

Diagnostic in Obesity Comorbidities

Dissecting obesogenic behaviours: the development and application of a test battery for targeting prescription for weight loss

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Received 22 February 2007; revised 22 May 2007; accepted 24 May 2007

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Summary

There are limited practical tools to help clinicians or public health workers manage obesity in their patients. We have previously developed a scanning technique for diagnosing environments leading to obesity (Analysis Grid for Environments/Elements Leading to Obesity). Here we describe the development of a tool for identifying behaviours in an individual most likely to lead to obesity. A questionnaire battery of five tests called the DAB-Q (Diet, Activity and Behaviour Questionnaire) was developed, piloted and internally validated with overweight women from a commercial weight loss programme. Outcome from the tests, which are available free on the Internet, provides clinicians with a simple, effective and time-saving tool for ranking foods, drinks and activities likely to be most effectively targeted for weight loss in an individual. This is based on total scores derived from measures of frequency, potential for change and potency of each item as a potential contributor to overweight.

Keywords: Activity, diet, obesity, questionnaire.

obesity reviews (2007) **8**, 481–486

Introduction

Obesity is in pandemic proportions (1), with a number of serious chronic diseases attributable to it, but including a range of mechanical disorders that may hinder motivation to change (2). This makes permanent weight loss notoriously difficult to effect in a modern 'obesogenic' environment (3).

An epidemiological triad, comprising host, vector and environment, has been used as a model to deal with a range of epidemics from infectious diseases, to road traffic injury (4). More recently, it has been proposed for dealing with obesity (5). Specifically, a model was developed and trialed for dissecting one corner of the triad by diagnosing 'obesogenic' environments in a community (6). Analysis Grid for Environments/Elements Leading to Obesity (ANGELO) makes use of a diagnostic grid and scoring system based

on four environmental types (physical, economic, socio-cultural and political), and two environmental sizes (micro and macro). This provides a guideline for priorities for intervention to be identified and ranked. The model has been tested in a number of situations including a matrix developed for governments by WHO (7).

At the level of the individual or 'host', a number of national guidelines are available to help clinicians prescribe generic approaches to weight control (e.g. 8,9). However, there are limited clinical tools for specific assessment and prescription. The National Heart Forum's 'Lightening the Load' toolkit in the UK (<http://www.heartforum.uk/publications> – accessed 22 May 2007) provides a toolkit for heart disease prevention at the clinical and community levels, with anthropometric and other measures. Full texts such as that by St Jeor (10) provide available individual tests. To our knowledge, however, there is currently no

single, validated nutrition, activity and behaviour questionnaire that can be completed and scored online by individuals, and used for weight loss prescription by clinicians. Behavioural studies show that small early successes in weight loss are important for motivation (11), and that single, rather than multiple behavioural changes are more likely to be adhered to (12). A tool that allows clinicians to identify and prioritize the main potential problems for an individual would enable a lifestyle prescription to be customized for that individual, potentially increasing the chances of successful weight loss.

In this article, we describe a battery of tests available at no cost on the Internet and requiring around 20 min only completion time for assessing aspects of lifestyle likely to be adversely affecting body weight within a 'host', or overweight individual. We have used the principles from the ANGELO model with environments, to develop an approach for understanding *individual factors* leading to obesity. The aim was to develop an easily administered assessment tool for overweight and obese patients attending a clinical practice, to identify and rank the main modifiable causes of weight gain in order of significance and potential changeability, and to use this ranking to recommend achievable changes for long-term weight loss for that individual. Elements of this process, labelled the DAB-Q (for Diet, Activity and Behaviour Questionnaire), have been discussed elsewhere (13). The current article describes the development and validation of the process, and the context and proposed mechanism of its use in a clinical approach to obesity.

Rationale

Body weight is influenced by both changeable (e.g. nutrition, physical activity) and unchangeable factors (e.g. genetics, gender, age and ethnic background). Clinical weight loss prescription need only consider the former (while recognizing the importance of the latter). Changeable factors relate primarily to volitional factors associated with energy balance, which can be categorized into (i) energy intake and (ii) physical activity. Within each of these, a positive energy balance can be created by either (i) an excess, or (ii) an insufficiency of factors influencing intake or expenditure. Hence, excess high energy-dense, and insufficient low energy-dense food or drink, could cause a tilt towards positive energy balance through energy intake, whereas excess TV viewing and insufficient leisure time activity could do the same through reduced energy expenditure.

A number of factors within both diet and exercise, contribute to weight gain in an individual. For example, excessive portion size and high energy-dense foods or drink can contribute to the calorific volume of energy intake (14),

while lack of time or motivation, laziness or injury may be reasons for insufficient energy expenditure (15).

Within these broad factors, there are a number of specific factors that may influence an individual. Within food types for example, it could be presumed that some individuals might tend to favour particular foods, such as sweets, French fries, ice cream or savories; or consume too much high-energy soft drink or fruit juice. Lack of physical activity may also be due to any one or more of a number of factors such as too much sedentary time, having a sedentary job, or spending too much leisure time watching TV (15).

In addition, certain maladaptive behaviours including binge eating, eating for reasons other than hunger, and habitual dieting can exert a compounding effect on body weight (16). These need to be identified to 'flag' for a clinician additional attention that may be required for an individual.

Identifying and prioritizing specific factors influencing body weight in an individual would enable a lifestyle prescription to be customized for that individual. Evidence suggests that individual approaches, targeted in this way, offer more prospect for successful weight loss and metabolic control than broader generic prescriptions (17). Behaviourally, there is also logic in selecting a limited number of manageable changes early in a behaviour change programme. Concentrating on changing consumption of one, two or three foods and/or activities might lead to a weight loss sufficient to then motivate the patient to proceed with other, more potentially difficult, dietary changes.

Methods

Key issues of concern for food and activity items identified as potentially 'obesogenic' within an individual are (i) frequency of occurrence of consumption or activity; (ii) the amount of food or drink consumed, or energy expended when an activity is carried out; (iii) the potential changeability of a behaviour; and (iv) the potency of a food, drink or activity as a cause of weight gain.

A grid can therefore be devised with a 2×2 matrix of cause (energy intake; energy expenditure) by extent (excess; insufficient) and with frequency (F), potential changeability (C) and potency (P) scores providing a total (T) score for each item as shown in Table 1 below.

To fill out the grid, a battery of four questionnaires was developed to measure the following in an individual:

1. *Test 1*: Foods/drinks consumed in excess and likely to assist weight loss if reduced (quadrant 'a' in Table 1).
2. *Test 2*: Foods/drinks that may assist weight loss if consumed more i.e. by reducing intake of more higher energy foods (quadrant 'b').

Table 1 Sample 'obesogenic' behaviour grid

Extent	Cause								
	Energy intake				Energy expenditure				
	F	C	P	T	F	C	P	T	
Excess	a				c				
Insufficient	b				d				

3. *Test 3*: Activities not carried out sufficiently and likely to assist weight gain if increased (quadrant 'c').

4. *Test 4*: (Passive) activities carried out in excess and likely to support weight loss if decreased (quadrant 'd').

A fifth questionnaire (*Test 5*) was designed to measure eating-related behaviours (e.g. binge, social, night eating, etc.) supporting weight gain. This was meant to signal external factors influencing quadrants of the above grid.

Each item in each of the first four tests described above was designated a quantity (e.g. 'nuts; one small handful') to maintain consistency of responses and eliminate potential discrepancies. Quantities were pre-assigned for the nutrition and physical activity questionnaires as those representing a standard amount of one serving or activity. Eating-related behaviours in questionnaire 5 were not quantified as these vary individually and the main purpose in posing these questions was to identify the behaviour so appropriate support could be offered. Determination of the questionnaire contents and determination of the quantities of the nutrition and physical activity questionnaires is described below.

Selection of questionnaire contents and determination of item quantities

For each questionnaire, an initial collection of items was derived through a review of the current literature, from pre-existing questionnaires (10), and from the contributions of clinical members of the Australian Society for the Study of Obesity circulated the draft questionnaires for comment.

Energy intake questionnaires

Food and beverage items likely to contribute to weight increase were initially drawn from the validated 'Short Fat Questionnaire' developed by Dobson *et al.* (18). Additional items were selected from a list of energy-dense foods/drinks that are frequently consumed in the Australian diet (19). Eighteen items were selected for this category. Quantification of the foods/drinks was based on portion sizes defined by the Dietary Guidelines for Australian Adults

(20) as food/drink items to 'choose sometimes, or in small amounts'. Food items and quantities in questionnaire 2 were also based on the recommendations outlined in the study by National Health and Medical Research Council (20) as those low in energy, fat and sugar, and high in fibre. Eight nutritional items, selected on the basis of 'bulk' and/or low energy density, were selected for this category.

Energy expenditure questionnaires

Activities included in the energy expenditure questionnaires were based on the amount of energy that each requires and their popularity among Australian adults (21). Activities were divided into those that would assist weight loss (e.g. walking, labouring, etc.) and passive activities likely to promote weight gain, if carried out in excess (e.g. TV viewing, driving, etc.). Six activities were selected for the energy-expenditure questionnaire and seven popular passive activities were selected for the energy-conserving questionnaire. Quantification of activities was based on current recommendations offered through the National Physical Activity Guidelines (22).

Eating behaviour questionnaire (Test 5)

This test is meant to 'flag' specific behavioural problems relating to obesity to a clinician. Items included in the questionnaire were selected from pre-validated questionnaires (17) and from eating behaviours contributing to weight gain as reported in the literature (16). Fifteen items were originally selected in this category and these are assessed for frequency and potential changeability only.

Selection of response categories and scoring system

Three different response categories, and a total score comprised of the product of these, are used for each item of the questionnaire. Each is described below:

Frequency (F)

Frequency (F) is measured for all test items using a 5-point Likert scale. Frequency of foods/drinks, activities or eating-related behaviours likely to promote weight gain are scaled from 0 (rarely or never) to 5 (daily) in Tests 1, 2 and 5. Frequency of foods/drinks or activities supporting a healthy weight is scaled from 5 (rarely or never) to 0 (daily) in Tests 2 and 4. To prevent confusion, however, scores are kept consistent (i.e. 0 = rarely or never) for the patient, but reversed in computer calculations.

Changeability (C)

Changeability scores are also determined using a 5-point Likert scale. Changeability scores are designed to determine the likelihood of an individual being able to modify that

aspect of his or her lifestyle. Scores range from 0 (extremely difficult/impossible to change) to 5 (very easy to change) in all questionnaires.

Potency (P)

A 4-point 'potency' (P) score is assigned to each item in the first four questionnaires to objectify the potential contribution of each item to potential weight gain or loss. Potency scores for the nutrition questionnaires are based on energy density (23). Food items that are 16.8 kJ (4 kcal g⁻¹) or more, and fluids more than 1.5 kJ (0.36 kcal) mL⁻¹, based on a conservative interpretation of cut-offs (24) are scored as 4 points. Foods less than 4 kilocalories per gram are scored as the exact calories per gram rounded to the nearest 0.5. Energy in drinks is similarly scaled to reflect points within the 4-point scale. Potency scores for physical activity items are based on their contribution to energy expenditure as determined from energy expenditure data (25). Items are scaled from 0 to 4 according to the amount of energy normally expended carrying out that activity. Those exerting the most energy are scored as a 4 while those exerting less are scored based on a scaling of activities relative to this and greater than resting metabolic rate.

Total Scores (T)

The total scores (T) for each item are determined by multiplying the frequency, changeability and potency scores to

give a total score from 0 to 100. Quantification in this manner allows for a ranking of items with the highest total scores representing those items likely to be contributing most to body weight, and easiest to modify for that individual. The advantage of using a Likert scale with a zero score is that in multiplication of totals, those scoring a zero either are not contributing significantly to weight gain or are extremely difficult for the individual to change and are eliminated from the final ranking.

Results

A sample of questions and response categories is shown in Table 2.

After pilot testing with nutrition students, and testing with a sample of 30 overweight or obese women presenting to a commercial weight control clinic, internal validity tests using a test-retest procedure of asking questions in a different way were carried out. A concordance criterion of 50% or more was used to discard questions where answers were not similar. This resulted in only one item being eliminated from the questionnaires.

An example of a test outcome is shown in Table 3.

Scores for all items above an arbitrary cut-off of 25 are ranked and displayed for each questionnaire within the test battery. Test 1 (Nutrition part A) quantifies scores for nutritional items consumed in excess by this patient. In consul-

Select one option in each of the categories F (frequency) and C (changeability) according to the key below:

Key:

<p>F How often do you eat or drink each of the following foods or drinks?</p> <p>0 Rarely or never</p> <p>1 Occasionally (2-3 times per month)</p> <p>2 Sometimes (1-3 times per week)</p> <p>3 Moderately (4-6 times per week)</p> <p>4 Daily</p> <p>5 More than once a day</p>	<p>C If you ever do consume that food or drink, how difficult would you find it to significantly <i>reduce</i> eating or drinking it (e.g. by at least 50%)?</p> <p>0 Very easy</p> <p>1 Easy</p> <p>2 In between</p> <p>3 Difficult</p> <p>4 Very difficult</p> <p>5 More than once a day</p>
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Table 2 Sample DAB-Q questions and response categories

Nutrition: Part A

	F					C						
	0	1	2	3	4	5	0	1	2	3	4	5
Pastries or croissants or muffins or doughnuts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Regular (non-diet) soft drink or cordial – one can soft drink or two small glasses cordial or more	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fast-food or take-away meals (e.g. McDonald's, KFC, Pizza, Thai, Indian, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

DAB-Q, Diet, Activity and Behaviour Questionnaire.

Table 3 Sample DAB-Q-test outcome and recommendations

Recommendations based on questionnaire responses	Score (0–100)
Try to eat/drink <i>less</i> of those foods with the highest scores shown here	
Sausages, salami, bacon, meat pies or hamburgers	64
Butter, margarine, mayonnaise, peanut butter or chocolate/hazelnut spread	48
Fruit juice	48
Chocolate, chocolate biscuits, sweet snack bars, etc.	36
Try to eat <i>more</i> of those foods with the highest scores shown here	
Fruit	60
Beans/peas/lentils	27
Water or diet soft drink	24
Try to do <i>less</i> of those activities with the highest scores shown here	
Watch TV or videos for about 3 h a day or more	48
Get other people to do active things for you (like carry things, shop, mow the lawn)	24
Use a computer for at least 2 h a day (not work-related)	24
Try to do more of those activities with the highest scores here	
Walk for exercise for a minimum of 30 min	32
Become involved in active play (i.e. football, sport, active games) with your family or friends	30
Jog, swim, cycle, paddle or do something moderately vigorous to make you puff or sweat for at least 30 min	28
Eating behaviour rank	
Binge eating	1
Social eating	2

DAB-Q, Diet, Activity and Behaviour Questionnaire.

tation with the clinician, the patient might select the top two or three of these (processed meats, spreads, fruit juice) to initially try to reduce (by at least a set amount e.g. 50%). Eliminating these items from the diet altogether might be the ultimate goal, but this is more likely to be effected slowly, hence a suggested decrease of 50%. From Test 2 (Nutrition part B), the patient might be encouraged to increase consumption of fruit, certain vegetables and water to increase satiety and reduce total calorie intake. Similarly with Tests 3 and 4 (Physical activity parts A and B), the patient could be encouraged to decrease television viewing time or passive activity using a computer, and increase daily walking or playing active games.

Because all tests have been scored on changeability – as rated by the patient – as well as potency – as rated by objective scores of energy density or energy use – those items scoring highest are likely not only to be easiest to change, but also to yield the most benefit from change.

Scoring on the eating behaviour questionnaire (Test 5) provides a flag for the clinician to determine whether more detailed intervention may be required. In the case presented here, binge eating and social eating are identified as possible influencing factors encouraging over-consumption. Referral to an eating disorder specialist might be appropriate for the former, while education on food selection in social situations might be useful for the latter. Treatment of these behaviours can occur concurrently with prescription to modify energy consumption and expenditure factors identified from nutrition and activity components of the questionnaire.

Discussion

The current article describes the development and internal validation of a simple, convenient, online test battery for identifying and prioritizing the main nutritional and physical activity factors influencing obesity in an individual or 'host'. This provides an aid to help reduce a clinician's diagnostic time for providing specific prescription advice on weight loss to individual patients.

While it is well known that successful weight control usually involves more than simple direction to change diet or exercise, an understanding of those components of diet or exercise likely to be contributing most to the problem is a vital component of treatment. The DAB-Q test battery provides support at the clinical level for the broader public health approach offered through the ANGELO framework, which is currently being widely tested in obesity prevention programmes in a range of different situations.

To facilitate research and use at the clinical level, the DAB-Q questionnaires are available at no cost to clinicians and researchers through an Internet URL (<http://www.professortrim.com/DAB-Q>) prescribed on an 'exploding card' for a patient by a clinician with an explanatory brochure provided to the clinician. The questionnaires are completed on the web site by the patient in his or her own time and the print-out results brought back for a second consultation with the clinician. This provides an objective direction for prescription with considerable time and effort saving. It should be noted, however, that while internal validity of the DAB-Q has been tested here,

external validity, testing potential predictive value of the tool, remains to be carried out. Items selected for each of the tests used are essentially Australian/English and may need to be modified for use in different cultures. Similarly, separate items could be developed for use in children and adolescents.

The DAB-Q, used here to select and manage individual factors leading to obesity, represents a second phase of a broader approach to obesity incorporating the three corners of an epidemiological triad for managing epidemics. An ANGELO framework for diagnosing environments has been described elsewhere (6), and is evolving through testing in a variety of situations (7). Other approaches to managing both the environment and the host can be encompassed under these two frameworks and opportunities exist for further research here. Attempts are also currently being made to diagnose and develop tools for dealing with issues associated with the third corner of the triad, that dealing with vectors and agents. This offers significant prospects in terms of technological changes (e.g. switches in pedometers to turn off children's TV if activity levels have not been reached; reduced energy density in foods, energy driven children's games, etc.). While not purporting to be a solution to the obesity epidemic, this approach encourages the development a number of 'tools' within a global approach to the problem.

Conflict of Interest Statement

No conflict of interest was declared.

Acknowledgement

The study was funded by Dairy Australia.

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