Curriculum Matters
Учебно съдържание, планове, програми и стандарти

ATTITUDES TOWARDS SIGNIFICANCE OF HEALTHY BODY WEIGHT AND ADIPOSE TISSUE FUNCTIONS AMONG BIOLOGY STUDENTS

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Abstract. Education plays an essential role in awareness and prevention of unhealthy lifestyles associated with body weight changes. The present survey aims: (1) to estimate the knowledge of causes and consequences of under/overweight among biology students and (2) to state their knowledge of beneficial functions of adipose tissue and their ability to define adipose tissue types in human body. The survey was carried out at Shumen University (Bulgaria). The biology students during their first semester at university, after their first year of education and master's degree were interviewed. The participants were asked: (1) to classify (rate 1 – 5) causes of under/overweight: disorders of digestive system, endocrine system disorders, psychological problems, stress, physical activity; (2) to describe the known by them health risks associated with being under/overweight; (3) to state their knowledge of any beneficial functions of adipose tissue; (4) to define adipose tissue types in human organism. Stress was considered as a main cause of underweight (37.35%) and lack of physical activity – as a main reason of overweight (31.93%). A small proportion of students (22.29%) was able to describe some negative consequences of reduced body weight, and 45.78% described some obesity-linked diseases. More than a half (57.23%) of respondents had a poor knowledge of significance of white adipose tissue. Only 10.24% of the respondents were able to distinguish white and brown types of adipose tissue, and a single student depicted beige adipocytes. A disturbing lack of sufficient knowledge of importance of healthy body weight among biology students was revealed. High school and university biology programs should be aimed at linking scientific knowledge with health consequences. The impact of level of education must be noticed.

Keywords: healthy body weight, adipose tissue, underweight, overweight

Introduction

Maintaining a healthy weight is important for general health. Education plays an essential role in awareness and prevention of unhealthy lifestyles associated

with body weight changes (Bugeja, 2007; Naghshizadian et al., 2014;Sidiropoulos, 2007). Changes in body weight affect mainly the amount of adipose tissue. This underlines the necessity of knowledge of adipose tissue functions. Nowadays adipose tissue is recognized as metabolite and endocrine organ that influences the function of nearly all other organ systems (Rutkowski et al., 2015). There are two types of adipose tissue – white and brown. White adipose tissue (WAT) serves as a fuel storage depot and produced variety of bioactive substances – adipokines.The main function of brown adipose tissue (BAT) is to generate heat (Enerback, 2009; Klingenspor, 2003). BAT in humans was thought to only exist in the newborn, but current studies discovered brown fat in adult humans (Cypesset al., 2009; Virtanen et al., 2009). Recently a third type of adipocytes (beige/bright adipocytes) has been established. These adipocytes resemble white adipocyte but upon activation transform into adipocytes similar to brown fat (Jespersen et al., 2013; Petrovic et al., 2010; Wu et al., 2012).

Specific knowledge of benefits of adipose tissue determines the attitudes towards significance of healthy weight. The amount of white adipose mass should be kept at a proper level (Feng et al., 2013). Body weight is determined by food intake and energy expenditure, regulated by complex neural and endocrine signals (Lenard & Berthoud, 2008). Changes in body weight can be caused by variety of physical and psychological factors (Collins&Bentz, 2009; Marti et al., 2004; Rosenbaum & Leibel, 1998). Physical factors of under/overweight include genetics and illness. Due to genetics, some people have higher or lower metabolic rates than others. Many illnesses can cause temporary weight loss: digestive system disorders, hyperthyroidism, diabetes, cancer, tuberculosis and AIDS. Similarly, some hormone problems may cause overweight, such as hypothyroidism, Cushing's syndrome and polycystic ovarian syndrome. Excessive stress also can be a reason for reduced appetite or for over-nutrition. Psychological causes of body weight changes include eating disorders and depression. Recently eating disorders have been recognised as a significant public health issue (Bailey et al., 2014; Brichard et al., 2003; El Ghoch et al., 2014). These conditions typically involve starvation and binge eating behaviors. Eating disorders include anorexia, bulimia and binge. Anorexia is characterized by self-starvation and excessive weight loss. Bulimia includes eating excessive amounts of food, then getting rid of the food through vomiting, laxative abuse or over-exercising. Binge eating disorderis characterized primarily by periods of uncontrolled continuous eating. Eating disorders often lead to dramatic changes in body weight and adipose tissue amount. There is a trend of increasing rate of eating disorders in Bulgaria (Kalibatseva & Smolak, 2013). The international data show that 75% of anorexia nervosa and bulimia nervosa cases and 50% of binge eating disorder onset before the age of 22 (Bailey et al., 2014).

Attitudes towards significance of healthy weight depend also on information about its impact on human health. The health consequences of both being underweight and overweight could be severe (Popova & Popova, 2010).[1] Underweight-may contribute to altered hematopoiesis and immunity. People who are underweight also have low muscle mass, endocrine system problems and hair loss. The vital nutrients deficiency leads to increased risk of osteoporosis and anemia. Obesity is involved in the pathogenesis of diabetes, hypertension, hyperlipidemia, stroke, heart disease, respiratory problems, osteoarthritis and several types of cancers.

The above mentioned health impact of normal weight underlines the importance of the present survey. It aims: (1) to estimate the knowledge of causes and consequences of being underweight or overweight among biology students and (2) to state their knowledge of beneficial functions of adipose tissue and their ability to define adipose tissue types in human body.

Materials and методs

Interview

This survey was carried out at Shumen University (Bulgaria). The interviewed biology bachelor students were chosen according to the level of education – students after high school (during their first semesterat university) and students after their first year of study. Master's degree students were also involved in the survey.

As a first step of the study, the demographic characteristics of the students who accepted to participate in the interview were determined. The second part of the questionnaire included questions on their knowledge of causes and consequences of being underweight or overweight. The participants were asked: (1) to classify (rate 1 – 5) causes of under/overweight: disorders of digestive system, endocrine system disorders, psychological problems, stress, physical activity; (2) to describe the known by them health risks associated with being under/overweight; (3) to state their knowledge of any beneficial functions of adipose tissue; (4) to define adipose tissue types in human organism.

Education of interviewers

The researchers and ecology students (Faculty of Natural Sciences, University of Shumen, Bulgaria) performed the survey. The students were trained to conduct a survey. They were acquainted with: the stages of the study, the questions in the questionnaire, the tasks and responsibilities of interviewers, the tasks and responsibilities of the controller and the protocol survey. A pilot study was carried out with 15 respondents in order to improve the questionnaire: abstruse questions were edited, arrangement of questions was changed, the number of possible answers was improved. The interviewers were able to explain issues which are unclear to some respondents.

Check for logic errors

Data from each questionnaire were checked for inconsistencies. Questionnaires containing logical errors were excluded from the study.

Statistical analisys

A descriptive statistic procedure like percentage and frequency distribution were employed for data analysis. The chi-square test was used to compare different groups of data. Moreover, simple linear (Pearson correlation) coefficient test is calculated to determine the correlation between answers and demographic features of the informants. Depending on the values of the Pearson's contingency coefficient (r) the following types of correlation were differentiated: r =0 lack of correlation, 0 <r≤ 0.3 weak correlation,0.3 <r≤ 0.5 moderate correlation, 0.5 <r≤ 0.7 significant correlation,0.7 <r≤ 0.9 strong correlation,0.9 <r< 1 very strong correlation, r = 1 means functional dependence.

Results and discussion

Table 1 reveals the socio-demographic characteristics of interviewed students. A total of 166 respondents were included in this study. The mean age of the sampled respondents was 22.74 years. Students aged 18-25 years constituted the majority (80.72%). The distribution of male and female respondents was respectively 24.10% and 75.90%. Respondents represent three levels of education: 1) bachelor students after high school (during the first semester at university) (42.77%); 2) bachelor students after the first year of study at university (46.39%) and 3) master`s degree students (10.84%).

Tables 2 and 3 summarize the attitudes of the respondents towards the major causes for being under/overweight.

Table 1. Socio-demographic characteristics
of interviewed students (n=166)

Socio-demographic characteristics	Number	Percent
Age (years)		
18-25	134	80.72
More than 25	32	19.28
Mean age (SD)	22.74 (4.90)	
Gender		

Female	126	75.90
Male	40	24.10
Level of education		
After high school	71	42.77
After first year at university	77	46.39
Master`s degree students	18	10.84
Place of residence		
Urban area	115	69.28
Rural area	42	25.30

Table 2. Respondents` attitudes towards different causes
of being underweight

Cause for being underweight	Rate (%)				
	1	2	3	4	5
Digestive system disorders	27.11	23.49	23.49	18.07	7.83
Endocrine system disorders	9.04	21.08	18.67	27.71	23.49
Mental (psychiatric) disorders	15.66	21.08	21.69	24.70	16.87
Stress	37.35	29.52	22.89	5.42	4.82
Physical activity	9.64	6.02	13.86	24.10	46.39

Digestive and endocrine systems disorders

Among the most widely known by respondents causes for underweight were digestive disorders (27.11%). The same cause was stated as a major reason leading to obesity by 20.48% of students. Endocrine system disorders were also often reported (22.29%) as a possible cause for overweight. Surprisingly, only 9.04% considered hormonal problems as possible cause for underweight. The attitude towards digestive and endocrine diseases as causes of weight changes is of importance because these conditions must be treated by medical specialists. Digestive disorders are defined as conditions that affect the esophagus, stomach, gallbladder, bile ducts, small intestine and large intestine. These disorders often cause poor digestion and/or absorption of nutrients.

Several endocrine system disorders can cause for being under/overweight, the most important is thyroid function. Hyperthyroidism is a cause for weight loss and hypothyroidism – for weight gain (Fox et al., 2008; Milionis & Milionis, 2013).

Table 3. Respondents` attitudes towards different causes of being overweight

Cause for being overweight	Rate (%)				
	1	2	3	4	5
Digestive system disorders	20.48	18.67	23.49	18.67	18.67
Endocrine system disorders	22.29	30.12	12.65	16.27	18.67
Mental (psychiatric) disorders	6.63	8.43	24.70	26.51	33.73
Stress	18.07	18.67	21.69	28.31	13.25
Physical activity	31.93	24.70	17.47	10.84	15.06

Mental (*psychiatric*) *disorders*

These disorders were pointed by 15.66% of respondents as a major cause of underweight and only by 6.63% – of overweight. In other countries eating disorders are recognised as a significant public health issue (Mathews et al., 2011). These conditions often develop during young adulthood, and the information is important for their prevention. Moreover, in these cases, advice from a psychologist should be sought in addition to medical specialists. Obviously, prevention strategies across the eating disorders were not enough in Bulgaria. In present study mental disorders were associated mainly with weight loss conditions. According to Popova & Popova (2010) anorexia nervosais a problem of more than 200 000 adolescents in Bulgaria. Another psychological cause of underweight is depression. Individuals suffering from depression often present with a reduced appetite and rapid weight loss. On the other hand, the results reveal a poor knowledge on binge eating. As can be seen from Table 3, 33.73% of respondents considered psychiatric disturbances as *rate 5* for obesity. This confirmed the statement (Bailey et al., 2014) that mainly bulimia nervosa and anorexia nervosa receive attention in the literature. Really, binge-eating disorder is a relatively new-described condition.[2] Recently different studies highlight the importance of considering binge-eating symptoms in treatment of people suffering from obesity (Decaluwé& Braet, 2003; Iacovino et al., 2012).

Stress

A large proportion of the students (37.35%) pointed as a main cause of underweight stress. It is well-known that many people under stress experience weight loss – anxiety can lead to a loss of appetite and digestive problems. Data analysis reveal some impact of level of education on this statement: majority of the students belongs to group just finished high school (Table 4). This data reveal a lack of enough information in high school programs about other important reasons leading to waste of body weight.

Table 4. Cross-relationships between the demographic variables and the statementthat stress is the major cause of underweight

	Rate 1	Rate 2	Rate 3	Rate 4	Rate 5	(blank)	total
	number (%)	number (%)	number (%)	number (%)	number (%)	number (%)	number (%)
Gender							
male	16 (40.00)	14 (35.00)	6 (15.00)	3 (7.50)	1 (2.50)	0 (0.00)	40 (100.00)
female	46 (36.51)	35 (27.78)	32 (25.40)	6 (4.76)	7 (5.56)	0 (0.00)	126 (100.00)
(no answer)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
	r = 0.17; SD – NS						
Place of residence							
urban area	41 (35.65)	33 (28.70)	28 (24.35)	7 (6.09)	6 (5.22)	0 (0.00)	115 (100.00)
rural area	19 (45.24)	11 (26.19)	9 (21.43)	1 (2.38)	2 (4.76)	0 (0.00)	42 (100.00)
(no answer)	2 (22.22)	5 (55.56)	1 (11.11)	1 (11.11)	0 (0.00)	0 (0.00)	9 (100.00)
	r = 0.22; SD – NS						
Level of education							
after high school	33 (46.48)	13 (18.31)	15 (21.13)	5 (7.04)	5 (7.04)	0 (0.00)	71 (100.00)
after first year at university	23 (29.87)	31 (40.26)	17 (22.08)	3 (3.90)	3 (3.90)	0 (0.00)	77 (100.00)

master`s degree students	6 (33.33)	5 (27.78)	6 (33.33)	1 (5.56)	0 (0.00)	0 (0.00)	18 (100.00)
	r = 0.30; SD – S						
total	62 (37.35)	49 (29.52)	38 (22.89)	9 (5.42)	8 (4.82)	0 (0.00)	166 (100.00)

SD – Statistical difference between expected and observed frequencies: NS – Non Significant; S – Significant;

r – Pearson`s contingency coefficient: 0 <r< 0.3 weak correlation,0.3 <r< 0.5 moderate correlation

On the other hand, only 18.07% declared stress as a cause for obesity. Obviously, excessive stress not always comes to mind when considering overweight. These results disclose that student`s specific knowledge on stress-related events in human body is not connected with health consequences. It must be noticed that epidemiological studies have found that stress can cause not only weight gain, but also can increase the amount of central body fat. Central body fat accumulation (greater visceral fat) is related to elevated secretion of the key stress-hormone – cortisol (Moyer et al., 1994; Epel et al., 2000). Knowledge of stress-related body changes is of importance since in addition to excess weight, body shape is an important marker of increased health-risk. There is evidence that being lean and having greater central fat is an unhealthy profile (Larsson et al., 1984).

Physical activity
Excessive or limited exercise also could lead to changes in body weight. Body weight is determined by food intake and energy expenditure (Lenard &Berthoud, 2008). The large proportion of respondents (31.93%) considered limited physical activity as a main reason leading to obesity. A possible explanation is a widespread statement that restricted physical activity can lead to overweight. It is well known that physical activity represents an important behavior that can modify body weight. Moreover, it can contribute to reduce numerous chronic health conditions (Jakicic & Otto, 2005). Demographic variables had no significant impact on this statement (Table 5).

On the other hand, physical activity was considered as a main reason for body weight waste only by 9.64% of students. It must be noticed that majority of students (46.39%) listed physical activity as a *rate 5* for underweight. The lack of information regarding this item could be dangerous: recent studies have revealed that young people sometimes perform exhaustive exercises because of the potential performance benefits of lean body mass. Trainers and their athletes should consider that the excessive loss of body mass also has

negative health impact (Berning & Steen, 1998). For this reason, the American Academy of Pediatrics published a general weight control practice guide for children and adolescents involved in all sports.[3] Safe weight loss strategies for participants in all sports and physical activities was recommended also by National Athletic Trainers' Association (NATA) (Turocy et al., 2011).

Table 5. Cross-relationships between the demographic variables and the statement that physical activity is the major cause of overweight

	Rate 1	Rate 2	Rate 3	Rate 4	Rate 5	(blank)	total
	number (%)	number (%)	number (%)	number (%)	number (%)	number (%)	number (%)
Gender							
male	18 (45.00)	8 (20.00)	4 (10.00)	6 (15.00)	4 (10.00)	0 (0.00)	40 (100.00)
female	35 (27.78)	33 (26.19)	25 (19.84)	12 (9.52)	21 (16.67)	0 (0.00)	126 (100.00)
	r = 0.24; SD – S						
Place of residence							
urban area	36 (31.30)	28 (24.35)	21 (18.26)	13 (11.30)	17 (14.78)	0 (0.00)	115 (100.00)
rural area	16 (38.10)	11 (26.19)	7 (16.67)	4 (9.52)	4 (9.52)	0 (0.00)	42 (100.00)
no mentioned	1 (11.11)	2 (22.22)	1 (11.11)	1 (11.11)	4 (44.44)	0 (0.00)	9 (100.00)
	r = 0.25; SD – NS						
Level of education							
after high school	23 (32.39)	16 (22.54)	12 (16.90)	11 (15.49)	9 (12.68)	0 (0.00)	71 (100.00)
after first year at university	28 (35.36)	20 (25.97)	12 (15.58)	5 (6.49)	12 (15.58)	0 (0.00)	77 (100.00)
master`s degree students	2 (11.11)	5 (27.78)	5 (27.78)	2 (11.11)	4 (22.22)	0 (0.00)	18 (100.00)
	r = 0.25; SD – NS						
total	53 (31.93)	41 (24.70)	29 (17.47)	18 (10.84)	25 (15.06)	0 (0.00)	166 (100.00)

SD – Statistical difference between expected and observed frequencies: NS – Non Significant; S – Significant; r – Pearson`s contingency coefficient: $0 < r < 0.3$ weak correlation

Another purpose of this survey was the disclosure of attitudes towards health consequences of body weight changes. Adipose tissue plays important roles in regulating whole body homeostasis (Wang, 2014). So, the knowledge how body weight changes influences health is of great importance. In present study only a small proportion of the students declare knowledge about any health risks associated with being under/overweight. As can be seen from Fig. 1, ability to depict some negative health consequences is associated with the level of education of students.

Only 22.29% of all students were able to describe some negative consequences of reduced body weight. Best known by respondents was impaired immune system. This observation discloses the necessity to ensure adequate information about health disturbances linked with underweight. It must be noticed that reduced body weight is a global health problem with a tendency of gradually increasing in the last decades not only in developing, but also in developed countries (Popova & Popova, 2010).
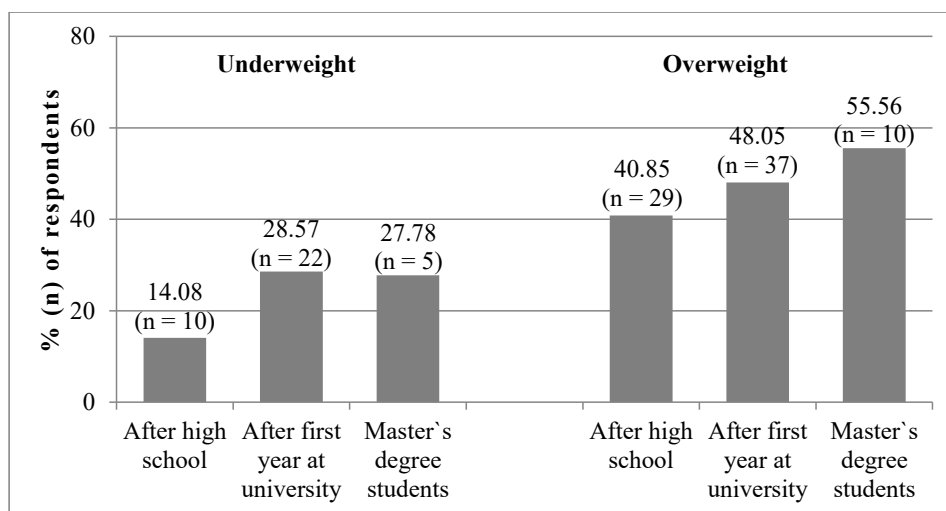

Fig. 1. Distribution of respondents,depicted some negative
health consequences of underweight and overweight,
in accordance with level of education; n – number

Students are more familiar with health risks of overweight – 45.78% described some obesity-linked diseases. A possible explanation is that nowadays obesity is widely discussed global problem. Obesity affects negatively almost all aspects of health (Guh et al., 2009; Rocha &Libby, 2009). In present study majority of students were able to describe its effects on cardiovascular system: high levels of cholesterol and high blood pressure were mentioned as known risk factors for heart diseases and stroke. The link between diabetes and obesity was also stated.

Body weight changes are associated mainly with the amount of adipose tissue. So, a matter of interest is the evaluation of the information about beneficial functions of white adipose tissue. The results of present survey reveal a lack of knowledge on significance of adipose tissue for human health among the larger proportion of students (Fig. 2). More than a half (57.23%) of respondents had a poor knowledge of significance of WAT (answers "No" and "I don`t know"). Positive answer was given by 40.36% of the respondents, but only 25.30% had a good knowledge and were able to represent some beneficial functions. The traditional role attributed to adipose tissue as energy storage was mostly quoted. The second known function was the action as a thermal insulator, helping to maintain body temperature. Adipose tissue functions as a cushion against trauma for the organs were also mentioned by some students.
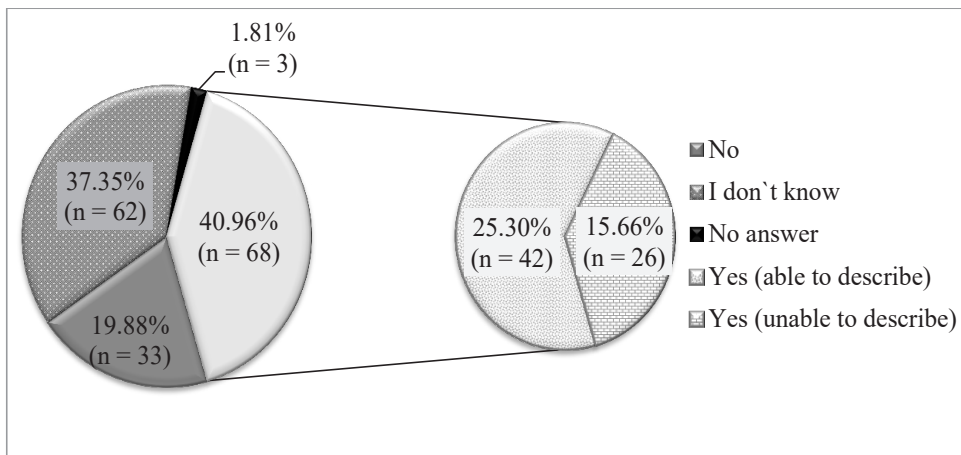

Fig. 2. Answers to the question
"Do you know any beneficial functionsof
white adipose tissue"; n – number

Level of education determined the knowledge of students of beneficial functions of white adipose tissue to a great degree. The benefits of adipose tissue were represented by 16.90% of students during the first semester at university, by 33.77% of students after the first year at university and by 22.22% of master`s degree students. No one student signified that adipose tissue is an important endocrine organ. It must be noticed that recently in scientific literature impact of changes in adipokynes plasma levels on human health has been widely discussed: obviously this information is not obtainable to the respondents.

In present study respondents were asked to define the type of adipocytes. This specific knowledge of adipose tissue was also very poor: 10.24% of the respondents were able to distinguish two types of adipose tissue – white and brown. Additionally, a single student depicted three types of adipose tissue – white, brown and beige. The analysis revealed an impact of the level of education: students able to describe adipocytes types were respectively 5.63% of students during the first semester at university, 15.58% of students after the first year at university and 11.11% of master`s degree students.

The above mentioned reveals that adequate depiction of adipose tissue functional role should be included in high school and university education programs. Anatomy and physiology reveal possibility for representation of adipose tissue with special accentuate on its significance of healthy weight. Moreover, recently obesity has been discussed in genetic studies as "multifactorial phenotype; inter-individual variation in such phenotypes is thought to result from the action of multiple genes and environmental factors" (Kim et al., 2014). According the same authors, understanding of genes-environmental interaction could give opportunity to be developed preventive health strategies for high-risk population subgroups. From this point of view, healthy weight could be discussed also in the course of genetics. Cell biology also is a useful tool to discuss the fundamental mechanisms of this important problem in modern society. Additional tool for edication are massmedia – informative campaigns could contribute to knowledge of young people on healthy lifstyle.

Conclusion

The results of present study reveal a disturbing lack of sufficient knowledge of importance of healthy body weight among biology students. The great amount of information about significance of normal body weight in specialized literature obviously cannot reach young people. High school and university biology programs should be aimed at linking scientific knowledge with health consequences. Studies focused on understanding the population's knowledge about under/overweight are important also to public health practitioners in developing informative campaigns.

The impact of level of education must be noticed. Education builds not only students' knowledge and skills, but also and positive attitudes abouthealthy lifestyle.

NOTES

1. http://obesityresearch.nih.gov/about/StrategicPlanforNIH_Obesity_Research_Full-Report_2011.pdf

2. https://justines2010blog.files.wordpress.com/2011/03/dsm-iv.pdf

3. http://pediatrics.aappublications.org/content/pediatrics/116/6/1557.full.pdf

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