Extended Theory of Planned Behavior on Eating and Physical Activity

Oi Ying Cheng, BSc
Claudia Long Ying Yam, BSc
Ning Sum Cheung, BSc
Pui Lo Penny Lee, BSc
Ming Chu Ngai, BSc
Chung-Ying Lin, PhD, OT/L

Objectives: The evidence for Theory of Planned Behavior (TPB) on explaining weight-reduction behaviors (healthy eating [HE] and physical activity [PA]) is inconsistent. Meanwhile, research has acknowledged that the role of weight-related self-stigma may influence HE and PA engagement. We proposed and evaluated an extended TPB model incorporating weight-related self-stigma. **Methods:** Through convenience sampling, we assessed the TPB factors of university students with overweight (65 men and 39 women). The students completed several questionnaires assessing subjective norms (from normative beliefs), attitudes, perceived behavioral control (from control beliefs), and behavioral intentions (on HE and PA). They also responded to questions regarding their weight-related self-stigma, HE (measured using a questionnaire on maladaptive eating behaviors), and PA. **Results:** The extended TPB partially explained HE and PA behaviors: weight-related self-stigma was significantly and directly associated with both HE ($\beta = 0.27$; $p = .001$) and PA ($\beta = -0.30$; $p = .006$). Perceived behavioral control was only indirectly associated with PA through intention. Behavioral intention was significantly associated with PA ($\beta = 0.26$; $p = .044$), but not with HE ($\beta = -0.001$; $p = .99$). **Conclusions:** Our findings partially support the extended TPB; however, our findings should be interpreted with caution because of the poor generalizability caused by our convenience sampling method.

Key words: obese; overweight; stigma; theory of planned behavior; young adult
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About 31.3% of persons 15-34 years of age in Hong Kong are classified as overweight or obese.[1] Unhealthy diet and physical inactivity are the main causes of overweight/obesity.[2] In Hong Kong, most young adults experience problems in maintaining healthy lifestyles; for instance, adhering to a healthy diet and carrying out regular PA: 95.4% of people aged 15-34 do not eat the recommended, adequate amounts of fruits or vegetables.[1] This may be due to the frequent eating-out behavior of the Hong Kong culture, which puts young adults at risk of being overweight/obese. Therefore, it is important to help young adults, especially those who are overweight/obese, engage in weight-reduction behaviors.[3] In this study, we focused on healthy eating (HE) and physical activity (PA). Moreover, we used maladaptive eating behaviors to represent a certain type of HE and assessed the metabolic equivalent of task (MET) to indicate the level of PA.

To design effective and successful treatment, it is important to explore whether any theory is capable of explaining HE and PA behaviors among young adults. A theory allows healthcare providers to conceptualize and handle therapy processes. Theory also can assist and guide healthcare provid-

Oi Ying Cheng, Claudia Long Ying Yam, Ning Sum Cheung, Pui Lo Penny Lee, Ming Chu Ngai, Research Assistants and Chung-Ying Lin, Assistant Professor, The Hong Kong Polytechnic University, Department of Rehabilitation Sciences, Hung Hom, Hong Kong.
Correspondence Dr Lin; cylin36933@gmail.com; cy.lin@polyu.edu.hk

ers to understand the needs of care recipients and in turn, can lead to successful treatment outcomes. Hence, theory is an essential element for finding out why people behave as observed and what interventions evoke desired behavioral changes. Accordingly, applying theory needs to be considered in treatments.[4] Indeed, research has found that interventions developed using theory are efficacious,[5,6] which indicates the importance of identifying a model to describe HE and PA for young adults.

The Theory of Planned Behavior (TPB), a potential theory to tackle weight-reduction behaviors,[7] contains 4 main constructs: behavioral intention, attitude, subjective norms, and perceived behavioral control (PBC). Attitude, subjective norms, and PBC are proposed to predict behavioral intention. Moreover, behavioral intention and PBC directly affect behavioral outcomes such as HE and PA.[7]

Ajzen proposes[7] that attitude consists of 2 components: *affective attitude*, which reflects the enjoyment and negative feelings derived from the performance of behavior and *evaluation attitude*, which reflects the perceived advantage or disadvantage of performing an action. Using people as an example, the feeling of satisfaction may be derived by participating in sports, and such a positive attitude may motivate individuals to engage in weight-reduction behaviors. Subjective norms come from normative beliefs and are an individual's perception of normative belief as to whether people should perform the behavior. For instance, people who are obese may perceive that being overweight incurs shame from their friends, and therefore, they should adopt weight-reduction behaviors. PBC that comes from control beliefs is an individual's perception of how difficult it is to perform a particular behavior. For example, individuals with obesity will engage in weight-reduction behaviors if they believe in their ability to lose weight with available facilities.

Indeed, a large amount of empirical evidence supports the use of TPB and some studies show that TPB effectively predicts the eating behavior[8] and physical activity.[9] Also, Godin et al[10] support the effectiveness of TPB on PA (as compared with sedentary behaviors) – that adults have significant increases in moderate to vigorous PA in a 3-month follow-up following an intervention based on the TPB model. Wasserkampf et al[11] found significant increases in moderate to vigorous PA at both 12- and 24-month follow-ups in a TPB intervention. However, some researchers have found that TPB partially predicted weight-reduction behaviors among women in a weight-reduction program. For example, Gardner and Hausenblas[12] found that diet adherence (ie, whether a person can consume the food listed on the diet without eating the non-listed food) but not exercise adherence (ie, whether a person can participate in a scheduled exercise program) was predicted by behavioral intention. Additionally, prediction using TPB was successful in New Zealand children but not in Native American children.[13,14] Therefore, TPB may be effective in predicting some but not all weight-reduction behaviors among all types of populations.

There is a debate regarding the use of TPB because of its parsimony. Some researchers think that TPB is too simple to explain the complicated underlying mechanisms of behaviors; they suggest retiring TPB.[15] In contrast, others argue that TPB is flexible and can be expanded.[16,17] For example, Lin et al[18] expanded the TPB by adding the pregnant women's relationship with husbands, action planning, and coping planning to assess their medication adherence. Strong et al[19] expanded the TPB by adding sleep knowledge, action planning, and coping planning on adolescents to assess their sleep hygiene behaviors.

We consider that the idea of expanding TPB may help explain our target behaviors in young adults with obesity (ie, HE and PA) as there may be other factors (eg, weight bias[20,21] or weight-related self-stigma[22]) contributing to our target behaviors. Therefore, we incorporated weight-related self-stigma into the TPB for our study.

Weight-related self-stigma, one type of weight stigma, is a kind of self-devaluation when people who are obese internalize or personalize negative social evaluation to themselves.[23,24] This stigma is a major contributor of self-prejudicial reactions (eg, individuals with obesity have less willpower and are less deserving of a fulfilling social life) and self-discriminatory reactions, and subsequently, results in low self-efficacy and lowered quality of life.[25,26] In addition, weight-related self-stigma may prevent people with obesity from performing weight-reduction behaviors. One study indicated a negative association between weight-related self-stigma and PA.[27] Another study revealed that weight-related

self-stigma decreased the engagement in PA among women with obesity.[28] Given the crucial role of weight-related self-stigma, we proposed to incorporate it into TPB, and the term "extended TPB" was used to indicate the TPB incorporated with weight-related self-stigma in this present study.

Given that no studies have used TPB to assess HE and PA for Hong Kong people who are overweight, the present study aimed to examine the relationships between the constructs in the extended TPB and attempts to explain HE and PA among overweight young adults. Specifically, factors that influence behaviors can differ as a function of culture, *research is thus needed to evaluate the validity of the TPB in weight-reduction behaviors in an East Asian country* (such as Hong Kong) before the TPB is used to inform the development of weight-reduction treatments. *Moreover, traditional Chinese culture values overweight (eg, becoming obese indicates good luck); thus, attitudes toward being overweight or obese in China may somewhat differ from the attitudes in Western countries*.

We hypothesized that subjective norms, participants' attitude, PBC, and weight-related self-stigma would be associated with behavioral intentions in HE and PA. We also hypothesized that PBC, behavioral intentions, and weight-related self-stigma would be directly associated with HE and PA.

METHODS

Participants and Procedures

Through convenience sampling, 324 young adults were recruited from a university campus, and each completed a survey on *Google Form*. Specifically, several occupational therapy students in a Hong Kong university invited potential participants in the campus. After identifying the eligibility of the potential participants, the students explained the study purpose to the potential participants. If a participant had a smartphone/laptop/tablet and agreed to participate, the student provided a QR code or a link for the participant to complete the questionnaires online. If a participant did not have any device to answer the online questionnaire and agreed to participate, the student provided a smartphone for the participant to complete the questionnaires on the *Google Form*. The participants were assured of their anonymity and informed of the study details. Only those who agreed to participate in this study (ie, they selected "agree" in the informed consent question) could continue to complete the questionnaires. Because this study focused on young adults, only data from those with a BMI ≥ 23 kg/m^2 (the cutoff of overweight for Asians[29]) were analyzed. Other inclusion criteria included: (1) 18-30 years old; (2) able to read and understand Chinese; and (3) agreed to participate. Participants were excluded if they had neurological illness (eg, stroke and spinal cord injury), functional disability (eg, blindness), and any kind of psychosis or intellectual disability. The exclusion criteria were assessed through self-reports. Finally, 65 men and 39 women were eligible for data analyses.

Measures

Apart from the questionnaires described below (ie, Weight-reduction Behaviors, TPB components, and Weight-related Self-stigma sections), the online survey included several questions regarding the participants' age, sex, height, weight, and disease status.

Weight-reduction Behaviors

We used the *Three-Factor Eating Questionnaire–Revised 18-item version (TFEQ-R18)*[30] to measure participants' eating behaviors through 3 different aspects: restrained eating (6 items), uncontrolled eating (9 items), and emotional eating (3 items). All items were rated on a 4-point Likert scale, except for the last item rated on a 6-point Likert scale. The TFEQ-R18 is an appropriate instrument for measuring eating behavior, with Cronbach's alphas of 0.75 for cognitive restraint, 0.85 for uncontrolled eating, and 0.87 for emotional eating.[30] A higher score in TFEQ-R18 indicates unhealthier eating behaviors.

We used the *International Physical Activity Questionnaire (IPAQ)* Chinese version short form[31] to measure participants' PA. It is a self-administered questionnaire that measures activity habits during the previous week. The item scores of time and days spent on different levels of physical activities are converted to MET-minute per week scores, with the formula of *MET level x minutes of activity/day x days per week*. The IPAQ form is a valid instrument for PA, with a content validity index of 0.99.[32] It also has satisfactory test-retest reliability, with an intraclass correlation coefficient = 0.79.[33]

Table 1
Questionnaire using Theory of Planned Behavior

	Health eating	Physical activity
Attitude	**For me to eat healthily is…**	**For me to exercise at least 30 minutes, 3 days per week is…**
Item 1	useful/useless	useful/useless
Item 2	beneficial/harmful	beneficial/harmful
Item 3	wise/foolish	wise/foolish
Item 4	good/bad	good/bad
Item 5	pleasant/unpleasant	pleasant/unpleasant
Item 6	correct/incorrect	correct/incorrect
Item 7	enjoyable/unenjoyable	enjoyable/unenjoyable
Item 8	satisfying/unsatisfying	satisfying/unsatisfying
SN		
Item 1	People who are important to me would approve of me thinking clearly before eating every day.	People who are important to me would approve of me exercising at least 30 minutes, 3 days per week.
Item 2	I feel under social pressure to think clearly before eating every day.	I feel under social pressure to exercise at least 30 minutes, 3 days per week.
Item 3	It is expected of me that I should think clearly before eating every day.	It is expected of me that I should exercise at least 30 minutes, 3 days per week
PBC		
Item 1	How much personal control do you feel you have over whether you think clearly before eating in the next week?	How much personal control do you feel you have over whether you exercise at least 30 minutes, 3 days in the next week?
Item 2	Whether or not I think clearly before eating in the next week is entirely up to me.	Whether or not I exercise at least 30 minutes, 3 days in the next week is entirely up to me
Item 3	How much do you feel that whether you think clearly before eating is beyond your control?	How much do you feel that whether you exercise at least 30 minutes, 3 days per week is beyond your control?
Item 4	How confident are you that you will be able to think clearly before eating in the next week?	How confident are you that you will be able to exercise at least 30 minutes, 3 days in the next week?
Item 5	To what extent do you see yourself as being capable of thinking clearly before eating in the next week?	To what extent do you see yourself as being capable of exercising at least 30 minutes, 3 days in the next week?
Intention		
Item 1	I plan to think clearly before eating from now on.	I plan to exercise at least 30 minutes, 3 days per week from now on.
Item 2	I will try to think clearly before eating from now on.	I will try to exercise at least 30 minutes, 3 days per week from now on.
Item 3	I intend to think clearly before eating from now on.	I intend to exercise at least 30 minutes, 3 days per week from now on.

Note.
SN = subjective norms
PBC = perceived behavioral control

TPB Components (Table 1)

Attitude. We used an 8-item semantic differential scale to measure participants' attitude toward HE and PA. Item stems "For me to eat healthily is…" and "For me to exercise at least 30 minutes, 3 days per week is…" were used for HE and PA be-

Table 2
Participant Characteristics (N = 104)

	M (SD)		
	Entire sample	**Male sample**	**Female sample**
Age (year)	22.08 (2.97)	22.71 (3.12)	21.03 (2.39)
Sex (men)[a]	65 (62.5)	65 (100)	0 (0)
Height (cm)	168.73 (8.38)	173.22 (6.27)	161.25 (5.67)
Weight (kg)	77.06 (13.46)	82.38 (13.18)	68.19 (8.31)
Body mass index (kg/m^2)	26.98 (3.66)	27.43 (4.04)	26.22 (2.83)
TFEQ score (1-4 Likert scale)	2.25 (0.40)	2.28 (0.44)	2.20 (0.32)
IPAQ score (MET)	1923.01 (1949.44)	1996.06 (2156.27)	1801.26 (1563.90)
WBIS (1-5 Likert scale)	3.08 (0.71)	3.04 (0.72)	3.14 (0.72)
Attitude toward healthy eating (1-7 Likert scale)	5.60 (0.86)	5.59 (0.90)	5.61 (0.81)
Attitude toward physical activity (1-7 Likert scale)	5.95 (0.92)	6.00 (0.94)	5.87 (0.89)
Subjective norms toward healthy eating (1-7 Likert scale)	4.21 (1.53)	4.15 (1.51)	4.32 (1.59)
Subjective norms toward physical activity (1-7 Likert scale)	4.28 (1.62)	4.28 (1.59)	4.28 (1.69)
PBC toward healthy eating (1-7 Likert scale)	4.86 (0.83)	5.07 (0.74)	4.49 (0.85)
PBC toward physical activity (1-7 Likert scale)	4.68 (1.28)	5.04 (1.08)	4.08 (1.37)
Intention toward healthy eating (1-7 Likert scale)	4.53 (1.52)	4.52 (1.39)	4.56 (1.74)
Intention toward physical activity (1-7 Likert scale)	4.82 (1.75)	5.00 (1.68)	4.52 (1.85)

Note.
a: Reported in N (%)
TFEQ = Three-Factor Eating Questionnaire–Revised 18-item version
IPAQ = International Physical Activity Questionnaire
MET = metabolic equivalent; 1 MET equals to 3.5 ml of Oxygen expenditure.
WBIS = Weight Bias Internalization Scale
WSSQ = Weight Self-Stigma Questionnaire
PBC = Perceived behavioral control

haviors, respectively. All items were measured with a 7-point bipolar scale (from 1 to 7)[7] on 8 bipolar adjective pairs (*useful–useless, beneficial–harmful, wise–foolish and good–bad, pleasant–unpleasant, correct–incorrect, enjoyable–unenjoyable* and *satisfying–unsatisfying*) for each item stem. The internal consistency of all items on people with epilepsy is excellent (α = 0.91).[34]

Subjective norms. Items "People who are important to me would approve of me … every day," "I feel under social pressure to … every day," and "It is expected of me that I should … every day" were used to measure subjective norms toward eating behaviors (with the blank filled in with "thinking/think clearly before eating") and PA (with the blank filled in with "exercising/exercise at least 30 minutes, 3 days per week"). Each statement was rated on a 7-point bipolar scale ranging from 1 to 7. Higher scores indicated higher levels of the subjective norms. The internal consistency of these 3 items on people with epilepsy has been shown to be excellent (α = 0.90).[34]

Perceived behavioral control (PBC). Items "How much personal control do you feel you have over whether you … in the next week?" "Whether or not I … in the next week is entirely up to me," "How much do you feel that whether you … is beyond your control?" "How confident are you that you will be able to … in the next week?" and "To what extent do you see yourself as being capable of … in the next week?" was used to measure PBC toward eating behaviors (with the blank

Table 3
Step-by-step Multiple Regression Models on Intention to Healthy Eating (N = 104)

	Dependent variable: Intention to healthy eating			
	B (SE)/ β (p-value)			
Attitude[a]	**0.66 (.16)/ 0.38 (< .001)**	**0.43 (.15)/ 0.25 (.004)**	0.29 (.15)/ 0.17 (.05)	**0.39 (.15)/ 0.22 (.01)**
Subjective norms[a]	--	**0.47 (.08)/ 0.47 (< .001)**	**0.43 (.08)/ 0.43 (< .001)**	**0.35 (.08)/ 0.35 (< .001)**
PBC[a]	--	--	**0.49 (.15)/ 0.27 (.002)**	**0.45 (.15)/ 0.25 (.003)**
WBIS score	--	--	--	**0.54 (.17)/ 0.26 (.002)**
R^2	0.141	0.346	0.406	0.464
Adjusted R^2	0.133	0.333	0.388	0.442
ΔR^2	--	0.205	0.060	0.058

Note.
Significant coefficients are presented in bold.
a: Attitude, subjective norms, and perceived behavioral control (PBC) on healthy eating
WBIS = Weight Bias Internalization Scale
PBC = perceived behavioral control

filled in "thinking/think clearly before eating") and PA (with the blank filled in "exercising/exercise at least 30 minutes, 3 days"). We used 7-point bipolar scales ranging from 1 to 7 to assess each item. Higher scores indicated higher levels of the PBC. The internal consistency of the 5 items is excellent (α = 0.85).[35]

Behavioral intention. We used items adopted from Sparks, Guthrie and Shepherd[36] to measure behavioral intention. Specifically, "I plan to … from now on," "I will try to … from now on," and "I intend to … from now on" were used to measure behavioral intention toward eating behaviors (with the blank filled in "think clearly before eating") and PA (with the blank filled in "exercise at least 30 minutes, 3 days per week"). We used 7-point bipolar scales ranging from 1 to 7 to assess each item. Higher scores indicated higher levels of behavioral intention. The internal consistency of the 3 items is excellent (α = 0.81).[37]

Weight-related Self-stigma

Weight Bias Internalization Scale (WBIS). We used the 11-item WBIS[23] to measure participants' internalized weight bias. All items were rated on a 5-point bipolar scale from 1 (strongly disagree) to 5 (strongly agree), and a higher score indicated a higher level of weight-related self-stigma. WBIS is a reliable instrument, with a Cronbach's alpha of 0.87.[38]

Data Analysis

We analyzed data using SPSS 23.0 (IBM Corp., Armonk, NY). We conducted descriptive analyses, including frequencies (for categorical variables) and mean (for continuous variables), for all demographic data and questionnaire scores. Four multiple regression models were constructed to understand the significant variables for intention to weight-reduction behaviors and the final weight-reduction behaviors. Before testing the multiple regression models, we applied the Shapiro-Wilk test to test the distributions of all the measures. The nonsignificant p-values (ranging 0.86 and 0.98) indicated that all measures were normally distributed. Therefore, the use of regression models was justified.

We constructed 4 regression models that had controlled demographics: age, sex, and BMI. The first model (Model 1) used intention of HE as the dependent variable, TPB factors except for intention (ie, attitude, subjective norms, and PBC), and WBIS as the independent variables. The sec-

Table 4
Step-by-step Multiple Regression Models on Healthy Eating (N = 104)

	Dependent variable: TFEQ score		
	B (SE)/ β (p-value)		
Attitude[a]	0.01 (.05)/ 0.03 (.81)	0.002 (.051)/ 0.005 (.96)	-0.03 (.05)/ -0.06 (.62)
Subjective norms[a]	0.03 (.03)/ 0.13 (.27)	0.04 (.03)/ 0.13 (.26)	0.04 (.03)/ 0.17 (.15)
Intention[a]	-0.02 (.03)/ -0.08 (.53)	-0.03 (.03)/ -0.11 (.40)	-0.01 (.04)/ -0.03 (.85)
PBC[a]		0.05 (.06)/ 0.10 (.39)	0.04 (.05)/ 0.09 (.42)
WBIS score			**-0.13 (.06)/ -0.22 (.04)**
R^2	0.013	0.021	0.061
Adjusted R^2	-0.016	-0.019	0.013
ΔR^2	--	0.007	0.040

Note.
Significant coefficients are presented in bold.
a: Attitude, subjective norms, perceived behavioral control (PBC), and behavioral intention on healthy eating
TFEQ = Three-Factor Eating Questionnaire–Revised 18-item version
WBIS = Weight Bias Internalization Scale
PBC = perceived behavioral control

ond model (Model 2) used intention of PA as the dependent variable, TPB factors except for intention (ie, attitude, subjective norms, and PBC), and WBIS as the independent variables. The third model (Model 3) used the TFEQ-R18 score as the dependent variable, and all the TPB factors (ie, attitude, subjective norms, PBC, and intention) as the independent variables. The fourth model (Model 4) used IPAQ score as the dependent variable, and all the TPB (ie, attitude, subjective norms, PBC, and intention) as the independent variables.

We further conducted another 4 step-by-step multiple regression models, which did not control for any demographic variables to understand the unique contribution of extended TPB factors on behavioral intentions and HE/PA behaviors. For these step-by-step multiple regression models, we first used behavioral intentions (including HE and PA intentions) as dependent variables and entered attitude as the only independent variable in the first step. Then, we entered attitude and subjective norms as independent variables in the second step. Attitude, subjective norms, and PBC were entered as the independent variables in the third step. Finally, attitude, subjective norms, PBC, and weight-related self-stigma were entered as independent variables in the last step.

Afterward, we used HE and PA behaviors as dependent variables, and used attitude as the only independent variable in the first step. Then, we used attitude and subjective norms as independent variables in the second step, attitude, subjective norms, and intention as independent variables in the third step, and attitude, subjective norms, intention, and PBC as independent variables in the fourth step. In the last step, we used attitude, subjective norms, intention, PBC, and weight-related self-stigma as independent variables. We considered that the step-by-step multiple regression models were appropriate because we could compare the R^2 changes between every 2 steps and identify the unique contribution of each independent variable.

RESULTS

Table 2 presents the demographics of the entire

Table 5
Step-by-step Multiple Regression Models on Intention to Physical Activity (N = 104)

	Dependent variable: Intention to physical activity			
	B (SE)/ β (p-value)			
Attitude[a]	**0.74 (.17)/ 0.40 (< .001)**	**0.55 (.17)/ 0.29 (.002)**	0.13 (.17)/ 0.07 (.45)	0.144 (.17)/ 0.07 (.41)
Subjective norms[a]	--	**0.36 (.10)/ 0.33 (< .001)**	**0.32 (.09)/ 0.29 (< .001)**	**0.29 (.09)/ 0.27 (.002)**
PBC[a]	--	--	**0.69 (.12)/ 0.49 (< .001)**	**0.68 (.12)/ 0.50(< .001)**
WBIS score	--	--	--	0.14 (.20)/ 0.06 (.50)
R^2	0.157	0.253	0.434	0.437
Adjusted R^2	0.149	0.238	0.417	0.414
ΔR^2	--	0.096	0.182	0.003

Note.
Significant coefficients are presented in bold.
a: Attitude, subjective norms, and perceived behavioral control (PBC) on physical activity
WBIS = Weight Bias Internalization Scale
PBC = perceived behavioral control

Table 6
Step-by-step Multiple Regression Models on Physical Activity (N = 104)

	Dependent variable: IPAQ score		
	B (SE)/ β (p-value)		
Attitude[a]	238.55 (227.15)/ 0.11 (.30)	258.34 (242.85)/ 0.12 (.29)	172.67 (235.09)/ 0.08 (.46)
Subjective norms[a]	-154.71 (130.82)/ -0.13 (.24)	-158.04 (132.18)/ -0.13 (.24)	-21.57 (134.77)/ -0.02 (.87)
Intention[a]	**254.10 (124.22)/ 0.23 (.04)**	270.96 (143.45)/ 0.24 (.06)	**299.10 (138.17)/ 0.27 (.03)**
PBC[a]		-46.10 (193.39)/ -0.03 (.81)	-148.29 (188.89)/ -0.10 (.43)
WBIS score			**-842.15 (277.84)/ -0.31 (.003)**
R^2	0.067	0.068	0.145
Adjusted R^2	0.039	0.030	0.104
ΔR^2	--	0.001	0.080

Note.
Significant coefficients are presented in bold.
a: Attitude, subjective norms, perceived behavioral control (PBC), and behavioral intention on physical activity
IPAQ = International Physical Activity Questionnaire
WBIS = Weight Bias Internalization Scale
PBC = perceived behavioral control

sample and subsamples stratified by sex. In brief, the mean (SD) TFEQ and IPAQ scores were 2.25 (0.40) and 1923.01 (1949.44) for the entire sample; 2.28 (0.44) and 1996.06 (2156.27) for the male sample; and 2.20 (0.32) and 1801.26 (1563.90) for the female sample.

After controlling for age, sex, and BMI, Model 1 showed that the WBIS score ($\beta = 0.27$; $p = .001$), attitude ($\beta = 0.23$; $p = .01$), subjective norms ($\beta = 0.33$; $p < .001$), and PBC ($\beta = 0.27$; $p = .003$) were statistically significant factors for HE intention. Model 2 illustrated that the WBIS score was significantly associated with the HE behavior ($\beta = -0.24$; $p = .04$). Model 3 indicated that subjective norms ($\beta = 0.23$; $p = .013$) and PBC ($\beta = 0.52$; $p < .001$) were significant factors for PA intention. Model 4 showed that the WBIS score ($\beta = -0.30$; $p = .006$) and PA intention ($\beta = 0.26$; $p = .044$) were significantly associated with the PA behavior.

Regarding the unique contribution of each factor in the extended TPB on HE intention and HE behavior (measured using TFEQ-R18), the step-by-step multiple regressions showed that attitude accounted for 14.1% of variance on HE intention, subjective norms for 20.5%, PBC for 6.0%, and WBIS score for 5.8%. Additionally, the WBIS score explained 4.0% of variance on HE behavior (ie, TFEQ-R18 score). Overall, results showed that TPB could only be partly associated with HE intention, whereas WBIS was an important factor in explaining both intention and behavior (Tables 3 and 4).

As for the unique contribution of each factor in the extended TPB on PA intention and PA behavior (measured using IPAQ), Tables 5 and 6 demonstrate that attitude accounted for 15.7% of variance on PA intention, subjective norms for 9.6%, PBC for 18.2%, and WBIS score for 0.3%. Additionally, PA intention and WBIS scores explained 6.7% and 8.0% of the variance on PA behavior (ie, IPAQ score). Overall, TPB factors were partly associated with PA intention and PA behavior, whereas WBIS contributed greatly in explaining both intention and behavior.

DISCUSSION

We aimed to examine the associations among TPB factors, weight-related self-stigma, and final weight-reduction behaviors (HE and PA). Overall, our results partially supported the extended TPB among overweight, young adults in their HE and PA behaviors. The incorporation of weight-related self-stigma in the TPB was supported because self-stigma was the most significant variables associated with both weight-reduction behaviors.

Weight-related Self-stigma and HE

In our study, weight-related self-stigma was associated with higher intention to eat healthily and to engage more HE behavior independently. A possible explanation is body dissatisfaction. Studies on individuals with overweight reported that higher weight-related self-stigma results in higher body dissatisfaction, which was linked with greater healthy eating intention[39] as well as with greater maladaptive eating behavior.[40,41] In other words, overweight individuals with high levels of weight-related self-stigma tend to self-devaluate their negative characteristics such as fatness and to pursue positive characteristics such as attractiveness from lean individuals.[42] In pursuit of such positive characteristics, obese individuals may have higher HE intention, and thus, have actual HE behaviors for the change of body shape. Additionally, it is possible that changing behavior on HE is easier than changing behavior on PA; thus, people with overweight who have high levels of self-stigma may want to engage in HE instead of in PA.

Our findings are in line with research by Lee et al,[43] which suggested that body satisfaction is both a predictor of behavioral intention to change the body and of the actual behavior to change the body. However, unlike Lee et al,[43] who found that behavioral intention directly predicted body change behavior, our results suggest that the effect of internalized stigma on HE behavior was not mediated by HE intention. A possible explanation is the discrepancy between HE intention and HE behavior assessed in this present study. We used items describing general HE to assess HE intention; thus, participants might have different interpretations for the behavior under this concept (eg, healthy food choices, appropriate amount of calorie intake).

In contrast, our HE behavior was measured using TFEQ-R18, which focuses on measuring the presence of maladaptive eating pattern (ie, restrained eating, uncontrolled eating and emotional eating). Such discrepancy might weaken the association be-

tween HE intention and actual HE behavior in our study. Nevertheless, weight-related self-stigma was associated with both HE intention and actual behavior, and future studies are warranted to investigate how to eliminate the weight-related self-stigma while maintaining the HE intention and HE behaviors for Hong Kong young adults with overweight.

Original TPB Constructs and HE

Our findings suggest that TPB variables were adequate for the explanation of intention to HE; however, our findings also indicated that neither intention nor PBC was associated with HE behavior. The nonsignificant finding in intention may be explained by the instability of intention. Conner et al[44] pointed out that eating behavior had a stronger association with intention when the intention was stable. In particular, young adults' intention to HE easily may be influenced by extrinsic cues such as the eating culture on campus, and therefore, tend to fluctuate. Fila and Smith found such nonsignificant findings among American youth.[13] The nonsignificant PBC may be due to inaccurate estimation of their control over behavioral performance.[45] Another explanation for our nonsignificant PBC could be the discrepancy between HE intention and HE behavior mentioned above. Therefore, PBC might be associated with intention, which is also based on estimations from participants, but not on the actual HE behavior.

Weight-related Self-stigma and PA

Weight-related self-stigma had direct effects on PA instead of mediating by intention. This finding is in line with the literature that stigma may significantly lower people's engagement in PA.[46,47] It also has been suggested that self-stigma may have influenced PA behavior under automatic processes rather than through behavioral intention. Chevance et al[48] found that PA was more significantly influenced by implicit attitudes in people with obesity than in the general population. Given that our findings showed that self-stigma was a statistically significant and direct factor in PA engagement, the extended TPB model is partially supported.

Original TPB Constructs and PA

Our results suggest that PBC has the strongest association with intention to engage in PA, which corroborates with the findings of Payne et al.[49] However, our study showed that attitude was not associated with PA, which is inconsistent with previous research.[50] One possible explanation is the samples that were studied. Specifically, Psouni et al[51] indicated that weaker correlations between TPB variables were found in the group of overweight/obese people than in the normal-weight respondents. Another possibility is that the association between attitude and intention was diminished due to the effects of PBC. Our step-by-step multiple regression models (Tables 3 and 4) showed that attitude was significantly associated with intention when PBC was not in the regression model. However, attitude became nonsignificant after PBC was included in the model. Therefore, PBC may reduce the association between attitude and intention.

Consistent with the majority of previous research showing that intention is the major predictor of PA,[52] our result indicated that intention significantly explained nearly 4% of the variance in PA. Because intention is an antecedent to behavior and also has a strong correlation with PA behavior, any education aimed at promoting PA among young adults should seek to influence their intentions. However, PBC was not significantly associated with PA; this may be explained by respondents' inaccurate estimations of control over behavioral performance.[45] Therefore, our participants might have had the intention to engage in PA and believed that they had the control to engage in PA. However, they might have over- or underestimate their control of PA engagement. As a result, a correlation was found in PBC and PA intention but not in PBC and PA behaviors.

Limitations

There are some limitations in this study. First, our sample was recruited through convenience sampling; therefore, our study incurred self-selection bias. As a result, the generalizability of our findings is not generalizable to other, larger populations. Second, all the measures were self-reports and response biases could not be avoided. Third, causal inferences cannot be drawn due to the cross-sectional design. Still, our findings have hypothesis-generating value for future studies to examine the causal relationships. Fourth, measures chosen

to examine HE intention and actual behavior partially reflect the relationships of the constructs of the extended TPB model. Last, most of our sample was comprised of men; our findings might have restricted generalizability to women. Because men and women have different eating and PA behaviors, future studies are warranted to corroborate our findings in a female sample.

Conclusion

The extended TPB could partially explain HE and PA behaviors among overweight, young adults. Among all constructs, self-stigma is the most significant factor for both weight-reduction behaviors (HE and PA), supporting the incorporation of weight-related self-stigma in the TPB. With self-stigma being found to be the most significant factor, future research can incorporate the extended TPB in examining specific HE behavior to further understand the underlying mechanisms.

Human Subjects Statement

The study was approved by the Ethics Committee in the Hong Kong Polytechnic University (Ref No. HSEARS20171212002).

Conflict of Interest Statement

All the authors declare that they have no conflicts of interest.

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References

1. Centre for Health Protection. *Report of Population Health Survey 2014/15*. 2017. Available at: https://www.chp.gov.hk/files/pdf/dh_hps_2014_15_full_report_eng.pdf. Accessed January 21, 2019.
2. World Health Organization. *Obesity and Overweight Fact Sheet*. 2018. Available at: http://www.who.int/mediacentre/factsheets/fs311/en/. Accessed January 21, 2019.
3. Pakpour AH, Lin CY, Alimoradi Z, et al. Social health and behavior needs more opportunity to be discussed. *Soc Health Behav*. 2018;1(1):1.
4. Lin CY, Strong C, Scott AJ, et al. A cluster randomized controlled trial of a theory-based sleep hygiene intervention for adolescents. *Sleep*. 2018 Nov 1;41(11). doi: 10.1093/sleep/zsy170.
5. Holman G., Kohlenberg RJ, Tsai M, et al. Functional analytic psychotherapy is a framework for implementing evidence-based practices: the example of integrated smoking cessation and depression treatment. *Int J Behav Consult Ther*. 2012;7(2-3):58-62.
6. Kilbourne AM, Neumann MS, Pincus HA, et al. Implementing evidence-based interventions in health care: application of the replicating effective programs framework. *Implement Sci.* 2007;2(1):42.
7. Ajzen I. The theory of planned behavior. *Organ Behav Hum Decis Process*. 1991;50(2):179-211.
8. Andrews KR, Silk KS, Eneli IU. Parents as health promoters: a theory of planned behavior perspective on the prevention of childhood obesity. *J Health Commun*. 2010;15(1):95-107.
9. Norman P, Conner M. The theory of planned behavior and exercise: evidence for the mediating and moderating roles of planning on intention-behavior relationships. *J Sport Exerc Psychol*. 2005;27(4):488-504.
10. Godin G, Belanger-Gravel A, Amireault S, et al. The effect of mere-measurement of cognitions on physical activity behavior: a randomized controlled trial among overweight and obese individuals. *Int J Behav Nutr Phys Act.* 2011;8:2.
11. Wasserkampf A, Silva MN, Santos IC, et al. Short- and long-term theory-based predictors of physical activity in women who participated in a weight-management program. *Health Educ Res*. 2014;29(6):941-952.
12. Gardner RE, Hausenblas HA. Understanding exercise and diet motivation in overweight women enrolled in a weight loss program: a prospective study using the theory of planned behavior. *J Appl Soc Psychol*. 2004;34(7):1353-1370.
13. Fila SA, Smith C. Applying the theory of planned behavior to healthy eating behaviors in urban Native American youth. *Int J Behav Nutr Phys Act*. 2006;3(1):11.
14. Hewitt AM, Stephens C. Healthy eating among 10–13-year-old New Zealand children: understanding choice using the Theory of Planned Behaviour and the role of parental influence. *Psychol Health Med*. 2007;12(5):526-535.
15. Sniehotta FF, Presseau J, Araújo-Soares V. Time to retire the theory of planned behaviour. *Health Psychol Rev.* 2014;8(1):1-7.
16. Damghanian M, Alijanzadeh M. Theory of planned behavior, self-stigma, and perceived barriers explains the behavior of seeking mental health services for people at risk of affective disorders. *Soc Health Behav*. 2018;1(2):54.
17. Han H, Kim Y. An investigation of green hotel customers' decision formation: Developing an extended model of the theory of planned behavior. *Int J Hosp Manag*. 2010;29(4):659-668.
18. Lin C-Y, Broström A, Nilsen P, Pakpour AH. Using extended Theory of Planned Behavior to understand aspirin adherence in pregnant women. *Pregnancy Hypertens*. 2018;12:84-89.
19. Strong C, Lin C-Y, Jalilolghadr S, et al. Sleep hygiene behaviors in Iranian adolescents: an application of the Theory of Planned Behavior. *J Sleep Res*. 2018;27(1):23-31.
20. Cheng MY, Wang S-M, Lam YY, et al. The relationships between weight bias, perceived weight stigma, eating behavior and psychological distress among un-

dergraduate students in Hong Kong. *J Nerv Ment Dis.* 2018;206(9):705-710.
21. Lin C-Y, Strong C, Latner JD, et al. Mediated effects of eating disturbances in the association of perceived weight stigma and emotional distress. *Eat Weight Disord.* 2019 Jan 30. doi: 10.1007/s40519-019-00641-8. [Epub ahead of print]
22. Wong PC, Hsieh Y-P, Ng HH, et al. Investigating the self-stigma and quality of life for overweight/obese children in Hong Kong: a preliminary study. *Child Indic Res.* 2018. doi: org/10.1107/s12187-018-9573-0. [Epub ahead of print]
23. Durso LE, Latner JD, White MA, et al. Internalized weight bias in obese patients with binge eating disorder: associations with eating disturbances and psychological functioning. *Int J Eat Disord*. 2012;45(3):423-427.
24. Tylka TL, Annunziato RA, Burgard D, et al. The weight-inclusive versus weight-normative approach to health: evaluating the evidence for prioritizing well-being over weight loss. *J Obes*. 2014; 2014:983495.
25. Hilbert A, Braehler E, Haeuser W, Zenger M. Weight bias internalization, core self-evaluation, and health in overweight and obese persons. *Obesity*. 2014;22(1):79-85.
26. Lillis J, Levin ME, Hayes SC. Exploring the relationship between body mass index and health-related quality of life: a pilot study of the impact of weight self-stigma and experiential avoidance. *J Health Psychol*. 2011;16(5):722-727.
27. Pearl RL, Puhl RM, Dovidio JF. Differential effects of weight bias experiences and internalization on exercise among women with overweight and obesity. *J Health Psychol*. 2015;20(12):1626-1632.
28. Mensinger JL, Meadows A. Internalized weight stigma mediates and moderates physical activity outcomes during a healthy living program for women with high body mass index. *Psychol Sport Exerc*. 2017;30:64-72.
29. WHO Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet*. 2004;363(9403):157-163.
30. Anglé S, Engblom J, Eriksson T, et al. Three factor eating questionnaire-R18 as a measure of cognitive restraint, uncontrolled eating and emotional eating in a sample of young Finnish females. *Int J Behav Nutr Phys Act*. 2009;6(1):41.
31. IPAQ Research Committee. *Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (IPAQ)–Short and Long Forms*. 2015. Available at: https://sites.google.com/site/theipaq/. Accessed January 21, 2019.
32. Liou YM, Jwo CJ, Yao KG, et al. Selection of appropriate Chinese terms to represent intensity and types of physical activity terms for use in the Taiwan version of IPAQ. *J Nurs Res*. 2008;16(4):252-263.
33. Macfarlane DJ, Lee CC, Ho EY, et al. Reliability and validity of the Chinese version of IPAQ (short, last 7 days). *J Sci Med Sport.* 2007;10(1):45-51.
34. Lin CY, Updegraff JA, Pakpour AH. The relationship between the theory of planned behavior and medication adherence in patients with epilepsy. *Epilepsy Behav*. 2016;61:231-236.
35. Latimer AE, Martin Ginis KA. The Theory of Planned Behavior in prediction of leisure time physical activity among individuals with spinal cord injury. *Rehabil Psychol*. 2005;50(4):389-396.
36. Sparks P, Guthrie CA, Shepherd R. The dimensional structure of the perceived behavioral control construct 1. *J Appl Soc Psychol*. 1997;27(5):418-438.
37. Kothe EJ, Mullan BA, Butow P. Promoting fruit and vegetable consumption. Testing an intervention based on the theory of planned behaviour. *Appetite*. 2012;58(3):997-1004.
38. Hilbert A, Baldofski S, Zenger M, et al. Weight bias internalization scale: psychometric properties and population norms. *PLoS One*. 2014;9(1):e86303.
39. Heijens T, Janssens W, Streukens S. The effect of history of teasing on body dissatisfaction and intention to eat healthy in overweight and obese subjects. *Eur J Public Health*. 2011;22(1):121-126.
40. Lampard A, MacLehose M, Eisenberg R, et al. Weight-related teasing in the school environment: associations with psychosocial health and weight control practices among adolescent boys and girls. *J Youth Adolesc*. 2014;43(10):1770-1780.
41. Wu YK, Berry DC. Impact of weight stigma on physiological and psychological health outcomes for overweight and obese adults: a systematic review. *J Adv Nurs*. 2018;74(5):1030-1042.
42. Wang SS, Brownell KD, Wadden TA. The influence of the stigma of obesity on overweight individuals. *Int J Obes*. 2004;28(10):1333.
43. Lee HH, Damhorst ML, Paff Ogle J. Body satisfaction and attitude theory: linkages with normative compliance and behaviors undertaken to change the body. *Fam Consum Sci Res J*. 2009;37(4):466-488.
44. Conner M, Sheeran P, Norman P, Armitage CJ. Temporal stability as a moderator of relationships in the theory of planned behaviour. *Br J Soc Psychol*. 2000;39(4):469-493.
45. Sheeran P, Trafimow D, Armitage CJ. Predicting behaviour from perceived behavioural control: tests of the accuracy assumption of the theory of planned behaviour. *Br J Soc Psychol*. 2003;42(3):393-410.
46. Carels RA, Wott CB, Young KM, et al. Implicit, explicit, and internalized weight bias and psychosocial maladjustment among treatment-seeking adults. *Eat Behav*. 2010;11(3):180-185.
47. Carels RA, Young KM, Wott CB, et al. Weight bias and weight loss treatment outcomes in treatment-seeking adults. *Ann Behav Med*. 2009;37(3):350-355.
48. Chevance G, Stephan Y, Héraud N, Boiché J. Interaction between self-regulation, intentions and implicit attitudes in the prediction of physical activity among persons with obesity. *Health Psychol*. 2018;37(3):257-261.
49. Payne N, Jones F, Harris PR. The role of perceived need within the theory of planned behaviour: a comparison of exercise and healthy eating. *Br J Health Psychol*. 2004;9(4):489-504.
50. Sas-Nowosielski K. Application of the theory of planned behaviour in predicting leisure time physical activity of Polish adolescents. *Human Movement*. 2006;7(2):105-110.
51. Psouni S, Chasandra M, Theodorakis Y. Exercise and healthy eating intentions and behaviors among normal weight and overweight/obese adults. *Psychology*.

2016;7(4):598-611.
52. Godin G, Amireault S, Bélanger-Gravel A, et al. Prediction of leisure-time physical activity among obese individuals. *Obesity*. 2009;17(4):706-712.