

Methodological Study of Weight Loss Clothing Based on Behaviour Change Theories for Obesity Prevention and Healthy Weight Loss

Minzi Dong¹, Kristina Brubacher^{2*}

¹Dalian Polytechnic University, Dalian, Liaoning, 116034, China

²The University of Manchester, Manchester, M1 3WE, UK

ABSTRACT

This study develops a feasible methodology for weight loss clothing design to guide strategic approaches. It aims to promote behavioral shifts from unhealthy habits to obesity prevention and healthy weight management. Using the Extended Transtheoretical Model (ETTM) as a framework, grounded in behavioral change theories and user-centered design, an online survey was conducted. Survey data and theoretical insights were synthesized to create evidence-based design strategies, advancing both theory and practice in health-focused fashion.

KEYWORDS

Behaviour change; User-centered; The extended transtheoretical model; Weight loss clothing; Design strategies

1 Research background

China has the world's highest obesity prevalence, with approximately 42% of adults obese/overweight, posing major public health challenges ^[1]. Recognized by the WHO (2021) as a key risk factor for noncommunicable diseases, obesity correlates positively with BMI ^[2]. The Blue Book highlights its broader impacts, including psychological distress and socioeconomic burdens. Obesity's multifactorial etiology involves dietary and lifestyle factors, but modern environments complicate weight loss, with emotional and cognitive factors playing critical roles ^[3-5]. Addressing these challenges requires innovative psychological interventions to reshape attitudes and behaviors. This study explores optimal frameworks for designing weight-loss apparel from a psychological perspective, aiming to counteract obesity-promoting behaviors and foster sustainable health practices aligned with prevention and management goals.

2 Current research and application state of weight loss clothing design

Current weight-loss clothing literature mainly comprises patent docs, showing progress in compression, material engineering, biotech, and thermal management. Innovations like targeted compression garments ^[6], adaptive thermal textiles ^[7], and smart sculpting apparel ^[8] have entered the market, as seen in 2XU's and HOTSUIT's products. However, scholarly research on how these garments motivate obese people to engage in physical activity is limited. The study ^[9] stands out, proposing a model integrating TTM, body schema, and perceived control for design. Yet, further tailored theoretical and context - specific design optimization is required.

3 Build theoretical model

The design of weight loss clothing should be user-centered, not product or technology centered. Stubbs and Lavin (2013) mentioned in their paper that for the majority of the population, weight management solutions would inevitably manifest as behaviour modification interventions ^[10]. There are plenty of theories trying to explain and solve the problems relevant to behaviour change, among them, the Transtheoretical Model(TTM) offers a promising framework for multiple risk weight management interventions ^[11].

TTM, conceptualized by Prochaska and DiClemente (1992), outlines five stages: precontemplation, contemplation, preparation, action, and maintenance ^[12]. Its strength lies in integrating decisional balance, change processes, and self-efficacy ^[11]. However, critics argue that TTM's linear progression oversimplifies motivational dynamics. Consequently, the researchers suggested for hybrid models that combine TTM with complementary theoretical lenses to better explain behavior change complexities.

The Extended Transtheoretical Model (ETTM) (see Figure 1) integrates TTM with the Theory of Planned Behavior (TPB), which posits that behavioral intention is shaped by attitude, subjective norm, and perceived behavioral control,

* **Corresponding Author:** Kristina Brubacher, kristina.brubacher@manchester.ac.uk

underpinned by salient beliefs ^[14-15]. ETTM enhances TTM's explanatory power, especially in culturally and environmentally influenced contexts.

TPB's scope remains limited, focusing primarily on internal psychological variables, in contrast to Skinner's operant conditioning paradigm, which emphasizes external environmental contingencies in behavioral regulation ^[16,18]. Skinner posits that behavior is governed by consequential outcomes rather than preceding psychological states ^[17-18]. Luthans and Kreitner (1985) identified four reinforcement strategies: positive reinforcement, negative reinforcement, punishment, and extinction, each modulating behavioral probability through stimulus application or withdrawal ^[19].

Another limitation of TPB is its neglect of self-identity and cultural influences, as noted by Saricam and Okur (2014) ^[14]. To address these gaps, this study incorporates Body Image and the FEA Model. Body image encompasses perceptual, cognitive, affective, and metacognitive dimensions of physical embodiment ^[20-22]. Distortion arises from discordance between perceived and actual body size, accompanied by maladaptive emotions ^[9]. Tylka (2012) suggests that positive body image fosters appreciation of bodily functionality and aesthetics, promoting beauty, comfort, confidence, and satisfaction ^[23].

The FEA (Functional-Expressive-Aesthetic) Model is a user-centric framework for deciphering apparel requirements within cultural contexts ^[24]. It resolves design challenges by aligning garment design with user needs across three dimensions: functionality (fit, protection, comfort), expression (symbolic communication of status, roles, values), and aesthetics (culturally contingent desires for beauty, manifested through artistic elements and body-garment relationships) ^[25].

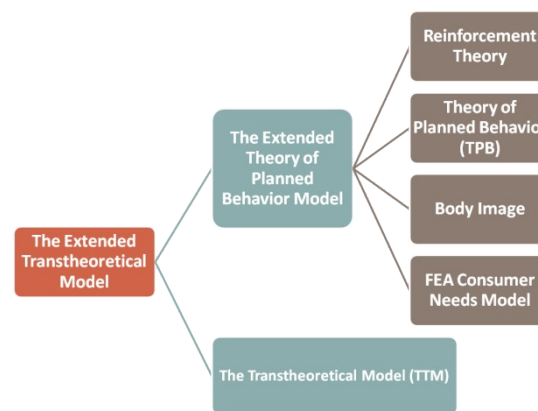


Figure 1 The extended transtheoretical model (ettm)

4 Research methods

Methodological Framework

This study employs literature analysis, theoretical speculation, and survey research to construct the Extended Transtheoretical Model (ETT). Survey research used an online questionnaire for Chinese adults aged 18+. Participants were recruited via random and snowball sampling. Questionnaire design, dissemination, and data collection were via Questionnaire Star WeChat Mini Program, with WeChat promoting the survey link. Data analysis adopted a mixed - methods approach using SPSSAU and Excel.

Instrument Design

The instrument within the ETTM framework has five dimensions:

- Biodemographic and Behavioral Profiling: Captures age, sex, stature, body mass, and weight - management cognitive schemas and behaviors.
- Motivational Architecture Analysis: Examines weight - loss health beliefs and behaviors via motivation and self - regulation evaluation.
- Weight Loss Motivational Typology: Uses a validated scale [26] to categorize weight - management motivations.
- Apparel Consumption Dynamics: Uses an FEA - based tool to assess clothing preferences.
- Weight Management Attire Perceptions: Explores attitudes towards weight - loss garments.

Pilot Study Refinements

Initial pre - testing had 57 valid responses. Based on analysis and feedback, questionnaire items were simplified, and the "Brand name" construct in the apparel demand scale was removed due to weak correlation.

5 Survey results and data analysis

5.1 Dimension 1

The survey received 101 valid responses, with 30.69% male and 69.31% female participants. Age groups were distributed as follows: 18-29 (48.51%), 30-39 (6.93%), 40-49 (12.87%), 50-59 (13.86%), and ≥ 60 (17.82%). BMI classification based on self-reported data showed underweight (3.96%), normal weight (58.42%), overweight (27.72%), and obese (9.9%).

5.2 Dimension 2

While 86.14% of participants were confident in preventing obesity or achieving weight loss, over 70% remained in pre-action stages: precontemplation (35.64%), contemplation (18.81%), and preparation (18.81%). No significant differences were found across age, gender, or weight categories ($p > 0.05$). Unhealthy eating patterns were more prevalent among normal weight (28.81%) and obese individuals (25%) than the overall average (23.76%). Poor exercise habits were most common among underweight (50%) and normal weight participants (38.98%), exceeding the aggregate average (37.62%). Key barriers to weight management were physical inactivity (40%) and unhealthy dietary practices (30%), highlighting the need for interventions extending beyond overweight/obese populations.

5.3 Dimension 3

The Weight Loss Motivation Scale identified three factors: "health," "social-comparative appearance," and "self-referential appearance," with Cronbach's α values of 0.887, 0.943, and 0.921, respectively. Construct validity was robust ($KMO = 0.874$, $p < 0.05$), and confirmatory factor analysis confirmed excellent convergent/discriminant validity ($AVE > 0.5$, $CR > 0.7$). Linear regression revealed significant positive predictors of weight loss motivation intensity ($R^2 = 1.000$), with appearance-related factors ($\beta = 0.435$ for social-comparative, $\beta = 0.304$ for self-referential) outweighing health ($\beta = 0.261$). These findings suggest suboptimal body image satisfaction and highlight the role of social perceptions in shaping motivations, warranting attention in intervention design.

Table 1 Result of linear regression analysis of the weight loss reasons scale (n=101)

	Parameter Estimates (n=101)							
	Unstandardized Coefficients		Standardized Coefficients	t	p	VIF	R^2	Adj R^2
	B	Std. Error	Beta					
Constant	0	0	-	2.478	0.015*	-		
Appearance in relation to oneself	0.304	0	0.355	157022598084867.000	0.000**	2.155		
Appearance in relation to others	0.435	0	0.531	236248876076526.000	0.000**	2.127	1	1
Health	0.261	0	0.296	168546875283497.000	0.000**	1.3		
F (3,97)=1.4019028470292216e 29,p=0.000								
Dependent Variable: Reasons for wanting to lose weight								
D-W: 0.301								
* $p < 0.05$ ** $p < 0.01$								

5.4 Dimension 4

The Apparel Consumer Demand Scale operationalizes three dimensions: "functional utility," "expressive symbolism," and "aesthetic appeal." Reliability assessments yielded Cronbach's α coefficients of 0.873, 0.816, and 0.800 respectively, confirming strong internal consistency. Construct validity was established through exploratory factor analysis ($KMO = 0.840$, $p < 0.01$) and further validated via confirmatory factor analysis, where all three factors demonstrated: (1) Average Variance Extracted (AVE) > 0.5 , (2) Composite Reliability (CR) > 0.7 , and (3) AVE square roots exceeding maximum inter-factor correlations—fulfilling convergent and discriminant validity criteria.

Dimensionality reduction produced three latent variables corresponding to the original factors. Bivariate correlations revealed significant positive relationships ($p < 0.01$) across all variable pairs. Linear regression analysis, regressing these variables on "apparel consumption propensity" (Table 2), produced an optimal model with no multicollinearity ($VIF < 3$). The equation—apparel consumption propensity = $0.200(\text{aesthetic appeal}) + 0.300(\text{expressive symbolism}) + 0.500^*(\text{functional utility})$ —explained 100% of variance in the dependent variable ($R^2 = 1.000$), with all predictors exerting substantial positive effects.

The dominance of functional utility ($\beta = 0.500$) suggests practical considerations remain paramount in apparel selection, while the significant contributions of expressive ($\beta = 0.300$) and aesthetic ($\beta = 0.200$) dimensions highlight the

growing importance of symbolic and hedonic consumption in contemporary markets. These findings provide actionable insights for marketers seeking to balance utilitarian and experiential value propositions.

Table 2 Linear regression analysis results of the scale measuring consumer demand for clothing

	Parameter Estimates (n=101)								
	Unstandardized Coefficients		Standardized Coefficients	t	p	VIF	R ²	Adj R ²	F
	B	Std. Error	Beta						
Constant	0	0	-	4.514	0.000**	-			
Aesthetic	0.2	0	0.267	78312292445168.900	0.000**	1.983	1	1	F (3,97)=5.670685691180148e 28,p=0.000
Expressive	0.3	0	0.355	93679314470156.700	0.000**	2.439			
Functional	0.5	0	0.562	189824341825824.000	0.000**	1.49			

Dependent Variable: Consumer demand for clothing
D-W: 0.798
* p<0.05 ** p<0.01

(n=101)

5.5 Dimension 5

Despite 96.04% of respondents reporting unfamiliarity with weight-loss apparel, only 10.89% expressed outright skepticism about its efficacy. Aesthetic preferences revealed distinct segmentation: 49.5% desired sportswear-inspired designs, while 39.6% favored everyday wear aesthetics.

Figure 2 presents a word cloud visualization of participants' ideal weight-loss garment attributes. Prominent themes emerging from lexical frequency analysis included: "body sculpting" (28.4% frequency), "effectiveness" (22.1%), "comfort" (19.7%), "tailored fit" (14.3%), "fashionable silhouette" (9.8%), and "discretion" (5.7%). These findings underscore consumers' dual prioritization of functional outcomes and wearability, suggesting market opportunities for hybrid designs that seamlessly integrate performance features with lifestyle aesthetics.



Figure 2 The key words used by the samples to describe their main concerns on ideal weight loss clothing

This study collected 75 valid responses regarding consumer valuations of weight-loss apparel. Price sensitivity analysis revealed distinct preferences: 54.67% of participants selected the 499 CNY price point, while 26.67% opted for the 500-999 CNY range, indicating a bimodal distribution of budget expectations.

Post-qualitative ideal-state analysis, a goodness-of-fit test ($\chi^2=30.900$, $p<0.001$) confirmed significant discrepancies between consumer expectations and current market offerings. Notably, two service-oriented strategies demonstrated exceptional response rates ($\geq 82\%$) and penetration indices (≥ 0.75):

(1) Continuous Feedback Loop: "Systematically monitor and address consumer inquiries through real-time service delivery"

(2) Usage Supervision Mechanism: "Implement professional oversight to evaluate product effectiveness and provide tailored recommendations"

These findings emphasize the critical role of post-purchase engagement in fostering brand loyalty, particularly through adaptive service models that prioritize consumer-centric improvement cycles. The results highlight opportunities for differentiated service strategies to enhance market competitiveness.

6 Suggestions on weight loss clothing design strategies

The formulation of optimal weight-loss apparel design strategies necessitates a user-centric, experience-oriented approach that integrates design, production, and sales processes. Building on the Expanded Transtheoretical Model (ETTM) and empirical survey data, this paper proposes targeted strategies across four critical dimensions—product aesthetics, functionality, pricing, and service ecosystems—while addressing spatial constraints.

6.1 Aesthetic Design Innovations

Leverage optical illusion principles to enhance body silhouette through strategic visual element design. Style recommendations include:

- Pure athletic wear aesthetics for performance-focused consumers.
- Hybrid designs blending athletic and lifestyle elements for cross-occasion versatility.

6.2 Functional Enhancements

Technical Optimization: Adapt existing sportswear technologies or innovate novel solutions prioritizing exercise adaptability and comfort.

Smart Integration: Incorporate flexible sensor systems and companion mobile applications for real-time biometric feedback and personalized coaching.

6.3 Pricing Strategy

Maintain price competitiveness within the 1000 CNY threshold to align with mainstream consumer budget expectations while ensuring technological value propositions.

6.4 Service Ecosystem Stratification

Tailor service strategies to ETTM-defined behavioral stages:

Precontemplation/Contemplation Stages:

Disseminate health literacy content via multimedia channels, emphasizing body positivity and product design philosophy.

Preparation/Action/Maintenance Stages (Non-Users):

Foster community engagement through hybrid events to strengthen behavioral intent and brand identity alignment.

Action/Maintenance Stages (Users):

Implement multi-component interventions:

Behavioral contracts to reinforce commitment.

Technical guidance for product optimization.

Continuous feedback loops with responsive service delivery.

Professional monitoring of usage outcomes, paired with incentivized rewards (e.g., healthy recipes, exercise plans).

Dynamic health knowledge updates through tailored communication.

Social support networks via structured online/offline interactions ^[26].

7 Conclusion

This paper presents preliminary findings from theoretical research into weight loss clothing design. Building upon behavioral change theories and user-centered design principles, we propose the Extended Transtheoretical Model (ETTM) as a novel theoretical framework to underpin weight loss apparel development. Guided by this model, targeted market surveys were systematically designed and conducted to identify key user needs and behavioral patterns. Based on these empirical findings, we formulated design strategies that align with ETTM tenets, providing actionable insights for subsequent experimental validations and practical implementations. The exploratory market analysis and strategic recommendations outlined here aim to catalyze innovation in weight loss clothing solutions by integrating psychological behavioral intervention mechanisms. These interventions seek to facilitate healthy habit formation through environmental and apparel-based nudges, ultimately contributing to obesity prevention and sustainable weight management. This research underscores the transformative potential of theoretically grounded design methodologies in creating impactful health-promoting products and services.

References

- [1] Wang Youfa, Sun Mingxiao, Yang Yuexin. Chinese Blue Book on Obesity Prevention and Control. Beijing: Peking University medical press, 2019:2,13.
- [2] World Health Organization. Obesity and overweight, <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight>, 2021.
- [3] Chinese Adult Overweight and obesity Prevention and Control Guidelines, Revised Committee. Guidelines for the prevention and control of overweight and obesity in Chinese adults. 2021. Beijing: people's medical press, 2021:1,7,14.
- [4] Drummond, Sandra. Obesity in the UK. The Journal of the Health Visitors' Association; Community Practitioner. 2003,76(3): 79.

- [5] R. Dalle Grave et al. Treating Obesity with Personalized Cognitive Behavioral Therapy. Springer International Publishing AG. 2018: 89.
- [6] The inventor Larkin, Elizabeth Anne (San Francisco, CA). Researchers Submit Patent Application, "Shaping Garments With Upper Leg Slimming Bands", for Approval (USPTO 20190014828). " Politics & Government Week. NewsRX LLC. 7 Feb. 2019, p. 11263.
- [7] Normans Media Ltd. Thin Ice - An Incredible, Innovative Weight-Loss Clothing Line Announced.M2 Presswire ; Coventry [Coventry]08 Sep 2015.
- [8] Shenzhen Smart Clothing Tech. Guo Sihui, Ren Xiulun, Chen Lu, Deng Kaosheng and Li Yingcai developed the invention. Shenzhen Smart Clothing Tech Submits Patent Application for Intelligent Slimming Clothing. Global IP News.Textile Patent News. New Delhi [New Delhi] Beijing, 06 May 2020. Patent Publication Number: CN109259351 (A).
- [9] Binks, Martin ; Chin, Shao-Hua(2018).Theoretical Rationale for How Slimming Garments May Motivate Physical Activity in People with Obesity. Progress in preventive medicine (New York, N.Y.), 2018-06, Vol.3 (4), p.e0017.
- [10] R. J. Stubbs , J. H. Lavin. The challenges of implementing behaviour changes that lead to sustained weight management. Nutrition bulletin. 2013, 38 (1):7.
- [11] Sara S. Johnson , Andrea L. Paiva , Carol O. Cummins , Janet L. Johnson , Sharon J. Dymont , Julie A. Wright, James O. Prochaska , Janice M. Prochaska, Karen Sherman. Transtheoretical Model-based multiple behavior intervention for weight management: Effectiveness on a population basis. Preventive medicine. 2008, 46 (3): 239.
- [12] Prochaska, J.O., Redding, C.A., Evers, K., 2002. The Transtheoretical Model and stages of change, In: Glanz, K., Rimer, B.K., Lewis, F.M (Eds.), Health Behavior and Health Education: Theory, Research, and Practice, 3rd ed. Jossey-Bass, Inc., San Francisco, CA.
- [13] Geke D.S. Ludden, Paul Hekkert. Design for healthy behavior Design interventions and stages of change. Conference: 9th International Conference on Design and Emotion. At: Bogota, Colombia. 2014: 3.
- [14] Canan Saricam and Nazan Okur. Analysing the Consumer Behavior Regarding Sustainable Fashion Using Theory of Planned Behavior. Consumer Behaviour and Sustainable Fashion Consumption. Textile Science and Clothing Technology. Springer Nature Singapore Pte Ltd. 2019: 1,16,21.
- [15] Sutton, S. , French, D. P. , Hennings, S. J. , Mitchell, J. , Wareham, N. J. , & Griffin, S. , et al. (2003). Eliciting salient beliefs in research on the theory of planned behaviour: the effect of question wording. Current Psychology, 22(3), 234-251.
- [16] Staats, A. W., "Skinner's Theory and the Emotion — Behaviour Relationship: Incipient Change with Major Implications", American Psychologist, 1988,43:747-8.
- [17] Skinner, B.F. , Contingencies of Reinforcement, Appleton Century — Crafts, New York.1969.
- [18] Maurice F. Villere and Sandra S. Hartman. Reinforcement Theory: A Practical Tool. Leadership & Organization Development Journal, 1991,12 (2): 27.
- [19] Luthans, F. and Kreitner, R. (1985), Organizational Behavior Modification and Beyond: An Operant and Social Learning Approach, Scott, Foresman, Glenview, ILL.
- [20] Mia Scheffers, Marijtje A. J. van Duijn, Ruud J. Bosscher, Durk Wiersma, Robert A. Schoevers, Jooske T. van Busschbach. Psychometric properties of the Dresden Body Image Questionnaire: A multiple-group confirmatory factor analysis across sex and age in a Dutch non-clinical sample. July 26, 2017.PLoS ONE 12(7): e0181908.
- [21] Cash TF. Body image: past, present, and future. Body Image. 2004; 1:1–5.
- [22] Ro'hricht F, Seidler KP, Joraschky P, Borkenhagen A, Lausberg H, Lemche E, et al. Consensus paper on the terminological differentiation of various aspect of body experience. Psychother Psychosom Med Psychol. 2005; 55:183–90.
- [23] Sarah Grogan. BODY IMAGE Understanding body dissatisfaction in man, woman and children.Routledge 711 Third Avenue, New York, NY 10017.2017:192.
- [24] Bailey Stokes and Catherine Black. Application of the Functional, Expressive and Aesthetic Consumer Needs Model: assessing the clothing needs of adolescent girls with disabilities.International Journal of Fashion Design, Technology and Education Vol. 5, No. 3, November 2012, 179–186.
- [25] Belinda T. Orzada and M. Jo Kallal.FEA Consumer Needs Model: 25 Years Later.Clothing and Textiles Research Journal .2019:1.
- [26] Andrea H. Meyer, Simone Weissen-Schelling, Simone Munsch, Jürgen Margraf.Initial Development and Reliability of a Motivation for Weight Loss Scale.Obes Facts 2010;3:205–211.