r_{\text{Diet}} = .294$; $r_{\text{Physical Activity}} = .359$) and perceived health ($r = .266$). A moderate relationship with BMI was also found ($r = -.129$). Even though the results with biochemical markers are not statistically significant, it should be taken into account that the participants are patients with very different clinical conditions, and their illnesses may inevitably alter these markers. In fact, when the patients were selected with illnesses less sensitive to biochemical changes, the correlations had a tendency to increase. In any case, future research in different populations will be able to investigate this further. In summary, the test has shown adequate reliability and evidence to evaluate adherence to healthy behaviour in Spanish patients.

The inclusion of metabolic profiles and BMI were considered as external validity criteria, as both parameters are shown to maintain a direct relationship with a healthy diet and physical activity. There is no doubt that those who follow a healthy diet tend to have healthy metabolic parameters and BMI. In accordance with previous studies, an inverse relationship has been demonstrated between adherence to healthy behaviour and BMI (Bemelmans et al., 2000; Leong et al., 2012). However, the results of this study differ from those considered in the bibliography in relation to biochemical parameters (Muros Molina, Oliveras López, Mayor Reyes, Reyes Burgos, & López García de la Serrana, 2011; Leblanc et al., 2014; Leblanc et al., 2015). The fact that patients are being monitored by hospital testing suggests possible decompensation during the clinical course of their illnesses, which is compatible with changes in biochemistry. This has been able to decisively influence not modifying metabolic profiles and therefore the absence of association with adherence to healthy habits. On another hand, another indicator that shows he good psychometric properties of the Motiva.Diaf questionnaire is the existing direct relationship between the perception of health and adherence to healthy behaviour. These results simultaneously converge with prior research where this relationship had been demonstrated (Duncan et al., 2014; Muñoz, Fíto, Marrugat, Covas, & Schröder, 2009). It is reasonable to assume that people who are concerned about their health take greater measures to maintain and improve it, and are therefore, the population who has the greatest perception of health.

Applying the SDT model in the educational design intervention has been described in previous studies (Fortier et al., 2012; Leblanc et al., 2014; Silva et al., 2010). Its components, the BN and the level of motivation may be used in the intervention design as measurement indicators as well as the objectives for intervention. For example, as presented by Leblanc et al. (2014) in their review, independently of the characteristics of the interventions and other factors of the population, direct work on the BN cannot be translated into greater adherence to performing PA and improvement of other psychological factors. However, given the existing relationship between the BN and autonomous motivation, and that autonomous motivation can predict behavioural results (Weman-Josefsson, Lindwall, & Ivarsson, 2015), other authors state that knowing the level of the BN or autonomous motivation can predict the duration of behaviour that is integrated in education intervention, such as physical activity (Leblanc et al., 2014). Therefore, as indicated by Rutten et al. (2014), improvement to BN adherence or acquiring autonomy may be considered as a variable of the replacement response. Motiva.Diaf measures BN and motivation separately, and therefore the measurement of these factors may be taken in to account upon designing interventions, or rather considered as a result of the interventions.

Another benefit of clinically applying the Motiva.Diaf questionnaire is the potential capacity to estimate maintaining the duration of the behaviour, as there is a relationship between this characteristic and the type of regulation. For example, the presence of interjected regulation—characterized by an internal process linked to an external stimulus (García del Castillo et al., 2015), for example, feeling guilty for not complying with the proposed behaviour—has been associated with greater efficacy in the new behaviour but not at the long term (Peddle et al., 2008). Likewise, Shigaki et al. (2010) have considered self-motivation as the only predictor of maintaining dietary habits, and noted that motivation derived from external pressure was not associated with long-lasting effects of intervention. In other words, those who maintain or improve healthy behaviour over time are those who maintain such behaviour because it represents a personal choice.

On the contrary, some authors have indicated that occasionally, the variables that make up SDT do not contribute to the complete explanation of changes considered for developing interventions to modify behaviour in which personal aspects such as education level (Peddle et al., 2008) age, and gender need to be taken into account (Hurkmans et al., 2010; Weman-Josefsson et al., 2015). Weman-Josefsson et al. (2015) observed that, as a function of age and gender, the type of regulation that influenced developing physical activity varied; therefore, they concluded the need to consider the association between BN, motivation, and behaviour. This circumstance has been taken into account in the Motiva.Diaf design by including personal and anthropometric variables, in addition to other variables linked to a lifestyle that may modify the measurement.

The value added to this study has been the fact that it included population with chronic health problems, compatible with changes to metabolic profile. It should be considered whether this circumstance limits analysis of results that have complicated the association of these parameters with adherence to behaviour. Therefore, it would be advisable to consider a healthy study population, as well as to gather more validity evidence from different sources (Lane, 2014: Padilla & Benítez, 2014; Ríos & Wells, 2014; Sireci & Faulkner-Bond, 2014).

Confirmation of psychometric properties of the Motiva. Diaf questionnaire has important implications for behavioural intervention at the clinical level, both for evaluating habits and their approach, as well as the design and implementation of education. Firstly, independently measuring adherence to behaviour recommendations allows for specific detection to address the needs of the population and plan for the efficiency of educative interventions developed by health personnel. Secondly, knowing the satisfaction of the BN can serve as orientation for designing educational interventions, as the educators can make

an effort to improve and reinforce behaviour from the lowest to the greatest adherence, respectively. Lastly, the fact that the questionnaire identifies patients' motivations to adhere to healthy behaviour allows prediction of the duration of the behaviour and therefore, to orient the type of monitoring that health professionals can provide. In conclusion, Motiva.Diaf is an instrument with adequate psychometric properties for evaluating adherence to healthy behaviour in Spanish patients.

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