Ethnicity, educational level and attitudes contribute to parental intentions about genetic testing for child obesity

Paul L. Kocken · Meinou H. C. Theunissen ·
Yvonne Schönbeck · Lidewij Henneman ·
A. Cecile J. W. Janssens · Symone B. Detmar

Received: 8 June 2012 / Accepted: 20 January 2013 / Published online: 7 February 2013
© Springer-Verlag Berlin Heidelberg 2013

Abstract The objective of this paper is to assess parental beliefs and intentions about genetic testing for their children in a multi-ethnic population with the aim of acquiring information to guide interventions for obesity prevention and management. A cross-sectional survey was conducted in parents of native Dutch children and children from a large minority population (Turks) selected from Youth Health Care registries.

P. L. Kocken (✉) · M. H. C. Theunissen · Y. Schönbeck ·
S. B. Detmar
Department of Child Health, TNO, P.O. Box 2215, 2301 CE
Leiden, the Netherlands
e-mail: paul.kocken@tno.nl

M. H. C. Theunissen
e-mail: meinou.theunissen@tno.nl

Y. Schönbeck
e-mail: yvonne.schonbeck@tno.nl

S. B. Detmar
e-mail: symone.detmar@tno.nl

P. L. Kocken
Department of Public Health and Primary Care, Leiden University
Medical Center (LUMC), P.O. Box 9600, 2300 RC Leiden,
the Netherlands

L. Henneman
EMGO Institute for Healthcare Research,
Department of Public and Occupational Health,
VU University Medical Center Amsterdam, P.O. Box 7057,
1007 MB Amsterdam, the Netherlands
e-mail: l.henneman@vumc.nl

L. Henneman
EMGO Institute for Healthcare Research, Department of Clinical
Genetics, VU University Medical Center Amsterdam,
P.O. Box 7057, 1007 MB Amsterdam, the Netherlands

A. C. J. W. Janssens
Department of Public Health, Erasmus University Medical Center
Rotterdam, P.O. Box 2040, 3000 CA Rotterdam, the Netherlands
e-mail: a.janssens@erasmusmc.nl

The age range of the children was 5–11 years. Parents with lower levels of education and parents of non-native children were more convinced that overweight has a genetic cause and their intentions to test the genetic predisposition of their child to overweight were firmer. A firmer intention to test the child was associated with the parents' perceptions of their child's susceptibility to being overweight, a positive attitude towards genetic testing, and anticipated regret at not having the child tested while at risk for overweight. Interaction effects were found in ethnic and socio-economic groups. Ethnicity and educational level play a role in parental beliefs about child overweight and genetic testing. Education programmes about obesity risk, genetic testing and the importance of behaviour change should be tailored to the cultural and behavioural factors relevant to ethnic and socio-economic target groups.

Keywords Genetics · Attitude · Health promotion · Obesity · Child

Introduction

There has been a considerable increase in the prevalence of overweight, including obesity, in the general population over the past few decades. Adult obesity partly has its origin in childhood (Dietz 1998). Childhood overweight increases the probability that this overweight will carry over into adulthood, putting adults at increased risk of cardiovascular disease and diabetes in later life (Guo et al. 2002; Eriksson et al. 2003). Childhood overweight also exacerbates the present health of children and adolescents (Daniels 2006; Gardner et al. 2009). Until now, prevention programmes have tried to change lifestyle without taking genetic predisposition into account. However, a gene–environment interaction has been found in studies of pairs of twins, indicating that genetic background can affect weight gain or loss (Bouchard 2009). The genetic

basis for most common health problems like overweight and type 2 diabetes mellitus is complex, involving multiple genetic variants and interactions with the environment. Currently, population screening and treatment of obesity based on genetic information is not in place and so it is necessary to look at behavioural factors. Although extensive research is in progress with the aim of assessing the genetic risk of obesity in individuals, it is not expected that testing such risk will soon be an integral part of personalised medicine. At this moment, genetic information is already being used in commercially available tests; however, the predictive capacity of such genetic tests is too low to be introduced for preventive purposes at population level and it is doubtful that people will benefit from these tests and adopt a healthier lifestyle (Janssens and Van Duijn 2010). Moreover, people need to be taught about the impact of knowing about genetic risks on their personal life and the social implications like the impact on employment and individual insurance plans (Chung 2007). Public awareness of these implications is still low.

Research has shown that parents of overweight children are interested in genetic testing for their child and that they are insufficiently aware of the implications of test results (Segal et al. 2007). Studies of disparities in genetic literacy have also shown a correlation with socio-economic status and ethnicity. Ethnic minority groups accept genetic tests more than native populations (Catz et al. 2005; Zimmerman et al. 2006). As prevalences of obesity and overweight are highest among these groups, informing minority groups about the pros and cons of genetic testing for overweight may be relevant (Clarke et al. 2009; Singh et al. 2011; Hawkins et al. 2009). However, the need for education and choice of target groups are dependent upon the scale on which reliable tests for the risk of overweight in children will become available in the future.

Little is known at present about parental beliefs and attitudes towards genetic testing for the risk of overweight in their children. Several studies have been conducted of public attitudes towards, and intentions about genetic testing. These studies show that the most important predictor for the intention to take a genetic test is the attitude towards the test (Botosaneanu et al. 2011; Henneman et al. 2006; Nordin et al. 2004). A clearer picture is required of beliefs and attitudes relating to genetic testing for children in the context of the perceived risk of overweight and obesity. This article looks at the beliefs of Dutch parents by comparison with non-native Turkish parents. Turks represent the largest ethnic minority group in the Netherlands. Overweight and obesity are two to three times more prevalent in Dutch children of Turkish origin than in native Dutch children (De Wilde et al. 2009; Fredriks et al. 2005). Contextual differences underlying the behaviours of ethnic groups may be relevant for the development of culturally appropriate preventive interventions or screening programmes.

The overall aim of this study is to assess the beliefs and intentions of parents from a multi-ethnic community about

future options for the genetic testing of their child for the risk of overweight with the aim of acquiring information to guide interventions for obesity prevention and management. We look at the following question: how are ethnicity, need, parental beliefs and attitudes towards genetic testing associated with the parental intentions towards future genetic testing options for overweight risk in their children?

Methods

Subjects and procedures

Native Dutch and ethnic Turkish children were selected from the Youth Health Care registers of two Regional Health Services in the Netherlands. The children had undergone regular routine medical examinations from Youth Health Care physicians and nurses during primary school. Children aged 5 and 10 years were selected for this study. The parent who spent the most time with the child was asked to fill out a questionnaire.

Children who underwent a routine medical examination between September 2005 and December 2006, and who were born between 1 January 2000 and 30 September 2000 or between 1 January 1995 and 30 September 1995, were included in the study. The registers were ordered by date of birth and all the Turkish children who met the criteria were selected. The first two Dutch native children after a Turkish child in the register were then selected. A child was defined as Turkish when at least one parent had been born in Turkey. A child was defined as native Dutch when both parents had been born in the Netherlands. The respondents were asked for informed consent to link data about the children's height and weight from the Youth Health Care registers with data collected using questionnaires. The parents of Turkish children received a questionnaire in Dutch and a translated questionnaire in Turkish. They were free to choose which questionnaire to return. Two reminders were sent to non-respondents. The study protocol was approved by the internal TNO Review Board.

Questionnaire

The questionnaire included scales based on determinants from theoretical models for health-service use and behaviour change, i.e., the Health Services Use model, the Health Belief Model and the Theory of Planned Behaviour extended to include anticipated regret (Andersen 1995; Ajzen 1991; Janz and Becker 1984; Sheeran and Orbell 1999; Gooding et al. 2006). We adopted theoretical concepts from these models: need, health beliefs, attitudes towards testing and anticipated regret. Scale items were formulated on the basis of qualitative focus group interviews about beliefs relating to overweight and genetic testing with three groups of Dutch parents and three groups of Turkish parents during

the preparatory stage of the survey. The questionnaire scales were adapted in the light of beliefs and practices in native and Turkish cultures identified during the interviews.

The survey questions targeting beliefs about genetic testing were introduced to the respondents using an imaginary scenario relating to a genetic test for obesity: ‘Please imagine that your child can be tested for genetic predisposition to overweight. For this test, a swab will be taken from the inside of your child’s cheek at the youth health care centre. If your child is more likely than others to get overweight, the child health care physician will discuss this with you. The questions below look at possible testing of this kind’.

Table 1 provides a summary of the questionnaire items and scales. Parental intention was adopted as the outcome measure for this study and was measured using one item following the above scenario: ‘I would test my child for genetic predisposition to overweight if a test became

available’. To determine need among parents for genetic testing, both subjective and objective assessments of child and parental weight status were made. The children’s BMIs were established on the basis of the registries of routine physical examinations by youth health care professionals. BMI cut-off points for overweight and obesity were in line with the international obesity task force thresholds (Cole et al. 2000). SD scores for BMI were based on the Dutch general population (Fredriks et al. 2000). Parental BMI was calculated on the basis of the heights and weights reported in the questionnaire. In addition to these BMIs, parents’ subjective assessments of the children’s weights and their own weights were obtained. The answer categories varied from ‘far too heavy’ to ‘far too light’.

The health beliefs about overweight were defined in this study as perceived susceptibility, concern about the child’s weight, and beliefs with regard to behavioural and genetic

Table 1 Questionnaire scales and items in the questionnaire

Scale/item	Number of items	Cronbach’s alpha or Pearson correlation	Examples of items, answer categories and score range
Need			
Perceived child weight	2	$r=0.84$	What do you think of your child’s weight at this moment? Compared to other children of his/her age, I find my child. Far too heavy (–2) far too light (2) (5 categories)
Perceived parent weight	1	–	What do you think of your own weight at this moment? Far too heavy (–2) far too light (2) (5 categories)
Health beliefs			
Perceived susceptibility	1	–	How certain is it that your child will become overweight in the future, or remain overweight? Certainly not (–2)–certainly (2) (5 categories)
Concern about child weight ^a	3	$\alpha=0.78$	How concerned are you about your child having to diet to maintain a desirable weight? Unconcerned (–2)–very concerned (2) (5 categories)
Belief behaviour causes overweight	3	$\alpha=0.72$	What are the causes of overweight in children in your opinion? Eating a lot, little exercise, unhealthy eating. Certainly not (–2)–certainly (2) (5 categories)
Belief genetic factors cause overweight	8	$\alpha=0.75$	Overweight is determined by heredity. The metabolism of a person is determined by heredity. The agility of a person is determined by heredity. Totally disagree (–2)–totally agree (2) (5 categories)
Please imagine that your child can be tested for genetic predisposition to overweight. For this test, a swab will be taken from the inside of your child’s cheek at the youth health care centre. If your child is more likely than others to get overweight, the child health care physician will discuss this with you. The questions below look at possible testing of this kind			
Attitudes			
Attitude towards genetic testing for overweight	3	$\alpha=0.82$	I see myself as a good parent if I test my child for a genetic predisposition to overweight. Certainly not (–2)–certainly (2) (5 categories)
Anticipated regret	1	–	Will you regret not testing your child if your child becomes overweight later? Certainly not (–2)–certainly (2) (5 categories)
Intention			
Intention about genetic testing	1	–	I would test my child for a genetic predisposition to overweight if a test became available. Certainly not (–2)–certainly (2) (5 categories)

^a Subscale of Child Feeding Questionnaire (CFQ) (Birch et al. 2001)

causes of overweight. Attitude and anticipated regret toward genetic testing were the attitudinal factors measured in the questionnaire (Ajzen 1991; Sheeran and Orbell 1999; Sandberg and Conner 2008). The questionnaire also elicited information about demographic characteristics (gender, age), the country of birth of the child and parents, and the educational level of the parent who filled out the questionnaire.

Analyses

The differences between the background characteristics of the parents of Dutch and Turkish children, and the parents of normal and overweight children, were explored. *T* tests and one-way ANOVAs were conducted to analyse the relationship between background and overweight status as independent variables and parental beliefs about the causes of overweight and their intentions about future options for genetic testing of their child as dependent variables.

Stepwise multiple linear regression analysis was used to analyse the contribution of background characteristics, beliefs and attitudes to parental intentions about testing for child susceptibility to overweight. The background characteristics were added to the regression model in the first step, need factors in the second step, health beliefs in the third step and attitude factors in the fourth step. All independent variables were left in the regression model to allow for the exploration of the added significance of each variable for each block of included factors. In the last step, the interactions of ethnicity, educational level, and perceived child weight with other factors significantly related to intention were studied. We interpreted the interaction effects by inspecting plots. The analyses were performed using SPSS 14.0 (SPSS Inc. Chicago, IL, USA). A two-sided α of 0.05 was adopted as the significance level.

Results

Response and characteristics of response groups

A total of 882 out of 1,617 questionnaires were returned, a response rate of 55 %. The response was 57 % from Dutch parents, and 48 % from Turkish parents. There were no differences between respondents and non-respondents in terms of child age and gender.

The ethnicity of the children was 71 % Dutch and 29 % Turkish. According to international BMI cut-off scores, 11.8 % of the children were overweight and 3.9 % were obese (Table 2). The overweight and obesity rates of the Turkish children were considerably higher than those of the Dutch children (31.5 % and 10.1 % respectively). These results concur with other population studies in the

Table 2 Study population

	Total		Dutch		Turkish	
	<i>N</i> =882		<i>N</i> =626		<i>N</i> =256	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
Gender of the parent						
Female	773	88.2	574	91.8	199	79.3
Male	103	11.8	51	8.2	52	20.7
Parental education						
Low	322	37.9	168	27.2	154	66.4
Intermediate	346	40.8	284	46.0	62	26.7
High	181	21.3	165	26.7	16	6.9
BMI of parent						
Normal weight	482	58.2	405	67.5	77	33.8
Overweight	243	29.3	151	25.0	92	40.4
Obese	103	12.4	44	7.3	59	25.9
Gender of the child						
Girl	432	49.2	306	49.0	126	49.8
Boy	446	50.8	319	51.0	127	50.2
Child's age (at moment of questionnaire)						
5–8 years	466	54.3	340	54.8	126	52.9
≥8 years	392	45.7	280	45.2	112	47.1
Ethnicity						
Dutch	626	71.0	–	–	–	–
Turkish	256	29.0	–	–	–	–
Weight of child						
Normal weight	643	84.3	506	89.9	137	68.5
Overweight	90	11.8	45	8.0	45	22.5
Obese	30	3.9	12	2.1	18	9.0

Netherlands (De Wilde et al. 2009; Schönbeck et al. 2011). Turkish parents and parents of overweight children were more often overweight or obese than Dutch parents and parents of non-overweight children. Many Turkish respondents had a low educational level. The respondents' educational level corresponded reasonably closely to that of the general Dutch and Turkish populations.

Parental health beliefs and intentions about genetic testing for their children

At the univariate level, parents with lower levels of education, parents of Turkish children, and parents who considered their own weight to be too low had a statistically significant firmer belief that genetic factors cause overweight (Table 3). Parents with higher levels of education and native Dutch parents were more convinced that behaviour causes overweight. Furthermore,

Table 3 Background characteristics and need factors related to parental beliefs about the causes of overweight and intentions about genetic testing for their child

	Belief genetics causes overweight			Belief behaviour causes overweight			Intentions about genetic testing for child		
	(-2=lowest; 2=highest)			(-2=lowest; 2=highest)			(-2=lowest; 2=highest)		
	<i>N</i>	Mean (sd)	<i>P</i> value ^a	<i>N</i>	Mean (sd)	<i>P</i> value	<i>N</i>	Mean (sd)	<i>P</i> value
Background characteristics									
Gender of the parent									
Male	103	-0.16 (0.58)	0.834	102	1.25 (0.72)	0.089	103	0.35 (1.08)	0.071
Female	757	-0.15 (0.52)		763	1.37 (0.67)		759	0.15 (1.05)	
Parent's age									
20-35 years	188	-0.10 (0.53)	0.081	192	1.36 (0.68)	0.942	190	0.44 (1.06)	0.000**
36-40 years	241	-0.18 (0.56)		238	1.34 (0.66)		239	0.01 (1.05)	
>40 years	280	-0.20 (0.49)		283	1.36 (0.67)		280	0.12 (1.05)	
Parental education									
Low	312	-0.10 (0.56)	0.002**	316	1.26 (0.82)	0.001**	315	0.45 (1.02)	0.000**
Intermediate	342	-0.15 (0.51)		344	1.40 (0.61)		341	0.06 (1.03)	
High	180	-0.27 (0.48)		179	1.48 (0.52)		180	-0.17 (1.05)	
Parental ethnicity									
Dutch	619	-0.18 (0.47)	0.003**	640	1.44 (0.57)	0.000**	616	-0.06 (1.01)	0.000**
Turkish	246	-0.07 (0.63)		223	1.14 (0.87)		250	0.75 (0.93)	
Need									
BMI parent									
Normal weight	474	-0.18 (0.48)	0.444	478	1.44 (0.62)	0.000**	473	0.00 (1.03)	0.000**
Overweight	343	-0.13 (0.58)		341	1.27 (0.71)		343	0.40 (1.02)	
BMI child									
Normal weight	631	-0.18 (0.50)	0.102	636	1.39 (0.62)	0.000**	631	0.09 (1.05)	0.000**
Overweight	118	-0.08 (0.63)		118	1.15 (0.89)		118	0.73 (0.88)	
Perceived parent weight									
Too low	38	0.02 (0.52)	0.021*	37	1.38 (0.58)	0.849	37	0.16 (1.30)	0.001**
Normal	414	-0.10 (0.50)		420	1.37 (0.71)		415	0.04 (1.03)	
Too high	405	-0.13 (0.54)		405	1.34 (0.65)		407	0.32 (1.03)	
Perceived child weight									
Too low	85	-0.10 (0.49)	0.251	86	1.39 (0.68)	0.006**	84	-0.03 (1.12)	0.000**
Normal	573	-0.18 (0.51)		578	1.38 (0.65)		575	0.09 (1.01)	
Too high	105	-0.12 (0.62)		105	1.15 (0.85)		105	0.81 (0.87)	

^a *T* tests and one-way ANOVAs**p*<0.05; ***p*<0.01

overweight parents, parents with an overweight child according to BMI, and parents who thought their child was overweight were less convinced that behaviour causes overweight. Parents who were relatively young (in the 20–35 age bracket), parents with lower levels of education, parents of Turkish children, parents with overweight as indicated by parental BMI and perceived parent weight, and parents with an overweight child as indicated by child BMI and parental perceptions of child weight had firmer intentions about future options for genetic testing.

Factors contributing to parental intentions about genetic testing

The first step of the multiple linear regression analysis showed that parental education and ethnicity were significantly associated with the intention to proceed with genetic testing (Table 4). The background characteristics explained only 12 % of the variance in parental intentions about future options for genetic testing. In the second step, the need factor ‘perceived child weight’ was significantly associated with parental intentions about genetic testing for their

Table 4 Stepwise linear regression analysis with parental intentions about genetic testing of their child as outcome variable and background characteristics (step 1), need factors (step 2), health belief factors (step 3), attitude factors (step 4) and interactions (step 5) as independent variables ($N=705$)

	$\Delta R^2=$ 0.122** Step 1 (β)	$\Delta R^2=$ 0.030** Step 2 (β)	$\Delta R^2=$ 0.057** Step 3 (β)	$\Delta R^2=$ 0.399** Step 4 (β)	$\Delta R^2=$ 0.012** Step 5 (β)
Background characteristics					
Gender of the parent (female/male)	−0.01	−0.01	−0.00	0.04	0.03
Parent's age (range 20–59)	0.04	0.02	0.04	0.02	0.03
Parental education					
High vs low	−0.14**	−0.13**	−0.10*	−0.01	−0.01
Intermediate vs low	−0.07	−0.06	−0.06	−0.02	−0.04
Ethnicity (Turkish/Dutch)	0.29**	0.25**	0.20**	0.03	0.04
Need					
BMI parent (overweight/normal weight)		0.00	0.02	0.04	0.03
BMI child (overweight/normal weight)		0.06	0.03	0.04	0.03
Perceived child weight (−2=far too high; 2=far too low)		−0.11*	−0.02	0.02	0.02
Perceived parent weight (−2=far too high; 2=far too low)		−0.07	−0.03	−0.05	−0.06
Health beliefs about overweight					
Perceived susceptibility (−2=lowest, 2=highest)			0.08	0.07*	0.03
Concern about child weight (−2=lowest; 2=highest)			0.18**	0.06	0.06
Belief genetics causes overweight (−2=lowest; 2=highest)			0.13**	0.03	0.03
Belief behaviour causes overweight (−2=lowest; 2=highest)			0.09**	0.00	0.00
Attitudinal factors regarding genetic testing					
Attitude (−2=lowest; 2=highest)				0.59**	0.64**
Anticipated regret (−2=lowest; 2=highest)				0.16**	0.20**
Interactions					
Attitude×parental education (high vs low)					−0.09**
Anticipated regret×ethnicity					−0.07*
Perceived susceptibility×parental education (low vs intermediate)					0.10*

β standardised regression coefficient; R^2 squared multiple correlation coefficient; ΔR^2 increase in R^2 from previous step to current step

* $p<0.05$; ** $p<0.01$

children. The inclusion of the attitudinal factors in the model led to an increase in R^2 of 40 %. In this step, perceived susceptibility and both of the attitudinal factors—attitude towards genetic testing and anticipated regret—were significantly associated with parental intentions about future options for genetic testing. The significant association with concern about child weight and the beliefs that genetics or behaviour cause overweight disappeared in step 4. In step 5, interaction effects were found between attitude and educational level, perceived susceptibility and educational level, and anticipated regret and ethnicity. The association between attitude and intention to genetic testing was stronger in low-education than in high-education respondents. With respect to perceived susceptibility, the assessment of the child's susceptibility to overweight by respondents with intermediate education levels was more firmly associated

with the intention to seek genetic testing than was the case in the group of respondents with lower levels of education. The relationship between anticipated regret and intention was stronger in parents of Dutch children than in parents of Turkish children.

Discussion

This study provides an insight into parental beliefs and intentions with regard to the genetic causes of overweight in children. Parents with less education and non-native parents believed more firmly that overweight has a genetic cause and were more inclined towards genetic testing for their children than more highly educated parents and native Dutch parents. Other studies in adult populations have also

found positive attitudes towards genetic testing and a lag in genetic literacy in ethnic minority and low socio-economic status groups (Catz et al. 2005; Zimmerman et al. 2006). Parental intentions to avail themselves of future options to have a child tested for overweight risk is predicted best by their positive attitude towards such a test, especially in parents with low levels of education. This study shows that the factor anticipated regret also adds to the intention to seek a genetic test. The more parents anticipate regret about not having their child tested if the child turns out to be overweight in the future, the more parents plan to have the child tested to ascertain the child's susceptibility to overweight. This association was firmest in parents of native Dutch children. The relevance of anticipated regret for health behaviour was also found in studies of other health behaviours (Sheeran and Orbell 1999; Sandberg and Conner 2008). In the final model, parents' beliefs about the susceptibility of their child to overweight also contributed to the intention to proceed with genetic testing in the group of parents with intermediate levels of education. Perceived child weight did not interact with behavioural determinants of the intention to test the child. This implies that attitude, anticipated regret and perceived susceptibility as behavioural factors that contribute to the intention to test a child do not depend on parental assessments of the weight of their children. This study also shows that the association between perceived child weight and intention to test the child is confounded by perceived susceptibility and attitudinal factors regarding genetic testing. The parents' judgement of the child's risk for overweight and the perceived benefits of a genetic test seem more important to seek a genetic test than their opinion that a child is overweight or not. The expectation that parents of overweight children intend to make use of a genetic test to justify that they failed to manage their child's weight was not found in this study.

Study strengths and limitations

The limitations of this study were the cross-sectional design and the fact that questions were asked about parental intentions towards testing. If testing becomes available for the population as a whole, a longitudinal study of actual testing among parents is recommended.

A strength of this study was the inclusion of an ethnic minority population in which parents of overweight children are overrepresented. This enabled us to explore beliefs and intentions in a population where overweight is a genuine threat. The characteristics of the Dutch and Turkish response groups did not differ from the general populations in terms of the prevalence of child overweight and obesity, or the educational level of the parents, indicating that our study results are representative for these populations. Furthermore,

child gender and age in the response group matched the non-response group. The BMIs of the children of non-respondents could not be compared with those of respondents since we obtained informed consent to use register data from respondents only, and not from non-respondents.

The instruments and scales used in this study to measure beliefs and intentions were tailored to the immigrant response group using results from qualitative interviews. This meant that the expressions used in the questionnaire were familiar to the non-native respondents. The further development of robust instruments and scales for immigrant groups is recommended.

Implications for practice

Genetic testing for obesity may result in an overestimation of the role of genetic predisposition in the development of overweight and obesity and it is unclear whether test results will encourage people to make efforts to prevent obesity in themselves and in their offspring. The knowledge that a child is genetically predisposed may promote change of life style in children of parents who believe overweight is related to overeating and little physical activity, however parents may also use the test result as an excuse to dismiss oneself from taking action against overweight. Parents with lower levels of education, parents from minority groups, and parents who are overweight themselves or whose child is overweight could be educated about the importance of behaviour change for preventing or managing overweight and obesity, since these risk groups are less convinced that overweight is linked to behaviour. They could also be taught about the gene–environment interaction leading to the onset of obesity and the personal consequences of the awareness of genetic risks. The relationship between educational level and testing intention raises the question of whether people are equally informed about all the pros and cons of genetic testing. The relatively firm intentions of the group with lower education levels and the non-native minority group could indicate a lack of information about testing. This study shows that intentions about genetic testing for child obesity seem to take shape differently in different subpopulations, since intention is associated with specific behavioural factors in ethnic and socio-economic subgroups. This means that education about testing has to be tailored to specific behavioural factors in these groups, although it can be argued that such education only becomes relevant when reliable tests are available for the population as a whole. A culturally oriented approach could then be used in education programmes to inform ethnic minorities and low socio-economic groups about the benefits and implications of genetic tests, but primarily about the importance of behaviour change, regardless of a child's genetic predisposition.

Acknowledgments This work was supported by the Centre for Medical Systems Biology (CMSB) as part of the Netherlands Genomics Initiative (NGI). We thank the Regional Health Services Rotterdam-Rijnmond and Hart voor Brabant for allowing us to use the Youth Health Care register data from their districts.

Conflicts of interest The authors declare that they have no conflict of interest.

References

- Ajzen I (1991) The theory of planned behavior. *Organ Behav Hum Decis Process* 50:179–211
- Andersen RM (1995) Revisiting the behavioral model and access to medical care; does it matter? *J Health Soc Behav* 36:1–10
- Birch LL, Fisher JO, Grimm-Thomas K, Markey CN, Sawyer R, Johnson SL (2001) Confirmatory factor analysis of the child feeding questionnaire: a measure of parental attitudes, beliefs and practices about child feeding and obesity proneness. *Appetite* 36:201–210
- Botosaneanu A, Alexander JA, Banaszak-Holl J (2011) To test or not to test? The role of attitudes, knowledge, and religious involvement among U.S. adults on intent-to-obtain adult genetic testing. *Health Educ Behav* 38:617–628
- Bouchard C (2009) Childhood obesity: are genetic differences involved? *Am J Clin Nutr* 89:1494S–1501S
- Catz DS, Green NS, Tobin JN, Lloyd-Puryear MA, Kyler P, Umemoto A, Cernoch J, Brown R, Wolman F (2005) Attitudes about genetics in underserved, culturally diverse populations. *Community Genet* 8:161–172
- Chung WK (2007) Implementation of genetics to personalize medicine. *Gend Med* 4:248–265
- Clarke P, O'Malley PM, Johnston LD, Schulenberg JE (2009) Social disparities in BMI trajectories across adulthood by gender, race/ethnicity and lifetime socio-economic position: 1986–2004. *Int J Epidemiol* 38:499–509
- Cole TJ, Bellizzi MC, Flegal KM, Dietz WH (2000) Establishing a standard definition for child overweight and obesity worldwide: International survey. *BMJ* 320:1240–1243
- Daniels SR (2006) The consequences of childhood overweight and obesity. *Future Child* 16:47–67
- De Wilde JA, Van Dommelen P, Middelkoop BJC, Verkerk PH (2009) Trends in overweight and obesity prevalence in Dutch, Turkish, Moroccan and Surinamese South Asian children in the Netherlands. *Arch Dis Child* 94:795–800
- Dietz WH (1998) Health consequences of obesity in youth: childhood predictors of adult disease. *Pediatrics* 101:518–525
- Eriksson J, Forsen T, Osmond C, Barker D (2003) Obesity from cradle to grave. *Int J Obes Relat Metab Disord* 27:722–727
- Fredriks AM, van Buuren S, Wit JM, Verloove-Vanhorick SP (2000) Body index measurements in 1996–7 compared with 1980. *Arch Dis Child* 82:107–112
- Fredriks AM, Van Buuren S, Hira Sing RA, Wit JM, Pauline Verloove-Vanhorick S (2005) Alarming prevalences of overweight and obesity for children of Turkish, Moroccan and Dutch origin in The Netherlands according to international standards. *Acta Paediatrica* 94:496–498
- Gardner DS, Hosking J, Metcalf BS, Jeffery AN, Voss LD, Wilkin TJ (2009) Contribution of early weight gain to childhood overweight and metabolic health: a longitudinal study. *Pediatrics* 123:e67–e73
- Gooding HC, Organista K, Burack J, Biesecker BB (2006) Genetic susceptibility testing from a stress and coping perspective. *Soc Sci Med* 62:1880–1890
- Guo SS, Wu W, Chumlea WC, Roche AF (2002) Predicting overweight and obesity in adulthood from body mass index values in childhood and adolescence. *Am J Clin Nutr* 76:653–658
- Hawkins SS, Cole TJ, Law C (2009) The millennium cohort study child health group. An ecological systems approach to examining risk factors for early childhood overweight: Findings from the UK millennium cohort study. *J Epidemiol Comm Health* 6:147–155
- Hennenman L, Timmermans DRM, van der Wal G (2006) Public attitudes toward genetic testing: perceived benefits and objections. *Genet Test* 10:139–145
- Janssens ACJW, van Duijn CM (2010) An epidemiological perspective on the future of direct-to-consumer personal genome testing. *Investig Genet* 1(1):10
- Janz NK, Becker MH (1984) The health belief model: a decade later. *Health Educ Q* 11:1–47
- Nordin K, Björk J, Berglund G (2004) Factors influencing intention to obtain a genetic test for a hereditary disease in an affected group and in the general public. *Prev Med* 39:1107–1114
- Sandberg T, Conner M (2008) Anticipated regret as an additional predictor in the theory of planned behaviour: a meta-analysis. *Br J Soc Psychol* 47:589–606
- Schönbeck Y, Talma H, van Dommelen P, Bakker B, Buitendijk SE, HiraSing R, van Buuren S (2011) Increase in prevalence of overweight in Dutch children and adolescents: a comparison of nationwide growth studies in 1980, 1997 and 2009. *PLoS One* 6(11):e27608. doi:10.1371/journal.pone.0027608
- Segal ME, Polansky M, Sankar P (2007) Adults' values and attitudes about genetic testing for obesity risk in children. *Int J Pediatr Obes* 2:11–21
- Sheeran P, Orbell S (1999) Augmenting the theory of planned behavior: roles for anticipated regret and descriptive norms. *J Appl Soc Psychol* 29:2107–2142
- Singh GK, Siahpush M, Hiatt RA, Timsina LR (2011) Dramatic increases in obesity and overweight prevalence and body mass index among ethnic-immigrant and social class groups in the United States, 1976–2008. *J Community Health* 36:94–110
- Zimmerman RK, Tabbarah M, Nowalk MP, Raymund M, Jewell IK, Wilson SA, Ricci EM (2006) Racial differences in beliefs about genetic screening among patients at inner-city neighborhood health centers. *J Natl Med Assoc* 98:370–377