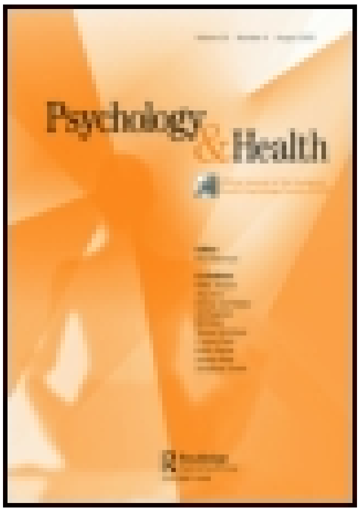

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A self-determination theory approach to adults' healthy body weight motivation: A longitudinal study focussing on food choices and recreational physical activity

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This study focuses on body weight motivation based on self-determination theory. The impact of body weight motivation on longitudinal changes in food choices, recreational physical activity and body mass index was explored. A sample of adults ($N = 2917$, 47% men), randomly selected from the telephone book, completed a questionnaire in two consecutive years (2012, 2013), self-reporting food choices, recreational physical activity and body weight motivation. Types of body weight motivation at $T1$ (autonomous regulation, introjected regulation, and external regulation) were tested with regard to their predictive potential for changes in food choices, recreational physical activity and body mass index (BMI). Autonomous motivation predicted improvements in food choices and long-term adherence to vigorous recreational physical activity in both genders. Introjected motivation predicted long-term adherence to vigorous recreational physical activity only in women. External motivation predicted negative changes in food choices; however, the type of body weight motivation had no impact on BMI in overweight adults in the long term. Autonomous goal-setting regarding body weight seems to be substantial for healthy food choices and adherence to recreational physical activity.

Keywords: body weight motivation; self-determination theory; recreational physical activity; food choices; body mass index; longitudinal

Adequate food choices, flexible control over eating behaviour and sufficient activity levels are considered to be the main approaches to positively influencing weight development (Dohle, Hartmann, & Keller, 2014; Fogelholm & Kukkonen-Harjula, 2000; Polivy, 1996); however, a large portion of the population experiences difficulties managing its weight (James et al., 2004), evoked by unhealthy food choices and inactive lifestyles. Western diets are typically energy-dense – dominated by red meat and high-fat, palatable foods that facilitate an oversupply of energy (Swinburn et al., 2011; Wang & Beydoun, 2009). In contrast, consumption of vegetables and fruits, relatively low in energy density and rich in vitamins, minerals and other bioactive compounds, are subject to insufficient intake rates (Lock, Pomerleau, Causer, & McKee, 2004). A physically active lifestyle helps to maintain energy balance and has beneficial effects on health parameters such as insulin sensitivity, physical fitness and well-being (Foreyt,

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Brunner, Goodrick, Jeor, & Miller, 1995; Fox, 1999). However, a large portion of the population is insufficient in its physical activity levels (Sjöström, Oja, Hagströmer, Smith, & Bauman, 2006), which is considered as another major risk factor for becoming overweight and obese (World Health Organisation [WHO], 2013).

Identifying drivers for positive changes in food choices and physical activity behaviour is crucial in explaining why some people are successful at regulating their body weight while others are at risk of weight gain or unhealthy weight cycling. One approach to identifying drivers for positive changes in weight-related behaviours is studying individual psychological factors such as people's underlying motives for striving for a healthy body weight. Rather than the intensity of the motivation itself, the type of motivation is considered to be the determinant for successful weight management and engagement in weight-related health behaviours; this was the object of examination in this study.

Motivation from the perspective of self-determination theory

The self-determination theory (SDT) introduced by Deci and Ryan (1985) is an extension of the classical categorisation of intrinsic and extrinsic motivation. The SDT focuses on the concept of autonomy in regulatory processes of motivation. More specifically, SDT distinguishes between autonomous and controlled forms of motivation regulation, which refers to the extent to which a person's regulatory processes of motivation are self-determined (Ryan & Connell, 1989). The natural underlying process that describes an individual's tendency to internalise external regulations into self-regulation is referred to as internalisation. Internalisation results in more self-determined action and is based on an assimilation of values into the inner sense of self (Deci & Ryan, 2002). Accordingly, SDT proposes different types of motivation regulation that differ in terms of the degree to which the regulation has been internalised and integrated; they fall along a continuum from least to most self-determined: Amotivation, external, introjected, identified, integrated and intrinsic. Amotivation describes the state of lacking the intention to engage in the behaviour at all. External and introjected regulations are two forms of extrinsic motivation that are considered to be controlled, as a person's intention to act is evoked by an interpersonal or intra-psychic force (Williams et al., 2002). Moreover, behaviour is performed either in response to external contingencies, such as expected punishment or incentives (external), or a need to maintain self-esteem or prevent a feeling of guilt (introjected) (Ryan & Deci, 2000; Williams et al., 2002). Identified and integrated regulations are the basis for a more self-determined (autonomous) yet extrinsically motivated behaviour. Behaviour that is based on identified regulation is accepted as personally important, but does not necessarily reflect one's beliefs and overarching values (Deci & Ryan, 2002). Integrated regulation is associated with volitional engagement in a specific behaviour – people act in congruence with their deeply held values. Nevertheless, the behaviour is still instrumentally oriented to achieve personally important goals (Deci & Ryan, 2002). The most autonomous and self-determined form of motivation is based on intrinsic regulation; it compromises engagement in an activity for its own sake and inherent enjoyment. People who act self-determined are more likely to engage in activities that reflect their own interests, their own values and their own goals, which results in more need satisfaction and psychological well-being. Being more autonomously motivated is also associated with volitionally consistent behaviour

(Koestner, Bernieri, & Zuckerman, 1992) and effective performance (Deci & Ryan, 2002; Thøgersen-Ntoumani & Fox, 2007). In contrast, individuals who strive for goals that are not personally endorsed (e.g. pressure by significant others, feelings of guilt) mostly lack self-determined action and are prone to discouragement after failures or negative experiences, resulting in less persistence in establishing the desired behaviour (Deci & Ryan, 1987).

SDT in the context of health behaviours

The SDT approach is attracting increasing attention in health behaviour studies and psychology-based interventions (e.g. Chatzisarantis & Hagger, 2009; Ingledew & Markland, 2008). Recent reviews about motivational dynamics based on SDT have emphasised the importance of autonomous regulation in physical activity (Teixeira, Carraça, Markland, Silva, & Ryan, 2012), eating regulation (Verstuyf, Patrick, Vansteenkiste, & Teixeira, 2012) and weight control programmes (Teixeira, Silva, Mata, Palmeira, & Markland, 2012). In particular, in a study about exercise behaviour, autonomous motivation towards exercise (e.g. exercising is personally important) emerged as a significant predictor for exercise participation, whereas externally regulated exercise behaviour (e.g. pressure by others to exercise) was not associated with exercise engagement (Standage, Sebire, & Loney, 2008). Another study revealed that autonomous regulation of eating behaviour (e.g. 'eating healthy is an integral part of my life') was linked to eating a more healthy diet (e.g. eating vegetables), whereas controlled regulation of eating behaviour (e.g. 'I would be humiliated if I was not in control of my eating behaviours') was linked to bulimic and depression symptoms, lower life satisfaction and lower self-esteem (Pelletier, Dion, Slovinec-D'Angelo, & Reid, 2004). Accordingly, an autonomous, self-motivated cognitive style is not only associated with better and sustainable health behaviour, but has also been reported as the most consistent outcome predictor for weight loss maintenance in obesity treatment (Williams, Grow, Freedman, Ryan, & Deci, 1996).

Treatment self-regulation questionnaire

The treatment self-regulation questionnaire (TSRQ) is based on the SDT approach. The first versions of the questionnaire in the health domain were used in the 1990s to assess patients' autonomous and controlled reasons for participating in an alcohol treatment, weight loss programme (Ryan, Plant, & O'Malley, 1995; Williams et al., 1996) or for following a diabetic diet and exercising regularly (Williams, Freedman, & Deci, 1998). In the following years, the TSRQ was modified and adapted to study various health behaviours, such as tobacco use, exercise and diet (Levesque et al., 2007). Levesque et al. (2007) recommended a version of the TSRQ to assess motivation across a variety of health behaviours that distinguishes among three sub-scales of motivation (autonomous, introjected and external) and amotivation (Levesque et al., 2007). The TSRQ does not further distinguish autonomous regulation in the three sub-scales – intrinsic, identified and integrated regulation – provided by the SDT approach. This is because within the health domain, intrinsic motivation, by Ryan and Deci's (2000) definition, is only rarely assessed, as only a few people perceive health behaviour (e.g. quitting smoking) as interesting, satisfying or intrinsically enjoyable (Levesque et al., 2007).

Moreover, according to Levesque et al. (2007), identified and integrated regulations regarding health behaviours are usually not measured separately because they were found to cluster well together (Levesque et al., 2007).

The present study

In this study, the authors examined the underlying motives for the desire to achieve or maintain a healthy body weight. Instead of focusing on self-determination towards physical activity (e.g. Behavioural regulation in exercise questionnaire, Mullan, Markland, & Ingledew, 1997) or eating behaviour (e.g. regulation of eating behaviour scale, Pelletier et al., 2004), a different approach was chosen: Focusing on body weight. A scale was applied that enabled the authors to identify whether body weight motivation is a driver for both changes in food choices and changes in recreational physical activity (PA). Additionally, motivation regulation towards eating or physical activity does not necessarily reflect motivation regulation towards body weight. For example, people might report that they feel humiliated when they are not in control of their eating behaviours; however, this does not necessarily indicate that they try to regulate their weight for introjected reasons. Thus, the present study seeks to address different types of motivation towards body weight and whether they predict changes in food choices and recreational PA in the long term. Based on the literature described above, the authors hypothesised that autonomous regulation for a healthy body weight would be more positively associated with healthy food choices and adherence to recreational PA in the long term than more controlled forms of regulation.

The existing knowledge of the motivational tendencies underlying health-related behaviours is mostly based on subgroups such as students or patients (e.g. Duncan, Hall, Wilson, & Jenny, 2010; Pelletier et al., 2004; Williams et al., 1998). The present study, however, was conducted with a large population-based sample of adults that is more diverse in terms of age and socioeconomic factors. Even though the observed effects among such a heterogeneous sample can be small, it permits more generalisability among different sociodemographic groups (e.g. education). Additionally, a whole range of interventions has been conducted that focused on patients' autonomous motivation with small to moderate effect sizes (e.g. Levy & Cardinal, 2004; Silva et al., 2011; Williams et al., 1996, 1998). The present study's approach enables us to study real-life behaviour independent of intervention studies or guided programmes. Notwithstanding exercise behaviour, eating behaviour and weight development are the results of a complex interplay of a broad range of psychological, physiological, genetic and environmental factors; this leads to a high variability in people's behaviours and body weights. In only focusing on a psychological factor (i.e. type of motivation), the authors only expect a limited amount of variance to be explained.

The study was designed to analyse the longitudinal relationship between types of motivation regulation and one-year changes in people's food choices and recreational PA. It is worth mentioning that the authors expected changes in people's behaviour within one year and without interventions to be small, and longitudinal studies investigating changes in health-related behaviours typically explain a small amount of variance (Jessor, Vandenbos, Vanderryn, Costa, & Turbin, 1995; van Strien, Herman, & Verheijden, 2014). Nevertheless, by taking advantage of the more sophisticated approach regarding motivation regulation offered by SDT – its application in a demographically diverse sample – a new, thorough understanding can be gained regarding body weight management at the population level. To the authors' knowledge, no previous research has documented such evidence using longitudinal data.

Methods

The Swiss food panel

This study examined data from the third (2012) and fourth (2013) wave of the Swiss food panel, a population-based longitudinal study conducted in Switzerland on eating behaviour and physical activity behaviour. The Swiss food panel started in February 2010, and the same individuals completed a mailed paper-and-pencil questionnaire for each subsequent year. The questionnaire consists of, among others, the food frequency questionnaire (FFQ), the global physical activity questionnaire version two (GPAQv2) and questions related to sociodemographic characteristics and self-reported anthropometric measurements (height and weight). An adapted version of the TSRQ was included in the third (2012) wave of the Swiss food panel for the first time; thus, the authors investigated the third (defined as Time 1) and the fourth (defined as Time 2) wave in the present study.

Sampling and participants

In 2010, a mail survey was sent to 20,912 randomly selected household addresses from the phone book in the German-speaking and French-speaking parts of Switzerland. In an accompanying letter, respondents were asked to participate in a longitudinal study. In case of multi-person households, the person who was registered in the telephone book completed the questionnaire, and the authors explained that the same person should fill in the questionnaire yearly for a longer period of time. No compensation for participating was offered. In the first wave in 2010, 6290 of all invited participants filled in the questionnaire (a response rate of 30%). Participating persons received a questionnaire every consecutive year.

For the longitudinal data file (including all waves), participants with missing gender, age or address details; participants who died; participants unwilling to participate in the next survey; participants who completed less than 50% of the questionnaire; and participants who had inconsistencies in their indicator variables (gender, birth date) between waves were excluded, limiting the sample size to $N = 3151$ (Figure 1). For this study, the longitudinal data file was additionally checked for inconsistencies in reported body heights at baseline and follow-up. All persons with body height differences greater than a 5 cm difference were excluded from the sample, as it was assumed that another person had completed the questionnaire on their behalf ($N = 162$). Because weight measures were analysed in this study, women who indicated the birth of a child during the study period under consideration (2012 and 2013) were also excluded ($N = 72$). Thus, the final sample for this study consisted of 2917 persons (47% males) with a mean age of 58 years (range 23–94 years) in 2013. Compared to the general Swiss population,[1] the final sample consisted of fewer males (census = 49%), more participants who had a higher secondary or college/university degree, and a lower percentage of young adults (20–39 years old) (12% vs. 34%). The lower proportion of young adults typically

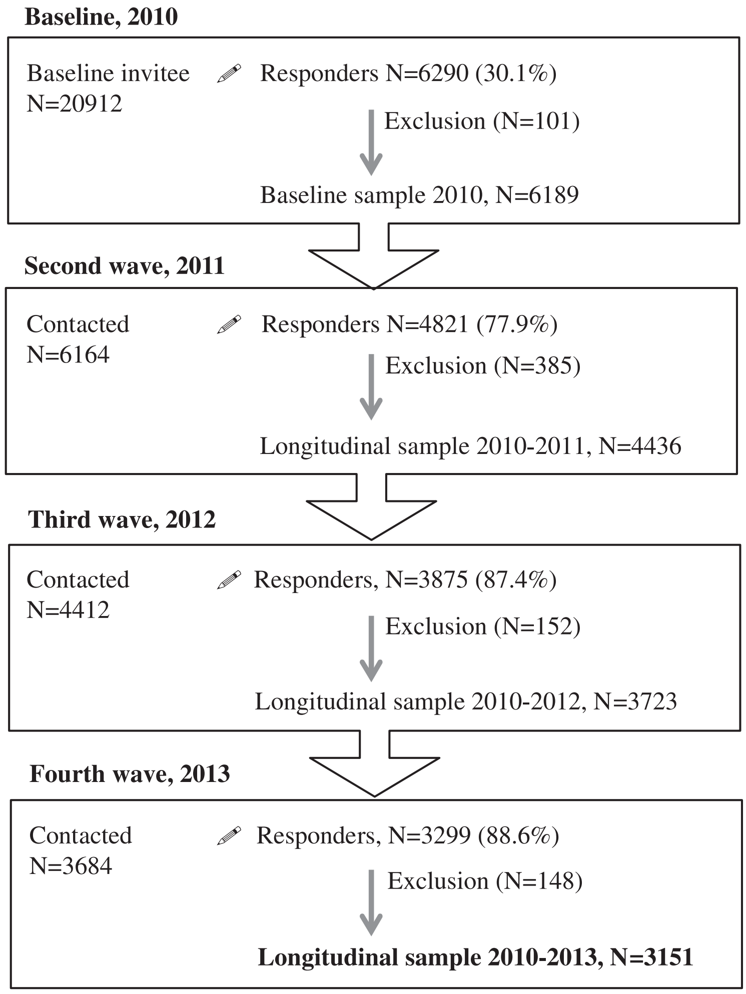

Figure 1. Flow chart of the study sample development.
Notes: The flow chart depicts the study sample from the Swiss food panel. Excluded were those participants with missing gender, age or address details; those who died; those unwilling to participate in the next wave; and those who filled in less than 50% of the questionnaire. Participants with inconsistent indicator variables (gender, birth date) between waves were also excluded.

occurs when the sampling is based on telephone book entries, because younger people are less likely to be registered in the telephone book. Of the participants, 70% live in the German-speaking cantons of Switzerland and 30% live in the French-speaking cantons of Switzerland.[2]

Over the four-year study period, response rates varied between 78% and 89% (Figure 1). Men, respondents with lower levels of education and participants living in the French-speaking part of Switzerland were slightly more likely to drop out over time. However, changes (2010 vs. 2013) in the sample's composition related to gender (men 49% vs. 47%), education (low 10% vs. 7%) and region (French-speaking 30% vs. 28%) were small.

Measures

Healthy body weight motivation

An adapted version of the TSRQ was used for the measurement of autonomous, introjected and external regulation towards a healthy body weight.[3] Thus, items were specified by the way they focused on participants' reasons for maintaining or reaching a healthy body weight (Table 1). Instead of assessing amotivation with the items from the questionnaire by Levesque et al. (2007), amotivated people were identified by answering the following filter question before answering the TSRQ: 'Would you like to have or maintain a healthy body weight?' This could be answered with 'yes', 'no' or 'it does not matter to me'. Participants who answered the filter question with 'no' or 'does not matter to me' were asked to skip the TSRQ because they were considered as amotivated. Data from amotivated individuals were excluded from further data analyses ($N = 254$, 8.7%). Excluded participants were more likely to be male (67.3%), were slightly older than the average ($M = 60$, range 26–92) and had a mean body mass index (BMI) of 25.71 (SD = 4.48). Of the excluded participants, 11% had a low level of education, 42.9% had a middle educational level, and 45.3% had a high level of education.

Food and alcohol consumption

The FFQ was specially designed for the Swiss food panel and used to estimate the frequency of habitual consumption of various foods. A detailed description of the test–retest study and the FFQ items was published previously (Hartmann, Siegrist, & van der Horst, 2012). The following food items were included in this study: Salad (lettuce, tomatoes) or raw vegetables; vegetables (cooked/steamed); fruit; pork; beef or veal;

Table 1. Mean scores and standard deviations for the different reasons to regulate body weight (based on the TSRQ).

The reason I would like to have a healthy body weight is because …	*M*	SD
Autonomous regulation ($\alpha = .90$)		
1 ... it is very important to be as healthy as possible	5.92	1.20
2 ... I personally believe that it is the best for my health	6.01	1.07
3 ... I would like to take responsibility for my own health	6.05	1.13
4 ... It is an important decision I really want to make	5.65	1.39
5 ... I thought about it carefully and think that this is important for many aspects of my life	5.39	1.55
6 ... It fits my life goals	5.37	1.53
Introjected regulation ($\alpha = .91$)		
7 ... I would be embarrassed if I did not have a healthy body weight	4.03	2.07
8 ... I would feel bad about myself if I do not have a healthy body weight	4.40	2.05
9 ... I would have a guilt conscience if I do not have a healthy body weight	3.88	2.00
10 ... I feel undisciplined when I do not have a healthy body weight	4.33	1.98
External regulation ($\alpha = .80$)		
11 ... I permanently feel pressure by others to have a healthy body weight	2.13	1.48
12 ... Others would be upset with me if I do not have a healthy body weight	1.69	1.12
13 ... I want others to see that I can do it	2.81	1.93
14 ... I want others to accept me	2.86	1.96

Note: *M*: mean; SD: standard deviation. Listwise deletion of missing values was used, resulting in $N = 2324$. Mean scores reflect the following response choices: 1 = *do not agree at all* to 7 = *totally agree*.

poultry (e.g. turkey, chicken); processed meats (e.g. cold cuts, sausages, ham); cookies; sweet pastries; chocolate; savouries (e.g. chips, nuts, salty snacks); wine; and beer.

Fruit, salad and vegetable frequencies were measured using five response options (coding): daily (7 times/week), 4–6 times/week (5 times/week), 1–3 times/week (2 times/week), 1–3 times/month (.5 times/week) and less or never (0). Participants were also asked how many portions of vegetables and salad (one portion = a handful), as well as fruits (one piece or one handful), they usually ate when they consumed these foods. Consumption frequencies and portion numbers were multiplied to indicate portions of fruit, vegetables and salad consumed per week. The consumption frequency of all meat-related and sweets-related items as well as savouries, wine and beer was measured using six response options: several times/day (14 times/week), daily (7 times/week), several times/week (3 times/week), several times/month (.75 times/week), several times/year (0) and less or never (0). Composite variables were created by adding up single items for sweets and savouries (sweet/savouries, $\alpha = .69$); vegetables and salad (vegetables/salad, $\alpha = .50$); meat ($\alpha = .72$); and alcohol ($\alpha = .52$). The composite variables indicate consumption frequencies (e.g. meat consumption frequency per week), except for vegetables and fruit, which indicate portions per week.

Recreational physical activity

Recreational PA was measured using the GPAQv2. The global physical activity questionnaire (GPAQ) was originally designed by the WHO to assess PA patterns in developing countries (Armstrong & Bull, 2006; WHO, 2014). GPAQ data in this study was cleaned and analysed according to the GPAQ Analysis Guide, provided by the WHO (2014). The GPAQ distinguishes among different activity settings or domains: Activity at work, travel to and from places and recreational activity. Within the recreational domain, information on frequency (days per week), duration (min) and level of intensity (vigorous, moderate) of PA in a typical week is self-reported. Vigorous-intensity PA denotes PA that is exhausting and causes a great increase in breathing and heart rate (e.g. running, soccer). Moderate-intensity PA denotes PA that is moderately exhausting and causes a small increase in breathing and heart rate (e.g. cycling, brisk walking). To express levels of PA participation, metabolic equivalents (METs) are calculated based on the self-reports in the GPAQ. One MET is defined as the energy expenditure of sitting quietly (resting metabolic rate) and is equivalent to a caloric consumption of 1 kcal/kg/hour. To take the relative energy expenditure of each activity into account, four METs are multiplied with reported minutes spent in moderate activities (MET-min/week) and eight METs are multiplied with minutes spent in vigorous activities (MET-min/week).

Anthropometry

BMI was calculated from self-reported weight and height (body weight (kg)/body height (m^2)). According to the international classification system of the WHO (2006), persons with BMI values of o 25 kg/m^2 were classified as overweight (37.8%) and persons with BMI values of >= 25 kg/m^2 were classified as normal weight (60.7%). Further, 9.5% of the participants had BMI values of <20, 51.2% between ≥20 and <25, 28.9% between ≥25 and <30, and 8.9% ≥30.

Data analysis

To explore changes in food choices and BMI between waves associated with different types of motivation regulation, hierarchical multiple regressions were conducted. The analysis of covariance is the analysis of choices for longitudinal continuous data with two measurement points (Twisk, 2013). This approach takes into account that participants' consumption values at Time 2 (*T*2) depend on their initial consumption values at Time 1 (*T*1) by including *T*1 values as independent variables in the regression model. This enables the removal of the potential influence of the initial consumption value at *T*1 so that the estimated effects of the other variables are independent of it (Cohen, Cohen, West, & Aiken, 2003). Separate regression equations were calculated for every food group variable (i.e. vegetables/salad, fruit, meat, sweets/savouries) and the alcohol variable. Because weight developments predicted by body weight motivation might differ depending on weight status, separate regression models were conducted for normal weight (BMI < 25) and overweight (BMI ≥ 25) participants. All regression models were carried out separately for males and females.

To explore the longitudinal relationship between types of motivation and changes in moderate and vigorous PA, various logistic regressions were conducted. Because the values for moderate PA and vigorous PA were positively skewed, each PA variable was dichotomised into active and inactive.[4] PA change variables were defined as follows: Participants who were physically inactive at both time points (*T*1, *T*2) were termed 'inactive'; participants who increased their activity were termed 'adopters' (inactive *T*1, but active *T*2); participants who quit PA were termed 'quitters' (active *T*1, but inactive *T*2); and participants who were active at both time points were termed 'maintainers' (active at *T*1 and *T*2). Six different models (three predicting moderate PA, three predicting vigorous PA) were tested, separated for gender: Maintainer vs. inactive, beginner vs. inactive and quitter vs. maintainer. Beside the models' χ^2-Statistic, contingency tables were checked for the prediction accuracy of the cases.

All analyses were performed with the longitudinal data-set from 2012 to 2013 ($N = 2663$) using the SPSS statistics software package version 20 (SPPS Inc., Chicago, IL).

Results

Table 2 depicts descriptives for both genders and waves. The mean values for autonomous and introjected regulation were higher in women compared to men, while gender differences in external regulation were only observed at *T*2. Women reported a higher vegetables/salad and fruit intake and a lower meat and alcohol consumption frequency compared to men; however, women were less physically active than men. No gender differences were observed for sweets (including savouries) consumption frequency. In general, not even half of the participants in this study, neither men nor women, reached the recommended 600 METs per week (Haskell et al., 2007), indicated by the low median values.

Table 3 displays the Pearson correlations among all of the investigated variables and between the *T*1 and *T*2 values. The SDT-based sub-scales closer to each other on the self-determined continuum (e.g. autonomous and introjected) were more highly correlated than the sub-scales that were farther apart (autonomous and external). The highest

Table 2. Characteristics of the study population ($N = 2663$).

		*T*1					*T*2				
		Women		Men			Women		Men		
	Range	*M*	SD	*M*	SD	*t*(*df*)	*M*	SD	*M*	SD	*t*(*df*)
Age (years)	23–93	54.40	13.24	58.68	13.76	$8.16(2661)^{**}$	55.40	13.24	59.68	13.76	$8.16(2661)^{**}$
BMI (kg/m^2)	17–64	23.62	4.37	25.69	3.45	$13.31(2642)^{**}$	23.62	4.38	25.75	3.53	$13.51(2628)^{**}$
Education (%)[a]											
Low		9.7		4.7			9.2		4.6		
Middle		39.0		32.4			40.0		32.2		
High		50.2		62.4		$\chi^2(2) = 387.65^{***}$	50.0		63.0		$\chi^2(2) = 398.17^{***}$
SDT-based measures[b]											
Autonomous regulation	1–7	5.82	1.06	5.57	1.08	$-5.84(2610)^{**}$	5.84	1.11	5.62	1.08	$-5.04(5270)^{**}$
Introjected regulation	1–7	4.16	1.86	4.02	1.69	$-2.00(2598)^{*}$	4.24	1.89	4.06	1.71	$-2.48(2455)^{**}$
External regulation	1–7	2.47	1.39	2.56	1.32	$1.57(2574)^{ns}$	2.30	1.35	2.47	1.27	$3.17(2482)^{**}$
Food variables											
Vegetables /salad (portions per week)	0–84	21.66	11.23	18.02	10.23	$-8.62(2631)^{**}$	21.42	11.03	17.54	10.30	$-9.26(2628)^{***}$
Fruits (portions per week)	0–42	11.00	7.92	8.28	7.45	$-9.01(2630)^{**}$	11.04	7.89	8.32	7.65	$-8.91(2620)^{***}$
Sweets (incl. savouries) (frequency per week)	0–35.75	4.44	4.15	4.53	4.13	$.55(2626)^{ns}$	4.37	4.14	4.36	4.00	$-.10(2622)^{ns}$
Meat (frequency per week)	0–42	3.89	3.11	5.26	3.61	$10.46(2628)^{**}$	3.74	3.37	5.19	3.69	$10.51(2615)^{***}$
Alcohol (frequency per week)	0–14.75	1.72	2.31	3.24	3.46	$13.52(2641)^{**}$	1.72	2.31	3.21	3.46	$13.52(2641)^{***}$
Recreational PA[c]											
Moderate (METs per week)	0–3000	839.17	1354.33	798.47	1216.41	$.78(2496)^{ns}$	812.41	1237.28	757.31	1168.74	$-1.13(2491)^{ns}$
Vigorous (METs per week)	0–3000	832.91	1864.53	1154.06	2506.58	$3.67(2497)^{**}$	865.58	2027.88	1131.42	2374.01	$3.03(8.89)^{**}$

Note: *M*: mean; SD: standard deviation; df: degrees of freedom; ns: not significant; METs: metabolic equivalents; PA: recreational physical activity.
$^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.; [a]Education level was categorised into three categories: (low) primary and lower secondary school, (middle) vocational school, (high) higher secondary school, college and university.
[b]Participants rated on a 7-point Likert scale that was numerically and verbally anchored (1 = *do not agree at all*, 7 = *fully agree*).
[c]PA values were positively skewed; therefore, median values are additionally reported in the following. Men: moderate PA = 480 METs per week, vigorous PA = 40 METs per week; women: moderate PA = 480 METs per week, vigorous PA = <1 MET per week.

Table 3. Pearson correlations among all variables ($N = 2663$).

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	Time 1																						
1	Autonomous	1																					
2	Introjected	.32**	1**																				
3	External	.15**	.43**	1**																			
4	BMI	−.09**	.10**	.24**	1																		
5	Vegetables/salad (portions a week)	.13**	.03	−.01	−.08**	1																	
6	Fruits (portions a week)	.16**	.03	−.02	−.01	.36**	1																
7	Sweets/savouries (frequency a week)	−.07**	.02	.03	−.08**	−.03	.02	1															
8	Meat (frequency a week)	−.07**	< −.01	.10**	.13**	−.07**	−.15**	.12**	1														
9	Alcohol (frequency a week)	−.02	< −.01	.06**	.01	−.02	−.07**	.02	.20**	1													
10	Moderate PA (METs)	.08**	.03	.03	−.08**	.07**	.08**	−.01	−.04	.05*	1												
11	Vigorous PA (METs)	.08**	.02	<.01	−.07**	.05*	.08**	−.03	.02	.03	.31**	1											
	Time 2																						
12	Autonomous	.60**	.23**	.11**	−.05*	.09**	.14**	−.08**	−.07**	−.01	.08**	.07**	1										
13	Introjected	.23**	.65**	.35**	.08**	.01	.03	.03	.01	−.02	.02	.05*	.32**	1**									
14	External	.07**	.27**	.62**	.29**	−.04	−.01	.01	.14**	.06**	<.01	−.03	.09**	.34**	1**								
15	BMI	−.07**	.10**	.23**	.91**	−.09**	−.01	−.07**	.14**	.01	−.08**	−.06**	−.05*	.10**	.28**	1							
16	Vegetables/salad (portions a week)	.14**	.03	−.04*	−.11**	.64**	.28**	−.02	−.05**	−.03	.06**	.07**	.10**	−.02	−.05*	−.12**	1						
17	Fruits (portions a week)	.16**	.03	−.01	−.03	.31**	.73**	.02	−.15**	−.05**	.07**	.08**	.13**	.02	−.01	−.04	.33**	1					
18	Sweets/savouries (frequency a week)	−.05*	.02	.01	−.09**	<.01	.01	.69**	.08**	.01	−.02	−.02	−.06**	<.01	.02	−.07**	−.01	.01	1				
19	Meat (frequency a week)	−.08**	−.01	.09**	.13**	−.09**	−.12**	.08**	.65**	.19**	−.06**	<.01	−.10**	<.01	.13**	.15**	−.06**	−.11**	.11**	1			
20	Alcohol (frequency a week)	−.02	.01	.07**	.05*	−.02	−.07**	−.03	.18**	.83**	.04	.02	−.02	−.02	.07**	.05*	−.04*	−.06**	.01	.21**	1		
21	Moderate PA (METs)	.12**	.06**	.02	−.06**	.06**	.08**	−.04	−.05*	.05*	.42**	.22**	.11**	.08**	.03	−.05*	.03	.06**	−.02	−.06**	.04	1	
22	Vigorous PA (MET)	.12**	.07**	.02	−.06**	.04	.09**	−.03	.02	.04	.18**	.39**	.11**	.09**	.03	−.05*	.04*	.08**	−.02	<.01	.04	.36**	1

Notes: BMI: body mass index; PA: recreational physical activity; MET: metabolic equivalents.
Pairwise deletion of missing values was used. Underlined correlations represent correlations between Time 1 and Time 2. Because of the high skewness of the PA variables, Spearman's correlation coefficients for PA variables between $T1$ and $T2$ were also conducted (moderate PA: $r_s = .53$, $p < .001$; vigorous PA: $r_s = .64$, $p < .001$.
$^{**}p < .001$; $^{*}p < .01$.

Table 4. Pearson correlations among SDT-based measures, food choices, alcohol frequency and recreational PA ($N = 2663$; $T1$).

	Autonomous		Introjected		External	
	Men	Women	Men	Women	Men	Women
Vegetables/salad	.13***	.11***	ns	ns	ns	ns
Fruit	.15***	.15***	ns	ns	ns	ns
Sweets/savouries	−.07*	−.07**	ns	ns	ns	ns
Meat	−.07*	ns	ns	ns	.09**	.10***
Alcohol	ns	ns	ns	ns	.09**	ns
Moderate PA[a]	.11***	.10***	ns	.08**	ns	−.06*
Vigorous PA[a]	.09**	ns	ns	.06*	ns	ns

Note: SDT: self-determination theory; PA: recreational physical activity.
Pairwise deletion of missing values was used.
[a]PA values were positively skewed, therefore, Spearman's correlation coefficients are depicted for the PA variables.
***$p < .001$; **$p < .01$; *$p < .05$.

correlation between the sub-scales occurred between introjected and external regulation, which might be due to the fact that both are controlled forms of regulation. Of special interest, BMI was positively correlated with the controlled forms of regulation and negatively correlated with autonomous regulation. Further analysis for normal weight and overweight participants showed that external regulation was more highly correlated with BMI in overweight participants ($r = .18$, $p < .001$) than in normal weight participants ($r = .06$, $p < .05$).

Table 4 shows the correlations between the SDT-based measures, the food and the alcohol consumption variables as well as the PA levels according to gender. Autonomous regulation was positively correlated with intake of fruits ($r = .15$, $p < .001$) and vegetables ($r = .13$ for men, $r = .11$ for women, $p < .001$) and negatively correlated with consumption frequency of sweets/savouries in both genders ($r = −.07$, $p < .05$) and meat in men ($r = −.07$, $p < .05$). Introjected regulation was not associated with any of the food groups. External regulation was positively correlated with consumption frequency of meat in both genders and alcohol intake in men ($r = .09$, $p < .01$). Table 4 also depicts Spearman's correlations between the SDT-based measures and PA levels. In men, autonomous regulation and recreational PA were positively correlated (moderate $r_s = .11$, $p < .001$; vigorous $r_s = .09$, $p < .01$). In women, autonomous regulation was positively associated with moderate PA ($r_s = .10$, $p < .001$), but not with vigorous PA. Both vigorous and moderate PA were correlated with introjected regulation in women ($r_s = .06$, $p < .05$ and $r_s = .08$, $p < .01$, respectively), but not in men. Lastly, the higher the external regulation in women, the lower their moderate PA level ($r_s = −.06$, $p < .05$).

SDT-based measures as predictors of change in food and alcohol consumption, recreational PA and BMI

Table 5 (women) and Table 6 (men) display the results of the hierarchical multiple regression analyses examining longitudinal relationships between the SDT-based measures and changes in food choices. Autonomous regulation at $T1$ was the only

Table 5. Longitudinal regressions with SDT-based measures (*T*1) as predictors for change in food choices (*T*2) *in women*, controlled for age and initial food choice (*T*1).

		Y = vegetables/salad intake *T*2 (*N* = 1381)					*Y* = fruit intake *T*2 (*N* = 1379)				
		B	SE B	β	*p*-value	$R^2/\Delta R^2$	B	SE B	β	*p*-value	$R^2/\Delta R^2$
Model 1	*Constant*	9.65	1.07		<.001		1.48	.67		.026	
	*Y T*1	.62	.02	.64	<.001		.68	.02	.68	<.001	
	Age *T*1	−.03	.02	−.04	.070	.407***	.04	.01	.06	.002	.479
Model 2	*Constant*	6.38	1.51		<.001		−.18	1.00		.859	
	*Y T*1	.61	.02	.63	<.001		.68	.02	.67	<.001	
	Age *T*1	−.04	.02	−.05	.019		.03	.01	.06	.006	
	Autonomous *T*1	.79	.23	**.08**	**.001**		.34	.16	.05	.031	
	Introjected *T*1	.04	.14	.01	.773		.06	.10	.01	.554	
	External *T*1	−.31	.18	−.04	.091	.006**	−.09	.12	−.02	.465	.002

		Y = sweets/savouries intake *T*2 (*N* = 1368)					*Y* = meat intake *T*2 (*N* = 1367)					*Y* = alcohol frequency *T*2 (*N* = 1387)				
		B	SE B	β	*p*-value	$R^2/\Delta R^2$	B	SE B	β	*p*-value	$R^2/\Delta R^2$	B	SE B	β	*p*-value	$R^2/\Delta R^2$
Model 1	*Constant*	1.19	.35		.001		1.33	.33		<.001		−.12	.15		.425	
	*Y T*1	.69	.02	.71	<.001		.68	.02	.63	<.001		.83	.02	.81	<.001	
	Age *T*1	<.01	.01	.01	.747	.503***	< −.01	.01	−.02	.450	.395***	.01	.01	.04	.008	.669
Model 2	*Constant*	1.09	.52		.036		1.26	.48		.009		−.26	.24		.262	
	*Y T*1	.69	.02	.71	<.001		.68	.02	.62	<.001		.83	.02	.81	<.001	
	Age *T*1	<.01	.01	.01	.763		< −.01	.01	−.02	.428		.01	<.01	.04	.014	
	Autonomous *T*1	.01	.08	<.01	.866		<.01	.07	<.01	.993		<.01	.04	<.01	.990	
	Introjected *T*1	.04	.05	.02	.359		< −.01	.04	< −.01	.944		−.01	.02	−.01	.732	
	External *T*1	−.06	.06	−.02	.300	.001	.04	.06	.02	.493	<.001	.08	.03	**.05**	**.006**	.002*

Note: *Y* corresponds to the food variable either at Time 1 (*Y T*1) or Time 2 (*Y T*2). There were no significant motivational predictors of changes for sweets/savouries and meat consumption in women.
*$p < .05$; **$p < .01$; ***$p < .001$.

Table 6. Longitudinal regressions with SDT-based measures (*T*1) as predictors for change in food choices (*T*2) *in men*, controlled for age and initial food choice (*T*1).

		Y = vegetables/salad intake v (*N* = 1131)					*Y* = fruit intake *T*2 (*N* = 1129)									
		B	SE B	*β*	*p*-value	R^2 /ΔR^2	B	SE B	*β*	*p*-value	R^2 /ΔR^2	B	SE B	*β*	*p*-value	R^2 /ΔR^2
Model 1	*Constant*	6.62	1.11		<.001		.52	.64		.416						
	*Y T*1	.64	.02	.63	<.001		.79	.02	.77	.000						
	Age *T*1	−.01	.02	−.01	.610	.398***	.02	.01	.04	.034	.567***					
Model 2	*Constant*	5.11	1.53		.001		.66	.92		.476						
	*Y T*1	.63	.02	.63	<.001		.79	.02	.77	<.001						
	Age *T*1	−.01	.02	−.01	.561		.02	.01	.04	.052						
	Autonomous *T*1	.38	.24	.04	.122		−.01	.15	< −.01	.963						
	Introjected *T*1	.16	.17	.03	.355		−.15	.10	−.03	.142						
	External *T*1	−.41	.20	−.05	.043	.004	.23	.12	.04	.062	.001					
		Y = sweets/savouries intake *T*2 (*N* = 1131)					*Y* = meat frequency *T*2 (*N* = 1134)					*Y* = alcohol frequency *T*2 (*N* = 1142)				
Model 1	*Constant*	.52	.64		.416		2.28	.42		<.001		.51	.25		.042	
	*Y T*1	.79	.02	.77	<.001		.66	.02	.64	<.001		.81	.02	.82	<.001	
	Age *T*1	.02	.01	.04	.034	.485***	−.01	.01	−.03	.172	.417***	.01	<.01	.01	.613	.676***
Model 2	*Constant*	.66	.92		.476		3.01	.57		<.001		.41	.37		.262	
	*Y T*1	.79	.02	.77	<.001		.65	.02	.63	<.001		.81	.02	.82	<.001	
	Age *T*1	.02	.01	.04	.052		−.01	.01	−.03	.195		<.01	<.01	.01	.608	
	Autonomous *T*1	−.01	.15	< −.01	.963		−.19	.09	**−.06**	**.027**		.02	.06	.01	.680	
	Introjected *T*1	−.15	.10	−.03	.142		−.02	.06	−.01	.785		.03	.04	.01	.543	
	External *T*1	.23	.12	.04	.062	.001	.16	.07	**.06**	**.025**	.005*	−.06	.05	−.02	.266	<.001

Note: SDT: self-determination theory. *Y* corresponds to the food variable either at Time 1 (*Y T*1) or at Time 2 (*Y T*2).
*$p < .05$; **$p < .01$; ***$p < .001$.

Table 7. Summary of logistic regression analysis with SDT-based measures (*T*1) as predictors for change in *vigorous PA*.

	Women						Men					
	B	SE	OR	95% CI	Wald statistic	p	B	SE	OR	95% CI	Wald statistic	p
	Inactive (N = 560) *vs. Maintainer* (N = 420)						*Inactive* (N = 420) *vs. Maintainer* (N = 430)					
Constant	1.02	.45	2.76		5.18	.023	.30	.46	1.35		.42	.516
Age *T*1	−.05	.01	.95	[.94, .96]	79.50	**<.001**	−.03	.01	.97	[.96, .98]	32.02	**<.001**
Autonomous *T*1	.21	.07	1.24	[1.08, 1.41]	9.64	**.002**	.26	.08	1.29	[1.12, 1.50]	11.80	**.001**
Introjected *T*1	.10	.04	1.10	[1.02, 1.20]	5.52	**.019**	.07	.05	1.07	[.97, 1.18]	1.84	.175
External *T*1	−.09	.05	.92	[.82, 1.02]	2.66	.103	−.08	.06	.93	[.82, 1.04]	1.60	.206
Model $\chi^2(4) = 47.84$, $p = <.001$; Pseudo-$R^2 = .06$ (Cox & Snell), .07 (Nagelkerke)							Model $\chi^2(4) = 101.91$, $p \leq .001$; Pseudo-$R^2 = .10$ (Cox & Snell), .13 (Nagelkerke)					
	Inactive (N = 560) *vs. Adopter* (N = 136)						*Inactive* (N = 420) *vs. Adopter* (N = 97)					
Constant	−1.16	.66	.31		3.16	.075	−1.3	.74	.28		3.02	.082
Age *T*1	−.03	.01	.97	[.95, .98]	16.47	<.001	−.02	.01	.98	[.96, 1.0]	6.43	.011
Autonomous *T*1	.25	.10	1.28	[1.05, 1.55]	6.14	.013	.23	.12	1.26	[1.0, 1.6]	3.73	.054
Introjected *T*1	.04	.06	1.04	[.93, 1.17]	.47	.495	.05	.08	1.05	[.90, 1.22]	.39	.533
External *T*1	−.04	.08	.96	[.83, 1.12]	.25	.616	−.14	.10	.87	[.73, 1.05]	2.02	.155
Model $\chi^2(4) = 22.04$, $p \leq .001$; Pseudo-$R^2 = .03$ (Cox & Snell), .05 (Nagelkerke)							Model $\chi^2(4) = 11.45$, $p \leq .02$; Pseudo-$R^2 = .02$ (Cox & Snell), .04 (Nagelkerke)					
	Maintainer (N = 420) *vs. Quitter* (N = 134)						*Maintainer* (N = 430) *vs. Quitter* (N = 97)					
Constant	.99	.99	.75		.20	.651	−1.60	.72	.20		4.97	.026
Age *T*1	.01	.01	1.01	[.99, 1.03]	.95	.330	.03	.01	1.03	[1.02, 1.05]	14.04	<.001
Autonomous *T*1	−.22	.10	.80	[.65, .98]	4.53	.033	−.35	.11	.71	[.57, .88]	9.27	.002
Introjected *T*1	.01	.06	1.01	[.89, 1.14]	.02	.881	.03	.08	1.03	[.88, 1.21]	.12	.734
External *T*1	−.01	.08	.99	[.84, 1.16]	.03	.875	−.01	.10	.99	[.81, 1.21]	.02	.898
Model $\chi^2(4) = 5.22$, $p > .05$; Pseudo-$R^2 = .01$ (Cox & Snell), .01 (Nagelkerke)							Model $\chi^2(4) = 47.84$, $p \leq .001$; Pseudo-$R^2 = .06$ (Cox & Snell), .07 (Nagelkerke)					

Note: SDT: self-determination theory; OR: odds ratio; CI: confidence interval; PA: recreational physical activity.
Inactive was defined by <80 MET-min pro week of vigorous PA at *T*1 (baseline) and *T*2 (follow up). Maintainer was defined by ≥80 MET-min pro week of vigorous PA at *T*1 and *T*2. Adopter was defined by <80 METs-min pro week at *T*1, and ≥80 METs-min pro week of vigorous PA at *T*2. Quitter was defined by ≥80 METs-min pro week of vigorous PA at *T*1 and <80 METs-min at *T*2.

Table 8. Longitudinal Regression with SDT-based measures (*T*1) predicting *changes* in BMI (*T*2), controlled for age and initial BMI (*T*1). Different regression models were conducted for normal weight and overweight participants and for men and women.

		Women ($N = 1005$)					Men ($N = 537$)				
		B	SE B	β	p-value	$R^2/\Delta R^2$	B	SE B	β	p-value	$R^2/\Delta R^2$
Normal weight (BMI < 25)											
Model 1	*Constant*	.82	.31		.01		1.79	.69		.010	
	BMI *T*1	.96	.01	.91	<.001		.93	.03	.81	<.001	
	Age *T*1	<.01	<.01	.01	.485	.826***	< −.01	<.01	−.01	.736	.648
Model 2	*Constant*	.67	.34		.045		1.51	.72		.037	
	BMI *T*1	.97	.01	.91	<.001		.93	.03	.80	<.001	
	Age *T*1	<.01	<.01	.01	.659		< −.01	<.01	−.02	.493	
	Autonomous *T*1	.04	.03	.02	.110		.05	.04	.04	.217	
	Introjected *T*1	−.04	.02	**−.04**	**.007**		.02	.03	.02	.596	
	External *T*1	.01	.02	.01	.706	.002*	.02	.04	.02	.548	.003
Overweight (BMI ≥ 25)											
Model 1	*Constant*	4.40	1.31		.001		5.89	.89		<.001	
	BMI *T*1	.82	.04	.77	<.001		.81	.03	.76	<.001	
	Age *T*1	.01	.01	.03	.335	.590	−.01	.01	−.04	.160	.582
Model 2	*Constant*	3.56	1.55		.022		6.21	1.00		<.001	
	BMI *T*1	.82	.04	.77	<.001		.80	.03	.75	<.001	
	Age *T*1	.01	.01	.03	.360		−.01	<.01	−.04	.112	
	Autonomous *T*1	.04	.16	.01	.780		−.05	.09	−.02	.542	
	Introjected *T*1	.17	.11	.06	.145		−.03	.07	−.01	.677	
	External *T*1	< −.01	.13	< −.01	.981	.004	.16	.07	.06	.034	.004

Note: SDT: self-determination theory; *T*1: time 1; *T*2: time 2.
***$p < .001$; **$p < .01$; *$p < .05$.

significant predictor for positive changes in food choices in both genders. More precisely, women reported higher vegetables/salad intake ($\beta = .08$, $p = .001$) at *T*2, while men reported lower meat consumption at *T*2 ($\beta = -.06$, $p = .027$). In contrast, external regulation was associated with negative changes in food choices. In particular, women tended to increase their alcohol consumption frequency ($\beta = .05$, $p = .006$) and men increased their meat frequency ($\beta = .06$, $p = .025$). Introjected regulation was not a significant predictor of change in food choices. No significant results were observed for sweets (incl. savouries) and fruit consumption in either men or women.

Table 7 displays the results of the various logistic regressions on changes in vigorous PA as outcomes and the types of regulation as predictors. First, the models predicting the likelihood of being a maintainer (vs. inactive) between *T*1 and *T*2 given the different types of regulation was significant for both genders (female model: $\chi^2(4) = 47.84$, $p \leq .001$; male model: $\chi^2(4) = 101.91$, $p \leq .001$). Autonomous regulation significantly predicted maintenance in vigorous PA between waves for women ($b = .21$, Wald $\chi^2(1) = 9.64$, $p < .01$) and men ($b = .26$, Wald $\chi^2(1) = 11.80$, $p = .001$). The odds ration (OR) of 1.24 for women and of 1.29 for men indicates an increased likelihood of long-term PA maintenance. Introjected regulation predicted PA maintenance only in women ($b = .10$, Wald $\chi^2(1) = 5.52$, $p < .05$) and was associated with an odds ratio of 1.10 for being a PA maintainer. Thus, introjected regulation distinguishes between women who maintain physical activity and those who are inactive. Second, the full models predicting group membership for inactive vs. adopter were statistically significant in both genders (female model: $\chi^2(4) = 22.04$, $p \leq .001$; male model: $\chi^2(4) = 11.45$, $p \leq .\ 02$). However, contingency tables indicated that no participant was correctly predicted as an adopter by the models. The same was true for the models predicting group membership for maintainer vs. quitter. The model's prediction accuracy for quitting vigorous PA was 0%. Thus, the models were not considered as good models to predict changes in vigorous PA related to different types of regulation. Third, the same models as described above were tested for moderate PA (Appendix 1, Supplemental data). Based on the contingency tables, none of the tested models resulted in an improved prediction.

Table 8 displays the results of the hierarchical multiple regression analyses examining motivational predictors of change in BMI for normal weight (BMI < 25) and overweight (BMI ≥ 25) participants and for men and women separately. The only significant predictor for change in BMI was introjected regulation in normal weight women ($\beta = -.04$, $p = .007$), indicating a lower BMI one year later. None of the other types of regulation predicted changes in BMI in normal weight or overweight participants.

Discussion

The main goal of this study was to assess motivation regulation within SDT for the desire to achieve or maintain a healthy body weight in a large, random sampling-based panel of adults. We further examined whether different types of regulation (autonomous, introjected and external) were associated with one-year changes in food choices, recreational PA and BMI.

As hypothesised, autonomous regulation was the only type of motivation that predicted healthier food choices in the long term (i.e. increased vegetable intake in women and decreased meat intake in men). Autonomous regulation was also a significant predictor for long-term engagement in vigorous PA in both genders. These results support the contention of SDT that autonomous goal-setting is associated with more advantageous health behaviours in the long term. Our results further suggest that autonomous regulation does not predict BMI changes in overweight and obese people. Even though they reported a healthy body weight as an important health goal and their high BMI suggests the necessity of weight loss, their BMI did not change within one year. As suggested previously, health concerns seem not to predict a significant amount of weight loss, and individuals reporting greater concern about their health are not any more successful in their weight loss attempts (Heinberg, Haythornthwaite, Rosofsky, McCarron, & Clarke, 2000). Concerns about the health effect of body weight might not be motivating enough to lose weight initially and overcome the barriers associated with weight-loss efforts without any interventions or guided weight-loss programmes. This is also substantiated by the result that autonomous regulation did not predict the adoption of moderate or vigorous PA. Perceived barriers (e.g. illness, lack of time) might hinder individuals in changing their PA behaviour permanently (Brinthaupt, Kang, & Anshel, 2010). Reasons for quitting PA might be diverse as well (e.g. bad health status, relocation into an activity-unfriendly environment), and apart from people's motivation to regulate their weight, other factors might be necessary to consider when predicting peoples' likelihood of quitting recreational PA. Overall, on a population basis, the adoption or quitting of recreational PA cannot be explained by people's self-determination towards body weight.

The results regarding introjected regulation were threefold. First, no associations between introjected regulation and food choices were observed. One might speculate that rather than focusing on the quality of foods chosen (e.g. vegetables) to regulate their weight, persons experiencing an introjected type of regulation are more concerned about the quantity of foods eaten. This thought is underpinned by the study by Pelletier et al. (2004), who identified introjected regulation of eating behaviour as positively linked with quantity rather than quality concerns regarding food. Consequently, perceived social expectations related to body image, striving for social approval and thus feelings of shame accompanying weight gain do not serve an important motivating function in the decision to engage in a healthy eating behaviour based on a high intake of favourable foods (e.g. vegetables) and a low intake of unfavourable foods (e.g. sweet, high-fat foods). In contrast, people might be at a higher risk of participating in dysfunctional eating behaviours (e.g. intense fasting) to regulate their weight (Verstuyf et al., 2012).

Second, introjected regulation predicts long-term adherence to vigorous, but not moderate, recreational PA; however, this was the case for females only. Our results match earlier findings addressing gender differences in the predictive potential of introjected regulation for exercise participation (Duncan et al., 2010; Wilson, Rodgers, Fraser, & Murray, 2004). Duncan et al. (2010) reported introjected regulation towards PA as the only significant predictor of exercise intensity in women, but not in men. Wilson et al. (2004) also found introjected regulation towards PA to be a significant predictor of exercise intention in women, but not in men. Women often exercise for weight and appearance reasons rather than for health reasons (Cash, Now, & Grant, 1994; McDonald & Thompson, 1992; Silberstein, Striegel-Moore, Timko, & Rodin, 1988), and evidence from the present study confirms that also on a population level, introjected regulation towards body weight is a significant predictor for vigorous PA in those women whose weight regulation attempts are appearance-oriented. Thus, self-imposed pressure based on a sense of obligation to successfully manage weight might evoke some kind of beneficial distress to exercise; however, introjected regulation has also been associated with negative psychological conditions such as lower self-worth and lower life satisfaction (Thøgersen-Ntoumani & Fox, 2007).

Third, introjected regulation predicted a lower body weight one year later. This was only the case for women who were classified as normal weight (BMI < 25). No association with weight development was observed in men. Body weight was reported as a central part of some women's sense of identity and social value (Clarke, 2002), and a desire to fit the sociocultural body ideal might be involved in women's concerns about weight gain. Indeed, body image dissatisfaction was reported to be greater in women with low general self-determination following media exposure to the 'thin ideal' (Mask & Blanchard, 2011), and introjected regulation seems to be related to a higher likelihood of striving for a socially prescribed ideal body size. Consequently, introjected regulation towards body weight appears to be an important aspect in the development of body size dissatisfaction. Those somehow externally induced weight management motives presumably act as underlying motivational forces to engage in unhealthy weight control behaviours (Thøgersen-Ntoumani, Ntoumanis, & Nikitaras, 2009). However, the present results also suggest a relationship with healthy weight loss activities such as the observed long-term vigorous exercise participation, which stands in contrast to the SDT that suggests that the more controlled forms of motivation are a less stable motivational basis in the long term (Deci & Ryan, 1987). Nevertheless, both a healthy eating pattern and engagement in PA are complementary factors in body weight regulation, and it remains unclear whether these people are more susceptible to weight gain or weight cycling caused by circumstances that temporarily prohibit PA, such as injuries.

Our analysis revealed that external regulation predicted negative changes in food choices. Mostly, externally motivated persons strive for extrinsic goal pursuits, such as acceptance by others or a demonstration of weight management abilities; they try to comply with others' demands and have not internalised a healthy body weight as an important factor for health and physical well-being. As our results indicate, balanced food choices and PA are not part of their strategies to maintain or achieve a healthy body weight. Additionally, external regulation in our study was more highly correlated with BMI in overweight participants than in normal weight participants, but external regulation had no impact on BMI in the long term in either the normal weight or overweight participants. These observations indicate that external regulation is rather a consequence than a cause of high BMI values. In fact, overweight and obese persons often need to deal with other people's expectations and social pressure, and they often receive more negative feedback from their social environment regarding their body weight than normal weight people do (Puhl & Heuer, 2009). Previous studies have emphasised a negative effect of social pressure on dietary habits (Satia, Kistal, Curry, & Trudeau, 2001), and accordingly, external regulation in our study was linked to an increase in meat consumption (men) and a trend towards increased alcohol consumption (women). This observation might indicate that eating behaviours are used to cope with distress that originates from external pressure to regulate weight; have self-comforting properties (Steptoe, Wardle, Pollard, Canaan, & Davies, 1996; Torres & Nowson, 2007); and might imply a refusal to diet at all (Puhl & Heuer, 2009; Puhl, Moss-Racusin, &

Schwartz, 2007). Additionally, 'prescribed' weight loss by a spouse or significant other might result in a perceived loss of self-determination and autonomy, and external forces can even disrupt conceptual engagement with a healthy body weight and its internalisation as one's own health goal (Ryan & Deci, 2000).

When interpreting the effects of the present longitudinal study, three aspects are important to consider. First, food frequencies and PA variables are based on self-reports; however, the FFQ and the GPAQ are sophisticated assessment tools for studies with large sample sizes and are suitable for long-term investigations at the population level (Armstrong & Bull, 2006; Bull, Maslin, & Armstrong, 2009; Cade, Thompson, Burley, & Warm, 2002). Second, data was gathered from a population-based sample. Compared to interventions or experimental studies with homogenous samples (e.g. students), the effects of survey research (real-life study) on population level can be weaker (Taris, 2000). However, these studies might serve as a basis for public health strategies and highlight effects among different sociodemographic groups. Third, the time interval of the present study is limited to one year, and changes in people's behaviour within one year are expected to be small. This is reflected in the fact that the pre-score of the dependent variable in the regressions explains most of the variance, and only a small amount of variance remains to be explained by the predictors. Using the same analysis, effect sizes observed in the present study are comparable with those from other studies explaining food behaviour (van Strien et al., 2014). Additionally, the study period under consideration was limited to one year; it is likely that longer follow-up periods would elicit greater effects (e.g. Jessor et al., 1995). Nevertheless, the impact of the body weight motivation on changes in people's health behaviour seems to be small and other factors might be also important to initiate behavioural changes. Despite these limitations, by conducting a longitudinal study, spurious correlations could be avoided and the causal ordering of effects could be examined. For example, even though external regulation and BMI were highly correlated in the cross-sectional analysis of the present study, external regulation did not predict BMI changes within one year. The study also highlights that in terms of motivation, even though it turned out to be an important factor for different health behaviours in the cross-sectional analysis, a lot of associations were not significant in the long term. Thus, cross-sectional studies could lead to an overestimation of the effects.

Conclusion

The results from this survey provide considerable insights into the relevance of weight management motives for healthy behaviours at the population level. Autonomous goal-setting for a healthy body weight seems to be more supportive in overcoming barriers to carry out healthy behaviours such as recreational PA and balanced food choices. Weight concerns regarding health are a motivational source for recreational PA adherence in both genders, whereas concern associated with body appeal and judgement by others was only a motivational source for recreational PA adherence in women.

The social context can catalyse or hinder personal growth and motivational development (Ryan & Deci, 2000), and according to the present results, a controlling social environment accompanied by pressure to change behaviour did not seem to be a beneficial condition for dietary improvements or the adoption of a PA routine. Applying strategies to lose weight requires additional effort, and none of the investigated types of motivation towards a healthy body weight seemed to be related to successful weight-loss efforts in overweight participants without intervention.

The results suggest that a translation of weight management strategies into daily health behaviours seems to be more sustainable in the long term when people's underlying regulatory processes are self-determined. Thus, by increasing people's knowledge about weight regulation strategies and how to overcome barriers to implement those strategies into a daily routine, they might feel more competent in regulating their weight, which is an essential factor for self-determined motivation regulation. Additionally, restrictiveness of socially constructed views regarding the body image of men and women, as well as social pressure from attached persons, might hinder some individuals from internalising successful weigh management as their own goal for good health and psychological well-being. Even in the public health domain, common forms of health promotion are based on campaigns of a stimulative nature. Public health campaigns should be designed and evaluated with regard to their potential to initiate internalisation of health goals. Taking the motivational tendencies of the target population into account seems to be more promising than emphasising the 'right' way to behave in a healthier manner.

Competing interests

The authors declare that they have no competing interest.

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Supplemental data

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Notes

1. Swiss Federal Statistical Office (2010).
2. Switzerland has four national languages (German, French, Italian, Rumantsch). Of Switzerland's population, about 65% are German-speaking, 23% are French-speaking, 8% are Italian-speaking and are .5% Rumantsch-speaking (Swiss Federal Statistical Office, 2012). German-speaking and French-speaking people represent the majority of Switzerland's population and thus were the only ones included in the study.
3. The aim was to assess motives for why people try to regulate weight, and the authors are aware that a subjective perception of a healthy weight is not necessarily equal to an objective perception of a healthy weight.
4. According to the GPAQ analysis guide, values of less than 10 min of vigorous or moderate PA are considered as negligible and respondents are categorised as inactive. Therefore, 10 min per week of moderate PA (4 METs × 10 min = 40 METs-min) and 10 min per week of vigorous PA (8 METs × 10 min = 80 METs-min) are considered as cut-off values for moderate PA and vigorous PA, respectively.

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