Original research paper:

Relationships between health literacy, motivation and diet and physical activity in people with type 2 diabetes participating in peer-led support groups

by

Lise Juul[1,2], Gill Rowlands[1,3], Helle Terkildsen Maindal[1,4]

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Institutions:

[1] Department of Public Health, Section for Health Promotion and Health Services, Aarhus University, DK

[2] Department of Clinical Medicine, Danish Centre for Mindfulness, Aarhus University, DK

[3] Institute of Health and Society, University of Newcastle, UK

[4] Steno Diabetes Center, Health Promotion Research, Copenhagen, DK

Corresponding author: Lise Juul, Department of Clinical Medicine, Danish Centre for Mindfulness, Aarhus University, Jens Chr. Skous Vej 4, 8000 Aarhus C Email: lise.juul@clin.au.dk

Abstract

Aims To investigate associations between health literacy (HL) and diet and physical activity, and motivation and diet and physical activity in Danish people with type 2 diabetes. *Methods* We used a cross-sectional design including 194 individuals with type 2 diabetes participating in peer-led support groups provided by the Danish Diabetes Association between January-December 2015. The participants completed a questionnaire at the first meeting including; The Summary of Diabetes Self-Care Activities (SDSCA) measure, The Treatment Self-Regulation Questionnaire (TSRQ) (Self-Determination Theory) measuring type of motivation, and two HL scales: The HLS-EU-Q16, and the Diabetes Health Literacy scale (Ishikawa, H). Data were analyzed using linear regression models adjusting for age, gender, educational level, diabetes duration, motivation and HL. *Results* The adjusted β (95%CI) showed that autonomous motivation and functional HL were associated with following recommended diet: autonomous motivation; 0.43(0.06; 0.80) and functional HL; 0.52(0.02; 1.00). Autonomous motivation was related to following physical activity recommendations; β (95%CI) 0.56(0.16; 0.96). *Conclusions* This study indicates that, for people with type 2 diabetes, functional HL and autonomous motivation may be important drivers for following diet recommendations, and autonomous motivation may be the most important factor for following recommendations regarding physical activity. These concepts may therefore be highly relevant to address in interventions to people with type 2 diabetes. Different interventions are suggested.

Key words: Type 2 diabetes, health behavior, self-care behavior, Self-Determination Theory, autonomous motivation, health literacy

1. Introduction

Healthy diet and physical activity are core components in type 2 diabetes self-management [1]. Investigation of factors and mechanisms that influence health behavior are therefore needed. Self-determination Theory (SDT) emphasizes the importance of the underlying reasons for behavior [2]. Following the recommendations for diet and physical activity by patients with type 2 diabetes usually reflect extrinsic motivation (behaving in order to attain some separable outcomes). SDT presents different types of extrinsic motivation, and states the quality of motivation depends on whether the regulation of behavior is imposed by others or oneself, e.g. in order to avoid guilt (controlled motivation) or by the true feeling of free choice and personal endorsement of the outcomes attained by the behavior (autonomous motivation). One route to autonomous motivation for behavior change is grasping the meaning of the behavior change and synthesize that meaning with respect to other goals and values [2]. The internalization process can be supported by social contexts that support the needs of autonomy, competence and relatedness [2]. One part of autonomy support is to provide knowledge, but involves also other highly important aspects such as attitude and relations that go beyond the cognitive aspect [3]. Williams et al found that perceived autonomy support in people with type 2 diabetes was associated with statistically significant decreases in HbA1c driven by statistically significant increases in autonomous motivation and perceived competence [4]. Studies from different countries support the association between autonomous motivation and following diet and physical activity recommendations [5-8].

Autonomous motivation is strongly in accordance with empowerment as operationalized by Schulz P.J, et al. [9]. Schulz P.J, et al. found the concepts empowerment and health literacy (HL) to be two different concepts, but both very important concepts when promoting appropriate health behavior [9]. The concept of HL concerns the “ability to access,

understand, appraise and apply information to make decisions regarding health", and has been conceptualized to comprise three components; functional, interactive/communicative and critical HL[10]. Functional HL consists of basic reading and writing skills applied for health, whereas interactive/communicative HL is the skill to extract health information and derive meaning from different forms of communication, and to apply this information to changing circumstances. Critical HL allows the patient to critically analyze information and to use this information to achieve greater control over situations"[11]. Lower functional HL has been found associated with higher HbA1c levels in people with type 2 diabetes [12, 13]. To our knowledge, communicative and critical HL has not been analyzed in relation to health behavior or clinical outcomes in people with type 2 diabetes.

As HL and motivation are two different but related concepts found to be positively associated with health in people with type 2 diabetes; we aimed to investigate associations i) between HL and health behavior (diet and physical activity) adjusted for motivation, and ii) between motivation and health behavior (diet and physical activity) adjusted for HL in Danish people with type 2 diabetes. We expected that both autonomous motivation and HL levels would be associated with following diet and physical activity recommendations. We expected no associations between controlled motivation and following diet and physical activity recommendations.

2. Methods

2.1 Design and procedure

We used a cross-sectional design including 194 people with type 2 diabetes. They participated in a peer-led support group provided by the Danish Diabetes Association as a routine service across Denmark in local community settings with consecutively inclusion.

Between January - December 2015, the peer-lead supporters of the groups were asked to encourage all participants with type 2 diabetes (n= 649) to complete the questionnaire at the first meeting. Participants took, on average, 30 minutes to complete the questionnaire. Data was collected as part of the Danish contribution to "the Diabetes Literacy Project (DLP) Participant Pre-questionnaire", part of the FP7 Diabetes and Literacy programme [14].

2.2. Outcomes

2.2.1 Summary of Diabetes Self-Care Activities (SDSCA) measure

Two subscales, general dieting and exercise, from the validated Summary of Diabetes Self-Care Activities (SDSCA) measure [15] were used to measure self-reported degree of following recommendations on diet and physical activity. Regarding diet, the SDSCA-questionnaire asked "How many of the last seven days have you followed recommended diet in relation to your diabetes?" and "On average, over the past months, how many days per week have you followed recommended diet in relation to your diabetes?". Likewise, regarding physical activity, the SDSCA-questionnaire asked "On how many of the last seven days did you participate in at least 30 minutes of physical activity" and "On how many of the last seven days did you participate in a specific exercise session (such as swimming, walking, biking) other than what you do around the house or as part of your work?". The scores were calculated as the average of the 2- items for each subscale. Internal and test-retest reliability have been found adequate for these scales. Furthermore, the validity of these scales has been supported by significant correlations with multiple measures using different methods of self-report [15].

2.2.2 The Treatment Self-Regulation Questionnaire (TSRQ)

The SDT-questionnaire scale, The Treatment Self-Regulation Questionnaire (TSRQ) was used to measure the degree of autonomous- and controlled motivation [16]. Questions like

“The reason I follow recommendations regarding diet and physical activity is that, I personally believe that these are important in remaining healthy” are used to measure autonomous motivation, whereas questions like “The reason I follow recommendations regarding diet and physical activity is that, other people would be upset with me if I didn't” are used to measure controlled motivation. Responses to the SDT questionnaires were made on a 7-point scale from 1 (strongly disagree) to 7 (strongly agree). The scores were calculated as the average of the items for each individual scale. Higher average scores represent higher levels of autonomous and controlled motivation. Construct validity of TSRQ has been supported by Levesque et al. [17], and the internal consistency in the TRSQ-scales measured by Cronbach´s alpha has previous been found >80 in a large Danish diabetes population [18].

2.2.3 The Health Literacy Scale-EU-Questionnaire 16 (HLS-EU-Q16)

The HLS-EU-Q16 was used for measuring comprehensive HL[19]. Examples of the items are “How easy would you say it is to find information on treatments of illnesses that concern you?”, “How easy would you say it is to use information the doctor gives you to make decisions about your illness?” and ““How easy would you say it is to understand information in the media on how to get healthier?”. Response categories to the HLS-EU-Q16 were; 1 (very easy), 2 (fairly easy), 3(fairly difficult) and 4 (very difficult). Following the instructions for the instrument [20], i) the two “difficult”- categories were coded with a 0 and the two “easy”- categories were coded with a 1. The HL score was computed by counting the number of 1´s (possible range 0-16); ii) Participants with a score<9 were categorized as having “likely inadequate” HL, participants with a score 9-12 were categorized as having “likely problematic” HL, and participants with a score >12 were categorized as having “likely sufficient” HL [20]. Cronbach’s alpha for the HLS-EU-Q16 questionnaire has been estimated to be 0.88 [21].

2.2.4 The Diabetes Health Literacy scale

The Diabetes Health Literacy scale by Ishikawa, H. et al, was used for measuring diabetes specific HL [22]. Examples of items measuring functional, communicative and critical HL, respectively, were; "In reading instructions or leaflets from hospitals/pharmacies, you found that the content was too difficult", "Since being diagnosed with diabetes, you have collected information from various sources", and "Since being diagnosed with diabetes, you have considered whether the information was applicable to your situation". Responses to the items were made on a 4-point scale from 1 (never) to 4 (often). The scores for functional HL were reversed such that higher scores indicate higher HL. To calculate the score for each subscale, the scores for the items on each subscale were summed and divided by the number of items for that subscale. Cronbach's alpha for the functional, communicative, and critical HL scales has been estimated to be 0.84, 0.77, and 0.65, respectively [22].

All the questionnaires had been translated into Danish using a standardized procedure.

2.2.5 Education

Education was categorized in three groups; 1) mandatory school (one year of preschool class and up to and including 9. grade) and an optional 11th year of school at the most (≤11 years), 2) secondary education and/or vocational training< 3 years at the most (>11<16 years) and, 3) secondary education and vocational training ≥3 years or tertiary education (≥16 years).

2.3 Analysis

The associations were analyzed using different linear regression models: i) crude models, ii) models adjusting for age, gender, educational level and diabetes duration, and iii) models

adjusting for age, gender, educational level, diabetes duration and the other analyzed factors. Hence, the association of health behavior with motivation was adjusted for HL, and the association of health behavior with HL was adjusted for motivation.

2.4 Ethical approval

The Danish Data Protection Agency approved the study and its database (J.no. 2014-41-3572). No further ethical approval was required for this research.

3 Results

A total of 194 of 649 eligible participants (30%) completed the questionnaire. The characteristics of the study population are shown in Table 1.

Self-reported frequency of following diet recommendations was found to be statistically significantly associated with autonomous motivation (the type of motivation with identified personal endorsement of doing behavior), β (95%CI) 0.73 (0.44 ; 1.01) (Table 2). Self-reported frequency of following diet recommendations was also to a lesser, but statistically significant extent associated with controlled motivation (the type of motivation where the underlying reasons for actions are characterized by e.g. avoiding shame or guilt), β (95%CI) 0.24 (0.04 ; 0.44) (Table 2). The results regarding autonomous motivation remained statistically significant in all adjusted analyses, controlling for age, gender, educational level, diabetes duration, controlled motivation and HL, β (95%CI) 0.43 (0.06 ; 0.80) and 0.60 (0.24 ; 0.98) (Table 2), whereas the association with controlled motivation became not statistically significant in the analyses adjusting for HL and autonomous motivation, β (95%CI) 0.22 (-0.01 ; 0.46) and 0.16 (-0.07; 0.39) (Table 2). Self-reported frequency of following diet recommendations was also found to be statistically significantly associated with functional

HL (basic reading and writing skills), β (95%CI) 0.58 (0.18 ; 0.98); and communicative HL (the skills to extract, understand and apply health information.), β (95%CI) 0.67 (0.17 , 1.17). This persisted when adjusted for age, gender, educational level and diabetes duration and with regard to functional HL; also when adjusted for motivation and communicative- and critical HL, β (95%CI) 0.52 (0.02 ; 1.00) (Table 2). The association of following recommended diet and communicative HL (the skills to extract, understand and apply health information), on the other hand, was not statistically significant when also adjusted for motivation, β (95%CI) 0.30 (-0.36; 0.96) (Table 2). Self-reported frequency of following diet recommendations was not found statistically significant associated with critical HL (the ability to critically analyze and use information) in any of the analyses, β (95%CI) 0.39 (-0.08 ; 0.87) (Table 2). Similar results was found with regard to comprehensive HL, which was not statistically significantly associated with following diet recommendations in any analysis, β (95%CI) 0.24 (-0.19 ; 0.66) (Table 2). Self-reported frequency of following physical activity recommendations was only found to be statistically significantly associated with autonomous motivation, β (95%CI) 0.61 (0.29 ; 0.92) (Table 2). However, this association persisted even when adjusted for age, gender, educational level, diabetes duration, controlled motivation and HL, β (95%CI) 0.56 (0.16 ; 0.96) and 0.53 (0.14 ; 0.93).

4 Discussion and conclusion

4.1 Discussion

4.1.1 Main findings

In this study, both HL and motivation were found statistically significant associated with following recommended health behavior in people with type 2 diabetes. With regard to self-reported frequency of following diet recommendations, both autonomous motivation and HL seemed important. The results also indicate that some of the people with type 2 diabetes were

motivated to follow diet recommendations for "controlled" reasons e.g. by expectations of others or by avoiding guilt. However, when adjusted for all the other factors in our analysis, the most important factors related to self-reported frequency of following diet recommendations were autonomous motivation and functional HL. As the association of autonomous motivation with following diet recommendations also was adjusted for functional HL, and the association of functional HL with following diet recommendations also was adjusted for autonomous motivation, both factors seemed independently important with β=0.43 (0.06 ; 0.80) and β=0.52 (0.02 ; 1.00), respectively.

The only factor associated with self-reported frequency of following physical activity recommendations in the present study was autonomous motivation. No clear associations were found between following physical activity recommendations and controlled motivation or between following physical activity recommendations and HL.

4.1.2 Comparison with existing literature

A Finnish study including 2856 people with type 2 diabetes found that, of all mutual adjusted explanatory factors including self-care competence, energy, well-being, depression, life stress and social support, autonomous motivation was the factor most strongly associated with engagement in physical activity [8]. A French study also explored the association between types of motivation measured by TSRQ and leisure time physical activity among people with type 2 diabetes, and in accordance with the Finnish study and our study, they found physical activity duration positively associated with autonomous motivation [7] . However, an American study [5] that examined the relationship between diabetes self-care activities and autonomous motivation for diet and physical activity, separately, only found a statistically significant association of autonomous motivation with diet and not with physical activity. They had dichotomised physical activity by "at least once during the last week". None of the

above studies included HL measures in the analyses. A recent study among Turkish people with diabetes found that two subscales of empowerment were associated with self-reported frequency of following diet and physical activity recommendations [23]. Functional HL was associated with neither diet nor physical activity in the Turkish study [23]. Despite these inconsistent results, it seems that autonomous motivation is of importance for health behavior in people with type 2 diabetes. The finding in our study that functional HL also is an important factor in relation to diet seems plausible, as information on diet and how to eat in an appropriate way may be more complex than information on e.g. how to be physically active. Also, the finding of a statistically significant association between communicative HL and diet before adjustment for motivation appears logical. Both the coefficients of autonomous motivation and communicative HL were attenuated when adjusted for each other, indicating their mutual relation. People with skills to extract, assess and apply health information are likely to have better skills to understand the meaning of behavior change, which may facilitate autonomous motivation. The relationship is probably also reciprocal; being autonomously motivated for behavior change will facilitate seeking more information. The finding that autonomous motivation was the strongest factor associated with behavior change supports the SDT´s emphasis that knowledge and skills alone are not sufficient to motivate behavior; they must be accompanied by autonomous motivation [2].

4.1.3 Strengths and limitations

A strength of the present study is that the associations of HL and motivation with health behavior are mutually adjusted for each other, providing deeper insight into potential mechanisms. A limitation of the study is that we do not know the characteristics of the participants who did not complete the questionnaire. Due to these circumstances, the question on representativity and thereby the generalizability of the findings remains. In our study, 28% of the participants had 11 or less years of education. For context, in a former study among a

register-based Danish diabetes population, the prevalence with lower educational level was 42% [18]. However, the levels of autonomous motivation and controlled motivation of the participants in our study were similar to those found in the former study [18]. As we adjusted for educational level, we have no reasons to think that the associations found in our study are invalid.

Functional, communicative and critical HL has not been measured in a Danish type 2 diabetes population before. However, recently health literacy was measured with two scales from the Australian Health Literacy Questionnaire (HLQ) in a large Danish population survey, and it was found that approx. 20% of the diabetes population reported difficulties in understanding health information and engaging with health care providers [24].

4.1.4 Addressing functional HL and autonomous motivation may require different intervention

To accommodate low functional HL, specific components have been found effective on HbA1c-levels in people with poor regulated type 2 diabetes and low functional HL [25]. These are; minimizing the number of new topics addressed in one session, focusing on selected critical behaviors, decreasing the complexity of information using concrete examples and visual aids, avoiding the use of medical jargon, and using "teach back" to ensure comprehension. Autonomy support is proposed to include listening with empathy, providing meaningful rationales for change without pressure adherence, offering choices and acknowledging that behavior change is demanding and challenging from the individual´s perspective [3]. Motivational interviewing (MI) has often been used in autonomy supportive interventions [26], and has e.g. shown effect on 3-years weight loss in obese women by focusing on autonomous motivation for physical activity [27, 28]. However, there may be other ways to support autonomous motivation than facilitating cognitive reflection. Proponents of SDT suggest that autonomous motivation can be encouraged by mindfulness

[29]. Mindfulness-Based Interventions (MBIs) aim to implement yoga and meditation practice in people's lives in order to practice paying attention on purpose in a non-judgmental and accepting way [30]. This practice is proposed to bring i) increased awareness of what is occurring in the body and in the mind; ii) an awareness of automatic and habitual patterns in everyday life with the potential of making conscious choices to facilitate behavioral changes; iii) an awareness of what is important in one´s life; and iiii) cultivation of compassion for oneself and others [31]. Recently, a randomized trial in people with diabetes showed clinical relevant effect on HbA1c of an MBI [32]. However, effects of MBIs in people with diabetes could go through different potential mechanisms. Having a chronic disease is often associated with stress, and stress is often associated with poor health behavior [33-35]. The effects of MBIs on well-being, reduction in stress and symptoms of anxiety and depression are well-documented [36].

In order to choose appropriate intervention, knowledge about the underlying problems and needs (e.g. lack of motivation or low functional HL) is crucial important.

4.2 Conclusions

This study indicates that, for people with type 2 diabetes, functional HL and autonomous motivation may be important drivers for following diet recommendations, and autonomous motivation may be the most important factor for following recommendations regarding physical activity. These concepts may therefore be highly relevant to address in interventions to people with type 2 diabetes. Different interventions are suggested.

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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Legends of tables

Table 1. Characteristics of the study population (n=194); people with type 2 diabetes participating in peer-led support groups, Denmark 2015

Table 2. Associations between self-reported frequency of self-care behaviors and motivation and health literacy (HL) level among people with type 2 diabetes participating in peer-led support groups, Denmark 2015

Table 1. Characteristics of the study population (n=194); people with type 2 diabetes participating in peer-led support groups, Denmark 2015

Demographic	
Gender, male, n(%)[a]	71(41)
Age, mean ±SD (years)[b]	64±10
Education, n(%)[c]	
≤11 years	53(28)
>11<16 years	106(56)
≥16 years	32(17)
Clinical	
Diabetes duration, median (q1,q3)(years)[b]	5(2,11)
BMI, mean±SD (kg/m^2)[c]	31(6)
Diabetes medication, n(%)[c]	
Oral blood glucose-lowering-agent only	134(71)
Insulin only	19(10)
Oral blood glucose-lowering-agent + Insulin	22(12)
Neither oral blood glucose-lowering-agent or insulin	14(7)
Health behavior[b]	
Days following diet recommendations (0 – 7), mean±SD	4.7(2.0)
Days following physical activity recommendations (0-7), mean±SD	3.7(2.1)
Motivation[b]	
Controlled motivation physical activity and diet recommendations (TSRQ), mean±SD	4.5(1.5)
Autonomous motivation physical activity and diet recommendations (TSRQ), mean±SD	6.2(1.0)
Health literacy[b]	

HLS-EU-Q16	
Likely inadequate HL, n(%)	19(11)
Likely problematic HL, n(%)	48(27)
Likely sufficient HL, n(%)	114(63)
Ishikawa	
Functional HL, mean±SD	2.8(0.7)
Communicative HL, mean±SD	3.3(0.6)
Critical HL, mean±SD	2.9(0.6)

[a] 11% missing data, [b]6-10% missing data, [c] 2-5% missing data

Table 2. Associations between self-reported frequency of self-care behaviors and motivation and health literacy (HL) level among people with type 2 diabetes participating in peer-led support groups, Denmark 2015

	General diet (SDSCA)				Exercise (SDSCA)			
	n	Crude β (95% CI)	n	Adjusted β (95% CI)	n	Crude β (95% CI)	N	Adjusted β (95% CI)
Autonomous motivation (TSRQ)	177	0.73 (0.44 ; 1.01)	139	0.75 (0.41 ; 1.09)[a]	182	0.61 (0.29 ; 0.92)	145	0.59 (0.22 ; 0.95)[a]
			128	0.43 (0.06 ; 0.80)[b]			130	0.56 (0.16 ; 0.96)[b]
			132	0.60 (0.24 ; 0.98)[c]			134	0.53 (0.14 ; 0.93)[c]
Controlled motivation (TSRQ)	173	0.24 (0.04 ; 0.44)	136	0.28 (0.05 ; 0.51)[a]	177	0.15 (-0.06 ; 0.37)	141	0.12 (-0.12 ; 0.37)[a]
			128	0.22 (-0.01 ; 0.46)[b]			130	0.02 (-0.23 ; 0.28)[b]
			132	0.16 (-0.07; 0.39)[c]			134	0.03 (-0.22 ; 0.28)[c]
HL level (HLS-EU-Q16)	176	0.24 (-0.19 ; 0.66)	139	0.11 (-0.40 ; 0.61)[a]	179	0.06 (-0.38 ; 0.51)	142	-0.07 (-0.61 ; 0.46)[a]
			132	-0.01 (-0.51 ; 0.49)[c]			134	-0.12 (-0.66 ; 0.28)[c]
Functional HL	175	0.58 (0.18 ; 0.98)	136	0.72 (0.25 ; 1.19)[a]	178	0.31 (-0.12 ; 0.74)	140	0.27 (-0.23 ; 0.78)[a]
			128	0.52 (0.02 ; 1.00)[b]			130	0.13 (-0.41 ; 0.67)[b]
Communicative HL	179	0.67 (0.17 , 1.17)	141	0.75 (0.18 ; 1.32)[a]	181	0.38 (-0.16 ; 0.92)	144	0.11 (-0.50 ; 0.73)[a]
			128	0.30 (-0.36; 0.96)[b]			130	-0.28 (-1.00 ; 0.44)[b]
Critical HL	178	0.39 (-0.08 ; 0.87)	141	0.43 (-0.09 ; 0.95)[a]	182	0.17 (-0.33 ; 0.67)	146	0.01 (-0.51 ; 0.57)[a]
			128	0.19 (-0.43 ; 0.81)[b]			130	0.20 (-0.48 ; 0.88)[b]

[a]for age, gender, educational level and diabetes duration [b] for age, gender, educational level, diabetes duration and the other analyzed factors in the table (except HLS-EU-Q16). [c] for age, gender, educational level, diabetes duration and the other analyzed factors in the table (except functional, communicative and critical HL)