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Original article

Nutrition assessment in process-driven, personalized dietetic intervention – The potential importance of assessing behavioural components to improve behavioural change: Results of the EU-funded IMPECD project

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SUMMARY

Background & aims: Although up-to-date definitions for nutrition assessment integrate behavioural components, it is not clear what behavioural components are to be assessed. Since behavioural modification is linked to effective therapeutic dietetic interventions, assessing behaviour and factors influencing behaviour might be beneficial to improve personalized dietetic outcome. The aim of the following report is to emphasize the role of behavioural components and factors affecting behaviour at baseline nutrition assessment in personalized dietetic intervention.

Methods: The present work is part of the EU-funded project IMPECD ("Improvement of Education and Competences in Dietetics", www.impecd.eu). The project aims to improve the clarity and consistency of national dietetic process models to unify education and training of future dietitians. Experts from five European Universities of Applied Sciences (UAS) in Antwerp (BE), Fulda (DE), Groningen (NL), Neubrandenburg (DE) and St. Pölten (AT) developed a Massive Open Online Course (MOOC) consisting of several clinical cases. It warranted a detailed evaluation of all dietetic care process steps, starting with nutrition assessment.

Results: Results for motivation assessed during nutrition assessment are not consistently positively associated with outcome and the added value of assessing them at baseline is still unclear. However, depressive symptoms, emotional distress, and anxiety negatively affect eating and physical activity and therefore limit the efficacy of the dietetic intervention. Assessing behavioural components including nutrition literacy is an important precondition for influence on behavioural modification.

Conclusion: Indisputably, baseline assessment of behavioural components and factors influencing behaviour are important to increase the therapeutic efficacy of personalized dietetic interventions.

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1. Introduction

Personalized dietetic interventions, used as synonymous to dietary advice, are based on consistent processes. This concept of following and recording a systematic process is described by process models and indicates that the dietetic intervention is clearly structured and continue along a consistent algorithm [1,2]. All process models are focusing on patient-centred care, which is best defined by "providing care that is respectful of and responsive to individual patient preferences, needs, and values and ensuring that patient values guide all clinical decisions" [3]. Therefore, assessing behavioural aspects already in nutrition assessment as first step in the algorithm [4] is important to design personalized dietetic interventions for "the intent of changing nutrition related behaviours, risk factors, environmental factors or aspects of physical or psychological health or nutrition status" [1].

This definition of The British Dietetic Association (BDA) implies that the main target of dietetic intervention is the change of eating and general lifestyle behaviour and related factors of a client. Consequently, great attention has to be paid to health behaviours, which is influenced by the social, cultural and physical environments. Behaviours are influenced by psychological factors and therefore important to be assessed by dietetic professionals. Therefore, the aims of this opinion paper are:

- to give an overview of definitions for nutrition assessment from professional societies in Clinical Nutrition and Dietetic Associations and to present the definition of the IMPECD consortium
- to give insight in the role of factors affecting behaviour
- to emphasize the role of behavioural components for dietetic intervention and
- to discuss the consequences for assessing behavioural components in dietetic interventions

The present opinion paper is authored by the consortium of the EU-sponsored strategic partnership "Improvement of Education and Competences in Dietetics" (IMPECD, www.impecd.eu, Project Agreement Number 2015-1-AT01-KA203-005039 GZ: 235/11/15, duration 01.09.2015–30.08.2018). IMPECD collaborates with five European Universities of Applied Sciences (UAS) in Austria, Germany Belgium and the Netherlands. All partnering UAS offer bachelor courses in dietetics and nutrition. The project aims to improve the clarity and consistency of national dietetic process models and to develop a unified model to be used in education and training of future dietitians. An overview of process models in dietetic care used in Europe [5] and the role of outcome evaluation are already published [6].

2. Behavioural assessment as part of nutrition assessment

Nutrition assessment is fundamental for determining dietetic diagnosis as well as planning, implementing, and evaluating the outcome of the dietetic intervention. Furthermore, nutrition assessment provides the baseline indicators for monitoring and outcome evaluation. National and international Dietetic Associations [1,7] and standard textbooks that are widely used in education and training of dietitians [8,9] recommend that behavioural components should be integrated in the nutrition assessment in addition to standard components such as client history, diet history and clinical status (see Tables 1 and 2 for an overview of nutrition assessment definitions). Additional assessment of behavioural components will enable dietitians to join in with the clients' current status to develop tailored treatment goals and dietary advices. Thereby, the dietitian–client relationship will improve and participation barriers will decrease, resulting in expanded motivation and adherence to recommendations [10,11]. In summary, including behavioural components support tailored advices and can improve behavioural change and outcomes. In addition, evaluating of behavioural components at baseline will support monitoring. So the treatment can be adapted in time. In consequence, all dietitians are challenged to assess also behavioural components as part of nutrition assessment.

The definitions provided in Tables 1 and 2 show a clear lack of data categories that should be included in nutritional assessment. Based on these limitations and to highlight behavioural components, the IMPECD consortium developed its own definition on nutrition assessment for internal methodological and educational purposes. Our definition follows a clear structure and encompasses dedication, central statement, aim and principles and operationalization:

IMPECD definition: Dietetic Assessment is the first step of the Dietetic Care Process. It is a systematic process to gather dietetically adequate and relevant information about the client by using state of the art methods. The aim is to identify nature and cause of dietetic related problems of the client. The gathered information is documented in types of categories (client history, diet history, behavioural-environmental aspects, and clinical status) or following the International Classification of Functioning, Disability and Health (ICF)-model.

3. Relevance of behavioural components as part of nutrition assessment

Assessing behavioural components in intervention programs and tailor the treatment to it is important as several studies have shown. Perri and colleagues [14] demonstrated that extended behavioural programs for enhancing self-management in obese women are associated with better outcomes compared to standard behaviour therapies or education only interventions. There is evidence that in some settings motivation might be more effective than drugs. Venditti et al. [10] investigated coaching approaches for weight loss and physical activity adherence. In total, 3234 subjects were recruited and randomly assigned to an intensive lifestyle, metformin, or placebo arm and followed for an average of 3.2 years. The lifestyle group learned self-regulatory skills for goal-setting, self-monitoring of food intake, activity and body weight, managing environmental cues, energy balance, and problem-solving. In result, the psychological aspects were more efficacious than drug or placebo treatment in delaying diabetes onset.

These results demonstrate, that information on conditions that influence behaviour or behavioural change are important for the dietitians to select the appropriate counselling theory or model for applying effective dietetic intervention to achieve behavioural change of the client. Several counselling techniques are available using different concepts stemming from psychology, psychotherapy and health sciences. In Table 3 are behavioural theories, models and counselling techniques listed. The theory underlying behavioural change can be used to focus on the components that are needed to guide behavioural change. Counselling techniques should be tailored and varied to the individual needs [1,15].

The baseline behavioural assessment increases therapy adherence and thereby improves eating behaviour [32,33]. Moreover, baseline behavioural assessment is mandatory for measuring behavioural improvements as outcome indicator, which can be supportive in evaluating the efficiency of dietetic interventions [31–39]. To show the big dimension of assessing behaviour in nutrition assessment a selection of assessment tools is shown in Table 4. Several psychological factors can have a negative impact on the outcome of the dietetic intervention. Therefore, important components of assessing behaviour are also factors affecting

Table 1
Definitions of nutritional assessment published by Societies for Clinical Nutrition.

Societies for Clinical Nutrition	Definitions and description
The European Society for Clinical Nutrition and Metabolism ESPEN (2017) [12]	"Nutritional assessment should be performed in all subjects identified as being at risk by nutritional risk screening, and will give the basis for the diagnosis decision, as well as for further actions including nutritional treatment. Predefined assessment tools like Subjective Global Assessment (SGA), Patient-Generated (PG) SGA and Mini Nutritional Assessment (MNA) could be used to facilitate the assessment procedure. Assessment of the nutritional status comprehends information on body weight, body height, body mass index (kg/m^2), body composition and biochemical indices. Objectives of the assessment are to evaluate the subject at risk according to the following measures: - A medical history should be taken, and physical examinations and biochemical analyses should be performed in order to decide the underlying disease or condition that may cause the potential state of malnutrition. - Social and psychological history is taken to establish potential effects of living conditions, loneliness and depression on nutritional needs, and whether input from other professional groups may be of benefit."
American Society for Parenteral and Enteral Nutrition ASPEN (2011) [13]	Nutrition assessment is "a comprehensive approach to diagnosing nutrition problems that uses a combination of the following: medical, nutrition, and medication histories; physical examination; anthropometric measurements; and laboratory data."

Table 2
Definitions of nutritional assessment published by Dietetic Associations.

Dietetic associations	Definitions
Academy of Nutrition and Dietetics AND (2017) [7]	Nutrition Assessment is a systematic approach to collect, classify, and synthesize important and relevant data from clients (where "client" refers to individual and population). This step also includes Reassessment, which additionally includes collection of new data, and comparing and reevaluating data from the previous interaction to the next. Nutrition Assessment is an ongoing, dynamic process that involves initial data collection as well as continual reassessment and analysis of the client's status compared with accepted standards, recommendations, and/or goals.
The British Dietetic Association (2016). Model and Process for Nutrition and Dietetic Practice [1]	Assessment is a systematic process of collecting and interpreting information in order to make decisions about the nature and cause of nutrition related health issues that affect an individual, a group or a population. Assessment is the first step in the nutrition and dietetic process. Its purpose is to obtain adequate and relevant information in order to identify nutrition-related problems and to inform the development and monitoring of the intervention. It is initiated by identification of need, such as screening, referral by a health professional, self-referral, high level public health data, epidemiological data or other similar process.

behaviour as depression, fatigue, emotional distress and anxiety. Depressive symptoms, emotional distress and anxiety are known to negatively affect eating and physical activity and limit the efficacy of the dietetic intervention. Fatigue complicates behavioural change through reduced motivation, reduced physical activity and general lethargy [31].

4. Factors influencing behaviour and the capacity for behavioural changes

Behaviour is influenced not only by nutrition literacy but also by several other factors as depression, fatigue, emotional distress and anxiety and these are important components to be assessed and to be used to guide behavioural change.

4.1. Nutrition literacy

Often patients have basic nutrition knowledge and are not able to turn theoretical knowledge into daily eating practice [32]. "Nutrition literacy is knowledge of nutrition principles and skills in food-related tasks" [33]. Dietetic interventions are pointless if the patient does not understand the instructions of a dietitian [32]. Nutrition literacy tests can check the ability, not only to read and write, but also to process dietary information [34,35]. Knowing the level of nutrition literacy of clients enable dietitians to tailor information in formats patients understand [36]. Nutrition literacy questionnaires can detect both, nutrition knowledge and nutrition skills. Consequently, using literacy questionnaires during assessment can assist the dietitian to choose appropriate communication models [37,38]. Gibbs and colleagues [32] showed that the Nutrition Literacy Assessment Instrument (NLAI) can better assess low levels in nutrition literacy compared to dietitian practitioner's own impression. In 44% of the cases, dietitians estimated educational status of patients incorrectly, but the NLAI could detected 90% of deficient knowledge, which illustrates the advantage of the tool. Two systematic reviews [39,40] showed positive associations between nutrition knowledge and diet quality and demonstrated that nutrition literacy is strongly linked to all major lifestyle diseases. They additionally stressed the use of high-quality validated nutrition literacy questionnaires as listed in Table 4 [39,40].

4.2. Depressive symptoms

Wang and colleagues [41] evaluated dietary change in about 3000 breast cancer survivors and showed baseline depressive symptoms to cause lowered completion of dietary recalls and visits in the control group. Successful behavioural activation in the intervention group counteracted the impact of depressive symptoms. Further trials confirmed the association between depressive symptoms and dietary intake mainly in obese patients, in which depressive disorders are prevalent [42,43]. Appelhans et al. [42] used the Beck Depression Inventory (BDI-II) (see Table 4) and showed that more severe depression associates with poorer diet quality in obese patients. Somerset et al. [43] investigated adherence to a 10-week weight loss intervention in 64 overall healthy participants without diagnosed depression and BMI > 27 kg/m^2. The results showed that depression symptoms analysed by Beck Depression Inventory (BDI-II) negatively correlates to the duration of participation ($r = 0.38$, $p < 0.05$). In summary, depressive symptoms – even in the absence of a medical diagnosis - can affect eating behaviour, readiness to change and predict poor weight loss outcome. In populations with high prevalence of undiagnosed depressogenic tendency assessing individual depressive symptoms at baseline and addressing them appropriately during dietetic intervention might be effective to improve adherence and dietetic intervention outcome.

Table 3
Important counselling theories and models underlying behaviour change.

Theory or model	Short description
CBT Cognitive Behavioural Theory [16]	CBT assumes that all behaviour is learned and that environmental and internal factors are related to one's behaviour. The theory endorses self-monitoring and problem solving, leading to more awareness of internal and external cues and their response.
C-SHIP Cognitive-Social Health Information Processing [17]	This model focuses on the individual's encodings and construals, expectancies, affects, goals and values, self-regulatory competencies, and their interactions with each other as well as the health-relevant information in the course of cognitive-affective processing.
COM-B system capability, opportunity, and motivation [18]	The COM-B system is a model of behaviour change: behaviour (B) occurs as the result of interaction between three necessary conditions, capabilities (C), opportunities (O) and motivation (M).
NLP Neurolinguistic programming [19]	NLP is a communication framework using techniques to understand and facilitate change in thinking and behaviour to achieve specific goals in life. According NLP there is a connection between neurological processes (neuro-), language (linguistic) and behavioural patterns learned through experience (programming).
TTM Transtheoretical Model [20]	The TTM was developed and introduced to understand behaviour change, especially associated with addictive behaviour. According TTM change involves progress through six stages: precontemplation, contemplation, preparation, action, maintenance, and termination.
MI Motivational Interviewing [21,22]	MI is a directive person-centred approach designed to explore ambivalence and activate motivation for change. A key component is to acknowledge that clients are entitled to make no change. MI invites people to consider their own situation and find their own solution.
TPB Theory of Planned Behaviour [23]	The TPB predicts and explains human behaviour in specific contexts. Behaviour is influenced by intentions to perform that behaviour. In turn, these intentions are preceded by attitude, social norm and self-efficacy with regard to the desired behaviour.
Bandura's social learning theory [24]	Behaviour and behavioural change depend on both outcome expectations and personal efficacy expectations. The self-efficacy expectations can vary along three dimensions: magnitude, generality and strength.
ASE-model Attitude, Social Norm, Self-Efficacy model [25]	The ASE-model (also called "I changed model) integrates ideas of Ajzen's Theory of Planned Behaviour (TPB) and the Bandura's social learning theory to explain behavioural intentions.
ACT Acceptance and Commitment Therapy [26,27]	According to ACT, psychological problems develop due to inappropriate or unhelpful regulation of behaviour through language processes leading to psychological inflexibility in relation to environmental contingencies. ACT aims to reduce the extent to which beliefs and other symptoms dominate conscious experience and behaviour.
PAPM Precaution Adoption Process model [28]	The PAPM consists of seven distinct states between ignorance and completed preventive action. The stages are "unaware of the issue", "aware of the issue but not personally engaged", "engaged and deciding what to do", "planning to act but not yet having acted", "having decided not to act", "acting" and "maintenance".
5As model Assess, Advise, Agree, assist, arrange [29]	The '5As' model of behaviour change provides a sequence of evidence-based clinician and office practice behaviours (Assess, Advise, Agree, Assist and Arrange) that can be applied in primary care settings to address a broad range of behaviours and health conditions.
GROW-model [30]	The GROW model (or process) is a linear method for goal setting and problem solving. **G** Goal setting for the session (short and long term) **R** Reality checking to explore the current situation **O** Options and alternative strategies, or course of actions **W** What is to be done, when and by whom and the will to do it

4.3. Emotional distress and anxiety

Also emotional distress and anxiety may interfere with the outcome of dietetic intervention. For example, emotional distress measured with Problem Areas In Diabetes (PAID) scale (see Table 4) at baseline is associated with lesser adherence to diet recommendations in type 2 diabetes [44,45]. In case of emotional stress at baseline, the authors recommend addressing patients' sense of worry and guilt, uncertain acceptance of diabetes diagnosis and unclear treatment goals during dietetic intervention. Reduction of baseline emotional distress and anxiety may also serve as an outcome indicator in dietetic intervention, for example in patients with eating disorders where high levels of residual anxiety after intervention may indicate higher risk of relapse. Sala et al. [46] examined anxiety traits using the State Trait Anxiety Inventory (STAI-Y) at baseline in 75 women with longstanding eating disorders and showed significant improvements of anxiety with weight gain although anxiety scores remained higher than normal. Another study indicated associations between unhealthy diet coping strategies and anxiety (STAI-Y) (see Table 4) or stress (perceived stress scale – PSS) in women with gestational diabetes [47]. The authors suggest concomitant stress reduction programs to increase diet adherence. Another case-control study on cardiovascular events underlines the role of anxiety and depressive symptoms. Only participants with low levels of anxiety had a higher adherence to the Mediterranean diet which has a significant protective factor [48]. In total 1000 Greeks were evaluated, half of them had an event of acute coronary syndrome or stroke in the past [48]. Therefore, the authors recommend to evaluate anxiety and depressive symptoms at baseline in the primary cardiovascular prevention of apparently healthy individuals and dietetic intervention should be provided combined with psychological treatment for synergistic effects [48].

4.4. Fatigue

Many diseases cause secondary conditions which impact dietary intake, for example diagnosed or undiagnosed fatigue [49]. Artom et al. [31] confirmed the relevance of undiagnosed fatigue for dietetic interventions in patients with advanced kidney disease. The etiology of fatigue is complex and involves e.g. chronic inflammation, depression and anxiety, sleep and malnutrition. Measures

Table 4
Tools to assess behaviour in nutrition assessment.

Questionnaires and instruments	Short description	Target group	Target	Practical application
Motivation				
Academic Motivation Scale [55]	Most frequently used instruments to assess academic motivation. It relies on the self-determination theory of human motivation.	General	Therapy adherence	28 items (7 subscales)
MAC2 R-NUTR, MAC2 R-PA [56] Motivation assessment of change (Nutrition, Physical Activity)	Assessing motivation for change toward healthy nutrition and physical activity. Allowing evaluating motivation to five stages: precontemplation, contemplation determination, action, maintenance.	General	Therapy adherence	18 items Likert scale (0 = totally false to 6 = totally true)
RCQ Readiness to Change Questionnaire [57]	The questionnaire (RCQ) shows the readiness to change of excessive drinkers, not seeking treatment for alcohol problems. The RCQ (TV) represents the questionnaire for the alcohol treatment-seeking population. Maintenance stages in the RCQ and RCQ (TV) are precontemplation, contemplation and action.	Alcohol abusers	Therapy adherence	12 items (RCQ) 15 items (RCQ (TV)) Scores: -8–+8 Higher scores are associated with overall agreement
SOCRATES Stages of Change Readiness and Treatment Eagerness Scale [58]	SOCRATES is an instrument to assess readiness for change in alcohol abusers. The instrument yields 3 factorially-derived scale scores: recognition, ambivalence, and taking steps.	Alcohol abusers	Therapy adherence	32 items 19 items (short version) Higher scores are associated with overall agreement
URICA University of Rhode Island Change Assessment Scale [59]	The URICA is a questionnaire designed to measure the stages of change. This instrument is well suited for complex problem behaviour, because it yields scores for each stage of change for each individual instead of classifying individuals into a single stage (domain psychotherapy: precontemplation, contemplation, action and maintenance)	Adolescents and adults in academic environments	Therapy adherence	32 items on the basis of principal components analysis
VMC – NUTR, VMC - PA Visual Motivation Change [56] (Nutrition, Physical Activity)	VCM was designed to determine the motivation to change toward nutrition and physical activity. Allowing evaluating motivation to 6 components: discrepancy, importance, self-efficacy, temptation, readiness to change, stabilization of change.	General	Therapy adherence	6 visual analog scales (VAS) 100 points
Literacy - general				
NVS Newest Vital Sign [36]	The NVS is a nutrition label and suitable for use as a quick screening test for limited literacy in primary health care settings. It correlates with the TOFHLA.	General (patient education)	Therapy adherence Level of education	6 items, time: about 3 min for administration ≥4 adequate literacy <4 limited literacy
WRAT4: Wide Range Achievement Test 4 [60]	The WRAT4 is an achievement test which measures an individual's ability to read words, comprehend sentences, spell, and compute solutions to math problems.	Children and adults (5–94 years)	Therapy adherence Level of education	Norms include standard scores: 100 ± 15, percentile scores, and grade levels. The standard scores are scaled based on the norm group.
Nutrition - Literacy				
DNT-15 Diabetes Numeracy Test [61]	The DNT-15 is a shortened version of the Diabetes Numeracy Test (DNT) and is designed to investigate numeracy skills in patients with diabetes. Numeracy is particularly important because these patients apply math skills to diabetes self-management activities, such as glucose monitoring, carbohydrate counting, and adjustment of insulin.	Patients with diabetes mellitus	Therapy adherence Level of education	15 items The approximate time of administration is 10–15 min.
NLAI Nutrition Literacy Assessment Instrument [32]	The NLAI is a content-valid measure of nutrition literacy. Practice tool to identify deficits and determine educational message.	General (nutrition related)	Therapy adherence Level of education	6 items per domain (36 items total)
NLS Nutrition Literacy Scale (NLS) ([62])	Nutrition literacy is the degree to which individuals have the capacity to obtain, process, and understand nutrition information and skills needed in order to make appropriate nutrition decisions (conceptual nutrition knowledge and functional capabilities).	General (nutrition related)	Therapy adherence Level of education	28 items, Mean NLS score 23.7 ± 4.1
Body esteem				
BESAA Body–esteem scale for adolescents and adults [63]	The BESAA that has 3 subscales: general feelings about appearance, weight satisfaction, and evaluations attributed to others about one's body and appearance.	Adolescents and young adults (m/w)	Diagnosis Outcome parameter	23 items: Likert-Scale Higher scores indicate more positive body esteem
WISE-Q Weight-Influenced Self-Esteem Questionnaire [64]	The WISE-Q is a self-report questionnaire measures the influence of negative perceptions of body weight on multiple dimensions of self-esteem. Two factors represent generalized and expected weight based self-esteem (WBSE).	General	Diagnosis Outcome parameter	Higher subscale scores indicate more positive body esteem
Depression				
CES-D Centre for Epidemiological Studies Depression Scale [65]	The CESD-R measures 9 symptoms defined by the American Psychiatric Association' Diagnostic and Statistical Manual (DSM-V) for major depressive episodes (sadness, loss of Interest, appetite, sleep, thinking/concentration, guilt, movement, suicidal).	General	Diagnosis	20 items → 6-items short form

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Table 4 (*continued*)

Questionnaires and instruments	Short description	Target group	Target	Practical application
CSDD Cornell Scale for Depression in Dementia	CSDD was specifically developed to assess signs and symptoms of major depression in patients with dementia.	Patients with dementia	Diagnosis	19 items of the scale, scores: 0–38, about 20 min >8 slight depression >12 moderate/severe depression
BDI-II Beck Depression Inventory-Second Edition [66]	The BDI-II is widely used as an indicator of the severity of depression. This tool shows strong reliability and validity, across a variety of study populations.	Patients with dementia	Severity	Self-report 21 items, about 5–10 min
GDS The Geriatric Depression Scale [67]	GDS assesses the cognitive, emotional and behavioural symptoms of depression in healthy and ill older people with normal to moderately decreased cognitive function.	Older people	Diagnosis	Self-report GDS-8: short form GDS-30: long form
Anxiety and Emotional Distress				
HADS Hospital Anxiety and Depression Subscale [68]	The HADS contains 7 questions about fear and 7 about depression. It is a reliable instrument for detecting mild to moderate states of depression and anxiety in the hospital in- and out-patient setting.	General	Diagnosis	Self-report 14 items, scores: 0-21 Anxiety >8 = ↑ Depression >8 = ↑
PAID Problem Areas in Diabetes score [45]	PAID is useful in measuring the association between psychological adjustment to diabetes and adherence to self-care behaviours. So PAID is a measure of diabetes-specific emotional distress. Available as PAID, PAID-5, and PAID-1. Domains: emotional problems, treatment-related problems, food-related problems, social network-related problems.	Patients with diabetes mellitus	Outcome parameter Therapy adherence	20 items: 5-point scale ≥40: “emotional burnout”. An extremely low score (0–10) combined with poor glycemic control may be indicative for no motivation or denial.
STAI State-Trait Anxiety Inventory [69]	STAI is a commonly used measure of trait and state anxiety. It can be used in clinical settings to diagnose anxiety and to distinguish it from depressive syndromes. It also is often used in research as an indicator of caregiver distress.	General	Diagnosis	Self-reported 20 items Higher scores suggest higher levels of anxiety
WRSM Weight-Related Symptom Measure [70]	The WRSM focuses on symptoms commonly associated with obesity and obesity treatment and the. The OWLQOL and WRSM are intended to be used together.	Adults, 18 and older	Outcome parameter	20 items, scores: 0-120 A lower score corresponds to low weight related symptoms
Cognitive				
DOS Delirium Observation Scale [71]	The Delirium Observation Screening Scale is an observational scale of verbal and nonverbal behaviour.	General, older people	Diagnosis	25 items, scores: 13 pro segment <3 no delirium ≥3 probable delirium
MMSE Mini-Mental State Examination [72]	The MMSE is a questionnaire that is used extensively in the clinical setting and is useful for detecting mild to severe cognitive impairment and dementia.	Older people	Diagnosis Outcome parameter	Cognitive impairment 21-24: mild 10-20: moderate ≤9: severe
Eating behaviour				
DEBQ Dutch Eating Behaviour Questionnaire [73]	The DEBQ measures eating styles that may contribute to or attenuate the development of overweight. It comprises three scales that measure emotional, external and restrained eating.	General	Diagnosis Outcome parameter	33 items and 3 subscales (Dutch version is available for clinical use. The English and other versions are only available for research purposes)
Fatigue				
BRAF MDQ Bristol Rheumatoid Arthritis Fatigue Multi-Dimensional Questionnaire [74]	The BRAF MDQ assess the overall experience and impact of rheumatoid arthritis fatigue (domains: physical fatigue, living with fatigue, cognitive fatigue and emotional fatigue).	Patients with rheumatoid arthritis	Diagnosis Outcome parameter	Self-reported 20 items (4 subscales), scores: 0-70 Higher scores reflect greater fatigue.
BRAF NRS Bristol Rheumatoid Arthritis Fatigue Numerical Rating Scales [74]	The BRAF NRS is a standardized numerical rating scales (NRS) for measuring a range of rheumatoid arthritis fatigue (domains: severity, effect on life, and coping ability).	Patients with rheumatoid arthritis	Diagnosis Outcome parameter	Self-reported NRS from 0 to 10 Higher scores reflect greater fatigue.
CFQ Chalder Fatigue Questionnaire [75]	The CFQ assess disabling fatigue severity in hospital and community populations. Covers physical fatigue (e.g. lack energy, feel weak, less muscle strength, need to rest), and mental fatigue (e.g., concentration, memory).	Hospitalized patients	Diagnosis Outcome parameter	Self-reported 11 items, scores: 0-33 Higher scores reflect greater fatigue.
CIS20R and CIS8R Checklist Individual Strength [76]	The CIS measures several aspects of fatigue in chronic fatigue syndrome (domains: subjective fatigue experience, concentration, motivation and levels).	General	Diagnosis Outcome parameter	Self-reported CIS8R: 8 items 27-35: heightened fatigue ≥35: severe fatigue
FSS Fatigue Severity Scale [77]	The FSS assess disabling fatigue in multiple sclerosis and systemic lupus erythematosus. The FSS covers physical, social, or cognitive effects of fatigue (e.g., function, work, motivation).	Patients with multiple sclerosis and systemic lupus erythematosus.	Diagnosis Outcome parameter	Self-reported 9 items, Likert-Scale Scores range from 1 to 7 with higher scores reflecting greater fatigue.

Table 4 (*continued*)

Questionnaires and instruments	Short description	Target group	Target	Practical application
FACIT-F Functional Assessment Chronic Illness Therapy (Fatigue) [78]	The FACIT-F measures fatigue in oncology patients with anaemia and is a stand-alone (or add-on) questionnaire in the cancer assessment (domains: physical fatigue, functional fatigue, emotional and social consequences of fatigue).	Patients with cancer und chronic disease	Diagnosis Outcome parameter	Self-reported 13 items, scores: 0-52 Higher scores reflecting less fatigue.
MAF Multi-Dimensional Assessment of Fatigue [79]	The MAF measures multiple dimensions of fatigue in adults with rheumatoid arthritis (domains: severity, distress, interference in activities of daily living and frequency and change during the previous week).	Patients with rheumatoid arthritis	Diagnosis Outcome parameter	Self-reported 15 items, scores: 1-50 A higher score represents greater fatigue severity, distress, or interference with activities of daily living.
MFI Multi-Dimensional Fatigue Inventory [80]	The MFI measures cancer fatigue using a multidimensional, short questionnaire, specifically without any somatic items (domains: general fatigue, physical fatigue, activity, motivation and mental fatigue).	Patients with cancer, healthy people who might be physically or cognitively tired	Diagnosis Outcome parameter	Self-reported 20 items (5 subscales) Scores: 4–20 with Higher scores reflect greater fatigue.
ProF Profile of Fatigue [81]	The ProF characterizes patterns of fatigue associated with primary Sjögren's syndrome. Contains somatic fatigue items for needing to rest, difficulty getting started, low stamina and weak muscles plus mental fatigue items for concentration and memory.	Patients with Sjögren's syndrome	Diagnosis Outcome parameter	Self-reported 16 items Scores for facets, domains, and total score all range from 0 to 7 with higher scores reflecting greater fatigue severity.
VAS Visual Analog Scales [82]	Fatigue VAS is a unidimensional measures aiming to capture an aspect of fatigue, typically severity or intensity. It comprises a 100-mm horizontal line, anchored by 2 statements representing extreme ends of a single fatigue continuum.	General	Diagnosis Outcome parameter	Self-reported Single–item scale, scores: 0–100 or 0-10 A higher score reflects greater fatigue.

against fatigue can also be part of dietetic intervention, e.g. increasing physical activity of the client [50,51] or increasing intake of anti-inflammatory nutrients. Another interesting trial pointed out that approximately 50% of patients with diagnosed chronic fatigue syndrome have food intolerances [52].

5. Discussion

Nutrition assessment is fundamental in process-driven personalized dietetic intervention and it seems obvious that assessing nutrition related behavioural components should be an integrated part of this. However, as we detailed above, assessment of behavioural components in personalized dietetic intervention might deserve more attention since it is associated with so much decreases in effect of dietetic interventions.

As exemplified in this paper we provide some starting points to grow awareness amongst dietitians about distracting factors in the behavioural field. Information on taking into account factors influencing behaviour which will alter the outcome of personalized dietetic intervention is limited, particularly by the quality of published studies. On the single study level, the study designs of the dietetic interventions are often inconsistently defined, information on the assessment of behavioural components are not available and studies vary greatly in duration and number of consultations. Therefore, meta-analyses summarize different kinds and qualities of dietetic intervention and that might contribute to the unsatisfying results. Even highly regarded Cochrane reviews do not provide minimal requirements to define dietetic interventions including the assessment of behavioural components. For example, the Cochrane review of Rees et al. [53] included all studies in which "dietary advice" comprised either verbal or written, single or multiple contacts with individuals or groups, and may be delivered by health professionals or other agencies such as fitness consultants, trade unions or commercial organizations.

Despite the poor results of the effectiveness of dietary advice in dietetic interventions, there is consistent evidence that successful change to more healthy diets improves health and reduces the risks for nutrition related diseases. A recent landmark paper in New England Journal of Medicine [54] associated changes in diet quality implemented between 1986 and 1998 with mortality during the succeeding 12 years (1998–2010) in about 75,000 US adults. A 20-percentile increase in diet quality is significantly associated with an 8–17% reduction in total mortality and a 7–15% risk reduction of cardiovascular death. However, the study did not account for relevant behavioural components. Sustained improvement of diet behaviour is only the second step. To reach this step, individuals must succeed in modifying their dietary behaviour. Dietetic intervention based on a detailed assessment of behavioural components is destined to enable and facilitate sustainable dietary modification.

The AND Workgroup on Nutrition Counselling performed a systematic review [16] to evaluate the evidence on behavioural change strategies used in dietetic intervention. The combined use of behavioural change theory and cognitive behavioural theory provided strong evidence to support the modification of dietary habits, body weight and cardiovascular/diabetes risk factors. On the other hand the review also showed no convincing evidence for using these theory [16]. Further well designed randomized controlled trials are needed to validate the effectiveness of the different models in dietetic interventions and to clarify which method should be used for the assessment of behaviour.

In summary, the IMPECD consortium emphasizes the role of behaviour and factors influencing behaviour in dietetic interventions. For further research and also in practice it is important to characterize intensively the patient by assessing behavioural components and thereby enable dietitians to join in with the clients' current status, helps to develop tailored treatment goals and dietary advices.

Beside dietitians also regulatory agencies and third-party payer, for example insurance companies are focused on outcomes. Outcome evaluation of dietetic intervention can be complicated because many factors may influence health outcomes [7]. When health outcomes are not as expected or desired, health care administrators are tasked with determining potential causes. Outcomes can be influenced by something done by the particular health care provider or by the way care is provided. Adding behaviour to nutrition assessment can not only assist to choose the optimal counselling model, it is also important to document baseline behavioural characteristics, which can serve as outcome indicators to prove the efficiency of dietetic interventions.

Up to now, the implementation of behavioural assessment is insufficiently considered and described in definitions and textbooks, even though benefits and positive health effects of the application of these tools are confirmed by numerous trials. Transparency is needed for which tools are mandatory and which are facultative. Our analysis showed that instructions on assessing behaviour aspects during nutrition assessment including ICF is still very limited.

The tools for clinical measure in nutrition assessment were largely developed by researchers in clinical nutrition and have many advantages for dietetic intervention. However, and in contrast to clinical nutrition, behavioural components are pivotal in dietetic intervention. An adequate consideration of the behavioural components might contribute to better study results. A high number of tools assessing behaviour are available but the appropriateness for the use of the methods in dietetic interventions is not shown. Further development of assessing factors influencing behaviour including defining the behaviour tools, validate and verify them for the dietetic use as well as education and training of dietitian is necessary to improve the dietetic interventions.

Taking into account that personalized dietetic interventions are designed with the intend of changing nutrition related behaviour and due to the shown importance of behavioural components further development of the assessment category behaviour and factors affecting behaviour is necessary. The definitions of nutrition assessment, especially the definition of the IMPECD consortium presented here, contains a dedication, a central statement, aim and principles as well as the operationalization. There is a great clearness on the kind of information needed for client history, diet history and clinical status. However, it is not clear nor documented what behavioural components are to be assessed by dietetic professionals.

Therefore, the next step should be to determine which components belong to the assessment of behaviour and which methods are the best to use. According to our search of literature important components of assessing behaviour are eating behaviour, motivation, nutrition literacy and health literacy competence as well as factors affecting behaviour as depression, fatigue, emotional distress and anxiety.

6. Conclusion

This opinion states that inclusion of behavioural components is of high importance in nutrition assessment in process-driven dietetic intervention to decrease resistance, provide new outcome indicators and to tailor the intervention to the individual needs of the client. To implement adequate communication strategies, psychological and social information received during dietetic assessment is indispensable.

Due to the steadily increasing cost pressure, effectiveness and efficiency of dietetic interventions to achieve positive health outcomes assessing behaviour components and factors influencing them is increasingly important for health care systems in Europe.

Conflicts of interest

None declared.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.clnesp.2019.03.017.

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