Dietary Stages of Change and Decisional Balance: A Meta-Analytic Review

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***Objective*: To examine evidence for properties of the transtheoretical model stages of change-decisional balance relationship as applied to dietary behavior. *Methods*: Data extracted from 27 studies of 8 different behaviors were examined. *Results*: The measurement structure of decisional balance, relative magnitude of the pros and cons within stages, and shifts in the pros and cons across stages were consistent with theory. Across behaviors, the average increase in pros (.82) was greater than the average decrease in cons (.55) from precontemplation to action stages. Conclusions: The transtheoretical model is useful for understanding the decision-making process involved in dietary behavior change.**

***Key words*: transtheoretical model, stages of change, decisional balance, dietary behavior, meta-analysis**

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The transtheoretical model of health behavior change (TTM)[1] has been extensively used to guide behavior change for health promotion.[2] According to the model, health behavior change is a process that involves progression through a series of stages. During the early stages of precontemplation and contemplation, individuals progress from not intending to take action to change a behavior to considering it. Individuals in the preparation stage are planning to take action in the very near future. Those in the action stage have made overt change, and those in the maintenance stage are working to sustain it. The decisional balance TTM construct informs understanding of the decision-making process that occurs as individuals progress through these stages.

Decisional balance is based on the decision-making model of Janis and Mann.[3] Janis and Mann conceptualized decision making as a process involving careful consideration of 8 factors that enter into a decisional "balance sheet" of comparative gains and losses: gains for self, losses for self, gains for significant others, losses for significant others, self-approval, self-disapproval, approval from others, and disapproval from others. In an application of Janis and Mann's model to the process of smoking cessation, Velicer et al designed a measure to assess the 8 components identified by Janis and Mann.[4] They found a simpler structure consisting of 2 orthogonal components, the pros (advantages) and cons (costs) of change. The scales were successful in differentiating among groups of smokers classified into different stages of change for smoking cessation. Further, analyses of the relationship between the pros and

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cons across stages supported the comparative approach to balancing decisions proposed by Janis and Mann. The 2-factor measurement structure has been replicated across diverse health behaviors.[5] The simple structure found has important applied advantages such as fewer dimensions to measure and intervene upon and fewer demands on participants.

The balance between the pros and cons varies across stages.[6] Because individuals in precontemplation are not intending to take action to change a behavior, the cons outweigh the pros in this stage. Pros increase and cons decrease from earlier to later stages. In action and maintenance stages, the pros outweigh the cons. A crossover between the pros and cons occurs between precontemplation and action stages.

The patterns of change in the pros and cons have been consistent across at least 48 health behaviors, and the magnitude of the changes has been replicated.[5] It should be noted however that these relationships are found only when using standardized scores, which control for ease of responding. Based on these data, strong and weak principles for progressing through the stages were formulated. The strong principle states that progression from precontemplation to action is a function of a one standard deviation increase in the pros of health behavior change. The weak principle states that progression from precontemplation to action is a function of a one-half standard deviation decrease in the cons of health behavior change.[7]

Horwath and Spencer et al conducted reviews of the literature on applications of the TTM to the process of dietary behavior change.[8,9] Horwath found that that the 2-factor structure for decisional balance was remarkably stable across behaviors.[8] In addition, differences between the pros and cons both within and across stages were consistent with previous TTM research: cons were higher than pros in precontemplation; pros increased between precontemplation and contemplation; cons were lower in action than in contemplation; and pros were higher than cons in action. A small number of studies included in the Spencer et al review examined TTM constructs other than the stages of change.[9] Thus, Spencer et al did not offer any conclusions regarding the utility of the decisional balance construct for informing understanding of the process of dietary behavior change.

Because previous reviews have focused on different aspects of the stages of change-decisional balance relationship, the extent of evidence for all of the properties of this relationship is unknown. The present review was undertaken to reexamine findings from studies included in earlier reviews as well as findings from additional studies of the stages of change-decisional balance relationship as applied to dietary behavior change. The aim was to summarize findings regarding the observed measurement structure of decisional balance, differences between the pros and cons within precontemplation and action and maintenance stages, differences between the pros and cons across stages, the presence of and stage at which a crossover occurred between the pros and cons, and strong and weak principles for progressing from precontemplation to action stages. The present investigation provides a more comprehensive understanding of the stages of change-decisional balance relationship by focusing on all of its properties. Moreover, it advances understanding of the utility of the stages of change and decisional balance TTM constructs for understanding the decision-making process that occurs as individuals attempt to modify their dietary behaviors.

METHODS

Procedure

Literature review. A database search was conducted using several computerized databases: CINAHL, EBMR, ERIC, Medline, and PsychINFO. Combinations of the following keywords were used: transtheoretical model, stages of change, decisional balance, pros, cons, nutrition, diet, dietary behavior, eating behavior, food intake, and nutrient intake. The Horwath and Spencer et al reviews and a meta-analytic review synthesizing findings from studies examining patterns of change in the pros and cons across a variety of health behaviors[5] were used for manual bibliography searching.

Studies were eligible for inclusion in the review if they were (1) published in English-language journals, (2) reported findings from quantitative analyses of the stages of change-decisional balance relationship (qualitative studies were thus excluded), and (3) tested for differences in

the pros and cons across stages of change (studies examining either the pros or cons but not both were excluded). No date restrictions were applied.

The combined searches identified 44 papers on the basis of screening titles and abstracts. Upon review of the full text, 17 did not meet inclusion criteria. The review included the 27 remaining studies that satisfied these criteria.[10-36] Across the 27 studies, the following 8 behaviors were studied: fruit and vegetable consumption,[12,14,15,17,19,21,22,26-28,31,35] dietary fat avoidance/reduction,[10,16,20,24,30,32-34] dairy consumption,[18,35] weight management,[29,33,36] consumption of a plant-based diet,[25] diabetes diet adherence,[23] consumer use of food labels,[13] and carbonated beverage consumption.[11] The included studies were published between 1988 and 2009.

Data extraction and coding. The studies examined different properties of the stages of change-decisional balance relationship. For example, the factor structure of decisional balance was examined in only 11 of the 27 studies. Whereas most studies used previously validated decisional balance measures, in this subset of studies, the factor structure of newly developed measures was examined, providing data for this study.[13,15,18,19,23,25,26,28,29,32,34] Moreover, the nature and extent of the stage-based comparisons conducted in each study differed. For example, there were a greater number of comparisons in studies that examined multiple behaviors;[33,35] conducted separate analyses by food type;[22,27,28] stratified analyses based on respondent demographic characteristics;[22] included measures of pros, cons, and a pro-con ratio or difference;[13,24,27,29,36] used multiple staging classifications;[10,27] conducted analyses at more than one time point;[14] and based comparisons on subscale or item scores for measuring specific types of pros and cons rather than on composite pro and con scores.[12,19,25,35] To account for these differences, data were extracted from each of the stage-based comparisons reported in each study. Characteristics of the included studies and the stage-based comparisons reported in each are summarized in Table 1.

The following were extracted: dietary behavior studied; sample characteristics (*N*, mean age, percent female, and race/ethnicity (largest percent)); stages studied; decisional balance measures used (ie, pros, cons, pro-con ratio or difference); observed factor structure of decisional balance; mean (SD) pro and con scores across stages; and pattern of significant differences in the pros and cons across stages.

Analysis

Frequency distributions were used to summarize the data. Findings regarding the measurement structure of decisional balance were summarized across the total number of studies in which this was examined. Because the number of stage-based comparisons differed in each study, findings regarding the relative magnitude of the pros and cons within precontemplation and action and maintenance stages, the pattern of shifts in the pros and cons across stages, and whether and at which stage a crossover occurred between the pros and cons were summarized across the total number of comparisons that provided data for examining these relationships.

Mean (SD) pro and con scores were used to determine the maximum increase in pros and the maximum decrease in cons from precontemplation to action stages using Prochaska's conventions.[7] For pros, the maximum increase was determined by identifying the lowest mean of a stage from precontemplation to action, along with the next highest value following the low. For cons, the highest mean of a stage from precontemplation to action was identified along with the next lowest value following the high. Once these 2 values were identified, effect size estimates were calculated using Cohen's *d*, defined as the difference between group means divided by the pooled standard deviation.[37] When change is in the expected direction (ie, pros increasing and cons decreasing across stages) effect size estimates for pros will be negative because the second mean used in the effect size calculation will be higher than the first. For cons, the reverse is true. Effect size estimates were calculated for each stage-based comparison and then averaged across comparisons for each of the dietary behaviors studied.

RESULTS

Factor Structure of Decisional Balance

Findings regarding properties of the stages of change-decisional balance relationship studied are summarized in Table

2. Of the 11 studies that examined the measurement structure of decisional balance, one (study number 16) conducted principal component analysis separately for the pro and con items measured. Because this analytic strategy precluded assessment of the factor structure for the total set of items, this study was excluded from analyses. Four fifths (80%) of the 10 remaining studies found a 2-factor measurement structure for decisional balance (ie, pros and cons). The 2-factor structure was stable across a variety of behaviors: fruit and vegetable consumption (study numbers 6 and 17), dietary fat avoidance/reduction (study numbers 23 and 25), dairy consumption (study number 9), weight management (study number 20), diabetes diet adherence (study number 14), and consumer use of food labels (study number 4). The 2 additional studies (study numbers 10 and 19) found a 5-factor measurement structure for decisional balance (ie, health benefits, general barriers, convenience issues, planning issues, and preparation issues and external motivations/barriers, health concerns, inconvenience factors, weight control, and purchase/preparation concerns, respectively).

Differences Between Pros and Cons Within Stages

Data were available for assessing whether the cons were higher than the pros in precontemplation and whether the reverse was true in action and maintenance in 21 studies. In one of the 21 studies (study number 15), con scores across stages were not reported; however, Pro scores and scores reflecting the ratio of the pros to the cons were included, enabling the calculation of con scores from these measures. In another study (study number 27), pro and con scores were reported for precontemplation and contemplation stages only, precluding assessment of the relative magnitude of the pros and cons in action and maintenance stages. In a third study (study number 12), pros and cons were measured in combined precontemplation/contemplation and action/maintenance stages. Thus, the relative magnitude of the pros and cons in precontemplation could not be determined. Among the 5 remaining studies, data on the pros and cons across stages were either unavailable (study number 2) or were not comparable (study numbers 3, 10, 16, and 26). For example, in one of the studies (study number 3), the percentage of respondents with high and low endorsements of the pros and scores on a 6-item measure of the cons across stages were reported. In 2 additional studies, subscale scores reflecting specific types of pros (ie, health benefits) and cons (ie, convenience issues) rather than composite pro and con scores were reported (study numbers 10 and 16), and in another (study number 26), pros and cons were assessed with single-item measures.

Across the 21 studies, there were 38 comparisons that provided data for assessing the relative magnitude of the pros and cons within precontemplation and action and maintenance stages. In 33 of 38 comparisons (87%), cons were higher than pros in precontemplation, and in 36 of 38 comparisons (95%), pros were higher than cons in action and maintenance.

Differences in the Pros and Cons Across Stages

All of the studies tested for differences in the pros and cons across stages. Two studies (study numbers 9 and 24) found that pros and cons differed across stages; however, the stages that differed were not reported. Thus, the patterns of change in the pros and cons could not be determined. Across studies, there were 53 comparisons of the pros and cons and 14 comparisons of pro-con ratio or difference scores across stages. In 43 of 53 (81%) of comparisons, significant differences between stages were found for the pros, with pros consistently increasing across stages. As shown in Table 3, the most frequent pattern of change for the pros (19 comparisons) was pros lower in precontemplation than in contemplation, preparation, and contemplation/preparation (in this subset of comparisons, pros were also lower in precontemplation than in action, maintenance, or action/maintenance stages). Other frequently occurring patterns were pros lower in precontemplation than in action, maintenance, or action/maintenance (7 comparisons); and among studies that classified respondents into preaction and postaction stages, pros lower in preaction than postaction (5 comparisons).

In 30 of 53 (57%) of comparisons, significant differences between stages were found for the cons. Across the 30 compari-

Table 1
Characteristics of Studies Included in the Meta-Analytic Review

Study no./ Reference	Yr	N[a]	Design[b]	SOC[c] Measure/ Stages	DB[d] Measure/ Reliability	Stage-based Comparisons/Analytic Method[e]
1[10]	2003	515	CS	PVM/ PC, C, P, A, M	PVM/AR	Composite pro and con scores (exercise) across dietary fat reduction stages Composite pro and con scores (dietary fat reduction) across exercise stages/MANOVA
2[11]	2006	399	CS	DFS/ PC, C, P, A, M	DFS/AR	Composite pro and con scores (carbonated beverage consumption) across stages/MANOVA
3[12]	1998	3557	CS	PVM/ PC, C, P, A/M	DFS/AR (Cons)	Single-item measure of pros and composite con scores (fruit and vegetable consumption) across stages/ANOVA
4[13]	2000	165	CS	DFS/ PC, C, A, M	DFS/AR	Composite pro and con scores and pro-con difference scores (consumer use of food labels) across stages/ANOVA
5[14]	2005	735	LONG	DFS/ PC, C, P, A, M	PVM/AR	Composite pro and con scores (fruit consumption) across stages at 3 different time points/ ANOVA
6[15]	2006	262	CS	PVM/ PC, C/P, A/M	DFS/AR	Composite pro and con scores (fruit and vegetable consumption) across stages/ANOVA
7[16]	2003	182	CS	DFS/ PC, C, P, A, M	DFS/AR (Pros)	Composite pro and con scores (dietary fat reduction) across stages/ANOVA
8[17]	2004	1253	CS	PVM/ PC, C/P, A/M	PVM	Composite pro and con scores (fruit and vegetable consumption) across stages/ANOVA
9[18]	2001	352 (DEV) 872 (VAL)	CS	PVM/ PC, C, P, A, M	DFS/AR	Composite pro and con scores (dairy consumption) across stages/MANOVA
10[19]	2006	420	CS	PVM/ PC, C, P, A, M	DFS/AR (health benefit Pros, general barrier and convenience issues Cons)	Subscale health benefit, planning issues, and preparation issues pro scores and general barriers and convenience issues con scores (fruit and vegetable consumption) across stages/ANOVA
11[20]	1997	393	CS	DFS/ PC, C, P, A, M	DFS/AR	Composite pro and con scores (dietary fat reduction) across stages/MANOVA
12[21]	2009	238	CS	DFS/ PC/C, P, A/M	DFS/AR (Pros)	Composite pro and con scores (fruit and vegetable consumption) across stages/ANOVA
13[22]	2002	1438	CS	DFS/ PC, C/P, A/M	DFS/AR	Composite pro and con scores (fruit consumption and vegetable consumption) across stages, by sex/ANOVA
14[23]	2005	193	CS	DFS/ PC, C, P, A, M	DFS/AR	Composite pro and con scores (diabetes diet adherence) across stages/ANOVA
15[24]	2004	151	CS	DFS/ PC, C, P, A, M	PVM/NR	Composite pro and con scores and pro-con ratio scores (dietary fat avoidance) across stages/ ANOVA
16[25]	2006	415	CS	DFS/ PC, C/P, A/M	DFS	Subscale well-being; weight and health; ethical; and convenience and financial pro scores and personal; family and convenience; health; information and junk food, shopping, eating out, and financial con scores (consumption of a plant-based diet) across stages/ANOVA
17[26]	2001	796	CS	DFS/ PC, C, P, A/M	DFS/AR	Composite pro and con scores (fruit and vegetable consumption) across stages/MANCOVA and ANCOVA
18[27]	2003	1545	CS	DFS/ PC, C, P, A, M	DFS/AR	Composite pro and con scores and pro-con difference scores (fruit intake and vegetable intake) within stages (FFQ intakes concordant and discordant with staging assignment A) and across stages (staging assignments A and B)/ANOVA
19[28]	2002	1545	CS	DFS/ PC, C, P, A, M	DFS/AR	Composite pro and con scores (fruit intake and vegetable intake) across stages/ANOVA
20[29]	1988	264 (DEV) 123 (VAL)	CS	DFS/ PC, C, A, M	DFS/AR	Composite pro and con scores and pro-con difference scores (weight management) across stages/ANOVA

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Table 1 (continued)
Characteristics of Studies Included in the Meta-Analytic Review

Study no./ Reference	Yr	N[a]	Design[b]	SOC[c] Measure/ Stages	DB[d] Measure/ Reliability	Stage-based Comparisons/Analytic Method[e]
21[30]	2000	491	CS	PVS/ PC, M	DFS/AR	Composite pro and con scores (dietary fat reduction) across stages/MANOVA
22[31]	2005	501	CS	DFS/ PC, C, P, A, M	PVM/AR	Composite pro and con scores (fruit and vegetable consumption) across stages/ANOVA
23[32]	2001	2639	CS	PVM/ PC, C, P, A, M	PVM/AR	Composite pro and con scores (dietary fat reduction) across stages/MANOVA
24[33]	1999	105 (DEV) 195 (VAL)	CS	DFS/ PC, C, P, A, M	DFS/AR (males, females, other islanders, and those with a secondary education)	Composite pro and con scores (weight management and dietary fat reduction) across stages/ ANOVA
25[34]	1996	366	CS	PVM/ PC, C, P, A, M	DFS/AR (Pros)	Composite pro and con scores (dietary fat reduction) across stages/ANOVA
26[35]	2002	205	CS	DFS/ Pre, Post	DFS/AR (Pros)	Single-item measures of feel better, more energy, improves mental ability pros and would not make a difference at my age, too much time to prepare, do not taste very good, and cost too much to prepare cons (fruit intake, vegetable intake, dairy consumption and dietary fat avoidance) across stages/ANOVA
27[36]	1999	86	CS	PVM/ PC, C, A/M	PVM/AR	Composite pro and con scores and pro-con difference scores (weight management) across stages/Mann-Whitney U test

Note.
a DEV = measurement development sample; VAL = measurement validation sample.
b CS = cross-sectional; LONG = longitudinal
c SOC = stages of change. PVM = previously validated measure; DFS = measure developed for study. Abbreviations for stages of change as follows: PC = precontemplation; C = contemplation; P = preparation; A = Action; M = maintenance; PC/C = combined precontemplation and contemplation C/P = combined contemplation and preparation; A/M = combined action and maintenance; Pre = preaction (combined precontemplation, contemplation and preparation); and Post = postaction (combined action and maintenance).
d DB = decisional balance. AR = acceptable reliability, defined as alpha coefficients of reliability for pro and con measures at or above .70, unless otherwise noted. NR = alpha coefficients not reported.
e ANOVA = analysis; of variance; ANCOVA = analysis of covariance; MANOVA = multivariate analysis of variance; MANCOVA = multivariate analysis of covariance.

sons, cons decreased from earlier to later stages of change. The patterns of change in the cons were more diverse. The most frequent patterns were cons higher in preaction than postaction (9 comparisons among studies that classified respondents into preaction and postaction stages); cons higher in precontemplation than in contemplation, preparation, or contemplation/preparation (5 comparisons); cons higher in precontemplation than in action or action/maintenance (4 comparisons); and cons higher in precontemplation, contemplation, preparation, and contemplation/preparation than in maintenance or action/maintenance (4 comparisons).

Across the 14 stage-based comparisons of pro-con ratio or difference scores, a consistent finding was that the difference increased from earlier to later stages. The patterns of change were ratio or difference scores smaller in precontemplation than in contemplation, preparation, and contemplation/preparation (7 comparisons); ratio or difference scores smaller in precontemplation than in action or maintenance (6 comparisons); and ratio or difference scores smaller in precontemplation and contemplation than in action (1 comparison).

Crossover Between the Pros and Cons

Data were available for assessing whether a crossover occurred between

Table 2
Summary of Findings on Properties of the Stages of Change-Decisional Balance Relationship Studied

Study no./ Reference	Dietary Behavior	Sample Characteristics (mean age, % female race/ethnicity (largest %)	Findings[a]
1[10]	Dietary fat reduction	Primary care clinic outpatients (mean age = 45 years; 81% female; 60% African American)	Cons of dietary fat reduction > Pros (PC exercise SOC). Pros of dietary fat reduction > Cons (A, M exercise SOC). PC < C (Pros of dietary fat reduction across exercise SOC). Cons of dietary fat reduction did not differ across exercise SOC. Crossover in C (exercise SOC). Cons of exercise > Pros (PC dietary fat reduction SOC). Pros > Cons (A, M dietary fat reduction SOC). PC < M (Pros of exercise across dietary fat reduction SOC). Cons of exercise did not differ across dietary fat reduction SOC. Crossover in P (dietary fat reduction SOC).
2[11]	Carbonated beverage consumption	Secondary school students (mean age = 12.57 years; 45% female; race/ethnicity not reported)	Insufficient data for comparing pros and cons within stages. PC > C, P, A, M (Pros). PC < C, P, A, M (Cons). Insufficient data for determining whether crossover occurred.
3[12]	Fruit and vegetable consumption	Adult church members (mean age = 51.40 years; 70.4% female; 98% African American)	Pro and con measures not comparable within stages. Pros did not differ across SOC. PC > C, P (Cons). Differences between pro and con measures precluded assessment of whether crossover occurred.
4[13]	Consumer use of food labels	College students (mean age = 22.74 years; 88% female; race/ethnicity not reported)	Two-factor measurement structure found for DB. Cons > Pros (PC). Pros > Cons (M). PC < M (Pros). PC > M (Cons). PC < M (pro-con difference). Crossover in M.
5[14]	Fruit consumption	Adults (mean age = 37.5 years; 51% female; race/ethnicity not reported)	Cons < Pros (PC, T1, T2, T3). Pros > Cons (A, M, T1, T2, T3). PC < C, P, A, M (Pros, T1, T2, T3); C < P (Pros T1). PC, C, P, A > M (Cons T1). PC, C, P > M (Cons T2). PC, C > M (Cons T3). No crossover found (T1, T2, T3).
6[15]	Fruit and vegetable consumption	Low-income adolescents (mean age = 12.21 years; 65% female; 100% African American)	Two-factor measurement structure found for DB. Cons > Pros (PC). Pros > Cons (A/M). PC < A/M (Pros). C/P > A/M (Cons). Crossover in A/M.
7[16]	Dietary fat reduction	Low-income middle school students (mean age = 13.82 years; 52% female; 50% African American)	Cons > Pros (PC). Pros > Cons (A/M). PC < A, M (Pros). Cons did not differ across SOC. Crossover in P.
8[17]	Fruit and vegetable consumption	Community-residing older adults (mean age = 75.40 years; 70% female; 78% white)	Cons < Pros (PC). Pros > Cons (A/M). PC < C/P, A/M (Pros). Cons did not differ across SOC. No crossover found.
9[18]	Dairy consumption	Two samples of community-residing adults (mean age not reported; 100% female; race/ethnicity not reported)	Two-factor measurement structure found for DB. Cons > Pros (PC). Pros > Cons (A, M). Pros significantly increased and cons significantly decreased across stages (stages at which pros and cons differed not reported). Crossover in C.
10[19]	Fruit and vegetable consumption	Low-income mothers (mean age = 32 years; 100% female; 100% African American)	Five-factor measurement structure found for DB. Pro and con measures not comparable within stages. PC < P, A, M (health benefits pros). PC < M (planning issues pros). General cons, convenience issues cons, and preparation issues cons did not differ across SOC. Differences between pro and con measures precluded assessment of whether crossover occurred.
11[20]	Dietary fat reduction	Municipal government employees (mean age = 42.20 years; 35.6% female; 84.9% white).	Cons > Pros (PC). Pros > Cons (A, M). PC < P, A, M (Pros). PC > M (Cons). Crossover in A.
12[21]	Fruit and vegetable consumption	Low-income parents and primary caregivers of preschool-aged children (mean age = 27 years; 97% female; 55% white)	Cons > Pros (PC/C). Pros > Cons (A/M). Pros did not differ across stages. PC/C > A/M (Con item "FV take too much time to prepare"). Crossover between PC/C and P.
13[22]	Fruit and vegetable consumption	Young adults aged 18 to 24 years from 10 states (mean age = 22 years; 62% female; 91% white)	Cons of fruit intake > Pros (PC, males and females). Pros of fruit intake > Cons (A/M, females only). PC < C/P, A/M (Pros of fruit intake, males and females). Cons of fruit intake did not differ across SOC (males and females). Crossover for fruit intake in C/P for females; no crossover found for males). Cons of vegetable intake > Pros (PC, males and females). Pros of vegetable intake > Cons (A/M, males and females). PC < C/P, A/M (Pros of vegetable intake, males and females). Cons of vegetable intake did not differ across SOC (males and females). Crossover for vegetable intake in C/P (females) and in A/M (males).
14[23]	Diabetes diet adherence	Type 1 and 2 diabetic patients (mean age = 57.84 years; 64.2% female; 53.5% white)	Two-factor measurement structure found for DB. Cons > Pros (PC). Pros > Cons (A, M). PC, C < A, M; PC < C, P (Pros). Cons did not differ across SOC. Crossover in A.

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Table 2 (continued)
Summary of Findings on Properties of the Stages of Change-Decisional Balance Relationship Studied

Study no./ Reference	Dietary Behavior	Sample Characteristics (mean age, % female race/ethnicity (largest %)	Findings[a]
15[24]	Dietary fat avoidance	WIC recipients with a child younger than 2 years of age (mean age = 27 years; 100% female; 91% white)	Cons < Pros (PC). Pros > Cons (A, M). PC < C, P, A, M (Pros). Cons did not differ across SOC. PC < P, A, M (pro-con ratio). No crossover found.
16[25]	Consumption of a plant-based diet	Adults (mean age not reported; 59.4% female; race/ethnicity not reported)	Four-and 5-factor measurement structure found for pros and cons, respectively. Pro and on measures not comparable within stages. PC < C/P, A/M (well-being and weight and health pros). PC < C/P (ethical pros). PC, C/P < A/M (convenience and financial pros). PC > C/P, A/M (personal cons). PC, C/P > A/M (family and convenience cons). PC > A/M (health cons). PC, C/P > A/M (junk food, shopping, eating out, and financial cons). PC < C/P; PC, C/P > A/M (information cons). Differences between pro and con measures precluded assessment of whether crossover occurred.
17[26]	Fruit and vegetable consumption	Adults (mean age = 39.3 years; 51% female; 100% Chinese Singaporeans)	Two-factor measurement structure found for DB. Cons > Pros (PC). Pros > Cons (A/M). PC < P; C < P (Pros). PC, C, P > A/M (Cons). Crossover between C and P.
18[27]	Fruit and vegetable consumption	Young adults (mean age not reported; 61% female; 90.3% white)	Cons of fruit intake > Pros (PC, concordant and discordant). Pros of fruit intake > Cons (A, M, concordant and discordant). Differences in pros and cons of fruit intake across stages not tested (concordant, discordant). Crossover for fruit intake in P (concordant) and C (discordant). Cons of vegetable intake > Pros (PC, concordant and discordant). Pros of vegetable intake > Cons (A, concordant and discordant; M, concordant). Differences in pros and cons of vegetable intake across stages not tested (concordant, discordant). Crossover for vegetable intake in P (concordant) and C (discordant). Cons of fruit intake > Pros (PC, algorithm A and B). Pros of fruit intake > Cons (A, M, algorithm A and B). PC < C, P, A, M (Pros of fruit intake, algorithm A and B). Differences in cons of fruit intake across stages not reported (algorithm A and B). PC < C, P, A, M (pro-con difference for fruit intake, algorithm A). PC < A (pro-con difference for fruit intake, algorithm B). Crossover for fruit intake in P (algorithm A and B). Cons of vegetable intake > Pros (PC algorithm A and B). Pros of vegetable intake > Cons in A, M (algorithm A and B). PC < C, P, A, M (Pros of vegetable intake, algorithm A and B). Differences in cons of vegetable intake across stages not reported (algorithm A and B). PC < P, A, M (pro-con difference for vegetable intake, algorithm A). PC < A (pro-con difference for vegetable intake, algorithm B). Crossover for vegetable intake in P (algorithm A and B).
19[28]	Fruit and vegetable consumption	Young adults (mean age not reported; 61% female; 90.3% white)	Five-factor measurement structure found for both fruit and vegetable decisional balance measures. Cons of fruit intake > Pros (PC). Pros of fruit intake > Cons (A, M). PC < C, P, A, M (Pros of fruit intake). PC < C, M; C > M (Cons of fruit intake). Crossover for fruit intake in P. Cons of vegetable intake > Pros (PC). Pros of vegetable intake > Cons (A, M). PC < C, P, A, M; A > M (Pros of vegetable intake). PC < C, P; C, P > M (Cons of vegetable intake). Crossover for vegetable intake in P.
20[29]	Weight management	Undergraduate and graduate students (mean age not reported; 70% female; race/ethnicity not reported)	Two-factor measurement structure found for DB. Cons > Pros (PC). Pros > Cons (A, M). PC < C, A, M (Pros). Cons did not differ across SOC. PC, C, M < A (pro-con difference). Crossover in C.
21[30]	Dietary fat reduction	Adults (mean age = 43.7 years; 100% female; race/ethnicity not reported)	Cons > Pros (PC). Pros > Cons (M). PC < M (Pros). PC > M (Cons). Insufficient data for determining stage at which crossover occurred.
22[31]	Fruit and vegetable consumption	Adolescents (mean age = 13.77 years; 100% female; race/ethnicity not reported)	Cons > Pros (PC). Pros > Cons (A,M). PC < C, P, A, M (Pros). PC > C, P, A, M (Cons). Crossover in C.
23[32]	Dietary fat reduction	Ninth grade students (mean age = 15.2 years; 50.2% female; 82.7% white)	Two-factor measurement structure found for DB. Cons > Pros (PC). Pros > Cons (A, M). PC < C, P, A, M (Pros). PC, C, P, A > M (Cons). Crossover in C.
24[33]	Weight management, dietary fat reduction	Adults (mean age = 32 years; 100% Pacific Islander)	Cons > Pros (PC). Pros > Cons (A, M) [both behaviors]. Pros increased and cons decreased across stages (stages at which pros and cons differed not reported) [both behaviors]. Crossover in P [both behaviors].
25[34]	Dietary fat reduction	Adults (mean age = 53 years (males) and 52.2 years (females); 56.5% female; race/ethnicity not reported)	Two-factor measurement structure found for DB. Cons > Pros (PC). Pros > Cons (A, M). PC, C < M (Pros). C > PC, M (Cons). Crossover between P and A.

(contnued on next page)

Table 2 (continued)
Summary of Findings on Properties of the Stages of Change-Decisional Balance Relationship Studied

Study no./ Reference	Dietary Behavior	Sample Characteristics (mean age, % female race/ethnicity (largest %)	Findings[a]
26[35]	Fruit, vegetable, and dairy consumption; dietary fat avoidance	Older adults participating in congregate dining programs (mean age not reported; 68.5% female; 93.2% white)	Pro and con measures not comparable within stages. Pre < post (feel better pro for fruit, vegetable, and dairy consumption and for avoiding fat; improves mental ability pro for fruit intake). Pre > post (would not make a difference at my age con for vegetable intake and avoiding fat; too much time to prepare con for vegetable intake; do not taste very good con for fruit and vegetable intake; cost too much to prepare con for fruit, vegetable, and dairy intake and for avoiding fat). Differences between pro and con measures precluded assessment of stage at which crossover occurred.
27[36]	Weight management	Women at 4 to 5 months post-partum (mean age = 30.8 years; 100% female; 85% white)	Cons of trying to lose weight > Pros (PC). Pros of trying to lose weight > Cons (A/M). PC < A/M (Pros of trying to lose weight). No significant differences in cons of trying to lose weight across SOC. PC < A/M (pro-con difference of trying to lose weight). Insufficient data for determining crossover stage for pros and cons of trying to lose weight. Cons of trying to prevent weight gain > Pros (PC). Pros of trying to prevent weight gain > Cons (A/M). PC < A/M (Pros of trying to prevent weight gain). No significant differences in cons of trying to prevent weight gain across SOC. PC < A/M (pro-con difference of trying to prevent weight gain). Insufficient data for determining crossover stage for trying to prevent weight gain. Cons of considering weight loss > Pros (PC). Insufficient data for determining whether Cons of considering weight loss > Pros in A/M. PC < C (Pros of considering weight loss). No significant differences in cons of considering weight loss across SOC. PC < C (pro-con difference of considering weight loss). Insufficient data for determining whether crossover occurred for considering weight loss.

Note.
a SOC = stages of change. Abbreviations for stages as follows: PC = precontemplation; C = contemplation; P = preparation; A = Action; M = maintenance; PC/C = combined precontemplation and contemplation; C/P = combined contemplation and preparation; A/M = combined action and maintenance; Pre = preaction (combined precontemplation, contemplation and preparation); and Post = postaction (combined action and maintenance).

the pros and cons in 20 studies. In 5 of the 7 remaining studies data on both the pros and cons across stages were either unavailable or were not comparable, as previously discussed (study numbers 2, 3, 10, 16, and 26). In another 2 studies (study numbers 21 and 27) data were provided on the pros and cons for 2 stages only, precluding assessment of the stage at which the crossover occurred.

Across the 20 studies, there were 35 comparisons that provided data for determining whether a crossover occurred between the pros and cons. In 29 of 35 comparisons (83%), a crossover was found. In most of the comparisons (24 of 29 or 83%), the crossover occurred between precontemplation and action stages.

Strong and Weak Principles for Progressing From Precontemplation to Action

Strong and weak principles for progressing from precontemplation to action were assessed among 14 studies of 6 behaviors that reported mean (SD) pro and con scores for at least precontemplation and action stages (study numbers 1, 3, 4, 6, 7, 8, 10, 11, 13, 14, 16, 18, 20 and 23). Across studies, data from 24 stage-based comparisons of the pros and 15 stage-based comparisons of the cons were available for calculating effect size estimates reflecting the magnitude of changes in the pros and cons across stages. The average maximum increase in the pros and the average maximum decrease in the cons for the 6 behaviors are shown in Table 4. For all 6 behaviors, the pros increased more than the cons decreased across stages. When averaged across behaviors, the mean maximum increase in the pros was -.82 (SD = .35; 95% CI = -.96, -.67; range = -1.62--.29), and the mean maximum decrease in the cons was .55 (SD = .29; 95% CI = .39, .71; range = .08 -1.07). This indicates that the magnitude of the maximum increase in the pros of dietary behavior change was approximately 150% as great as the maximum decrease in the cons of dietary behavior change.

Table 3
Patterns of Significant Shifts in the Pros and Cons Across Stages

Stages Between Which Shifts Occurred[a]	N
Pros	
Precontemplation and preparation	
PC < C, P or C/P[b]	19
PC < P[b]	2
PC < C	2
PC > C, P[b,c]	1
PC < C/P	1
PC < C, P[b]; C < P	1
PC < C, P[d]	1
PC, C < P	1
Precontemplation and action or maintenance	
PC < M	4
PC < A/M	2
PC < A, M	1
Precontemplation, contemplation, preparation and action or maintenance	
Pre < post	5
PC, C < M	1
P < A/M	1
PC, C/P < A/M	1
Cons	
Precontemplation and preparation	
PC > C, P or C/P[b]	2
PC < C, P[b,c]	1
PC > C, P	1
PC > C[b,e]	1
C > PC[e]	1
PC < C, P[f]	1
PC < C/P[g]	1
Precontemplation and action or maintenance	
PC > M	3
PC > A/M	1
Precontemplation, contemplation, preparation and action or maintenance	
Pre > post	9
PC, C/P > A/M	2
PC, C, P > M[h]	2
PC/C > A/M	1
PC, C, P > M	1
PC, C > M	1
PC, C, P > A/M	1
C/P > A/M	1
Pro-con Ratio or Difference	
Precontemplation and preparation	
PC < C/P[b]	3
PC < P[b]	2
PC < C, P[b]	1
PC < C	1
Precontemplation and action or maintenance	
PC < A/M	3
PC < A	2
PC < M	1
PC, C < A[f]	1

Notes.

a Abbreviations for stages of change as follows: PC = precontemplation; C = contemplation; P = preparation; A = Action; M = maintenance; PC/C = combined precontemplation and contemplation; C/P = combined contemplation and preparation; A/M = combined action and maintenance; Pre = preaction (combined precontemplation, contemplation and preparation); and Post = postaction (combined action and maintenance).

b Differences also found between PC and A, M, or A/M stages.

c Cessation of a negative behavior studied. Observed pattern is consistent with the TTM (i.e., Pros of the negative behavior decreasing and cons increasing across stages).

d Differences also found between PC, C and A, M, or A/M stages.

e Differences also found between C and M stages

f Differences also found between C, P and A, M or A/M stages.

g Differences also found between PC, C/P and A/M stages.

h Differences also found between A and M stages.

Table 4
Maximum Increases in the Pros and Maximum Decreases in the Cons From Precontemplation to Action Stages, By Dietary Behavior

Behavior	n	Mean ES[a] Pros	n	Mean ES Cons
Fruit and vegetable consumption	12	-.71	2	.37
Dietary fat avoidance/reduction	5	-.87	5	.56
Weight management	1	-1.31	1	.58
Consumption of a plant-based diet	4	-.66	5	.56
Diabetes diet adherence	1	-1.62	1	.61
Consumer use of food labels	1	-1.11	1	.67
Mean (SD) across behaviors	24	-.82 (.35)	15	.55 (.29)
95% confidence interval		-.96, -.67		.39, .71

Note.
a ES = effect size estimate

DISCUSSION

This study was undertaken to examine evidence for properties of the stages of change-decisional balance relationship as applied to dietary behavior change. Results supported the 2-factor measurement structure found for decisional balance in other TTM research.[5,7] The 2-factor structure was replicated in 8 of 10 studies and was stable across a variety of behaviors. Horwath found that the 2-factor structure was stable across dairy consumption; fruit, vegetable, and grain intake; and dietary fat reduction behaviors.[8] Our findings revealed that it was also stable across consumer use of food labels, diabetes diet adherence, and weight management behaviors.

The results also revealed that the cons of dietary behavior change are higher than the pros in precontemplation and that the reverse is true in action and maintenance, a finding that is consistent with the TTM and with findings from other studies of dietary behavior.[8] This was evident in over four fifths of comparisons across studies. The consistency of findings is noteworthy given the diverse behaviors and populations studied. Moreover, the comparisons reflected analyses that were varied based on such factors as food type, respondent demographic characteristics, and alternative staging classifications. Had these factors influenced the relationship between the pros and cons within stages, there would have been more differences than similarities across comparisons, which was not the case.

There was evidence of the pros and cons differing across stages. For the pros, significant differences between stages were found in 81% of comparisons; and for the cons, differences were evident in 57% of comparisons. Although diverse patterns of change were observed, in all cases, the observed shifts were consistent with the TTM: pros increasing and cons decreasing from earlier to later stages of change.

The most frequent pattern of change for the pros was pros increasing between precontemplation and preparation stages and remaining stable through later stages of change. For the cons, the most frequent pattern was cons higher in preaction than postaction stages. These patterns of change were similar to those observed by Horwath.[8] Horwath found that pros were lower in precontemplation than in contemplation and that cons were higher in contemplation (a preaction stage) than in action (a postaction stage). However, findings from the respective reviews are not directly comparable due to differences between the approaches used to summarize findings. Whereas Horwath summarized findings across studies, this study summarized findings across stage-based comparisons. The difference in approaches implicates the need for additional research employing a similar comparison-based approach to permit assess-

ment of similarities and differences between the observed patterns of change and patterns found in subsequent applications of the TTM to dietary behavior change.

Although cons differed across stages more often than not, changes in the cons occurred less often than did changes in the pros. A number of factors may explain this finding. The costs of dietary behavior change are often distal (eg, increased risk for diet-related diseases), whereas the advantages are proximal (eg, feeling better about oneself, having more energy, and losing or maintaining weight). As has been suggested elsewhere, health expectations may influence food choices only when the health consequences are expected to be soon, severe, and easy to recognize.[38] The pros may be more amenable to change than the cons because the anticipated benefits of change are more tangible and immediate whereas a reduction in the anticipated costs requires longer-term maintenance of dietary behavior change.

Alternatively, it may be more difficult to modify people's perceptions of the cons when confronted with impediments to change that are beyond their control. For example, previous research has identified a number of environmental barriers to healthful eating.[39,40] Because people have limited control over such factors as the availability and cost of healthful foods, their perceptions of the cons may persist in light of these factors. Another explanation is that it may be easier to increase the perceived advantages of change than it is to decrease the perceived costs. When individuals are at the beginning of the change process (ie, in the precontemplation stage of change), the cons outweigh the pros. This suggests that people have preexisting beliefs about the cons of change that are stronger than their endorsements of the pros. Decreasing the cons requires modifying these beliefs whereas increasing the pros involves heightening awareness of advantages of change that may have been previously unrecognized. It may be easier to increase this awareness than it is to decrease preexisting beliefs in particular, when the aforementioned factors are at work.

Finally, as shown in previous TTM research, the cons have a weaker magnitude of change across stages than do the pros.[5,7] To find differences in the cons requires twice the sample size needed to find differences in the pros. The included studies may not have had sufficiently large sample sizes for detecting changes in cons, a factor that may account for the smaller number of differences found. Findings implicate the need for replication studies of dietary behavior change that employ sufficiently large sample sizes for detecting changes in the cons across stages.

Findings also revealed evidence of a crossover between the pros and cons of dietary behavior change. Support was found for a crossover in most (83%) of the comparisons reported across studies. Consistent with previous TTM research, the crossover occurred prior to the action stage, suggesting that people will decide that the pros of changing dietary behavior outweigh the cons before they take action to modify their behavior.[6] The crossover occurred even when decreases in the cons were not evident. This suggests that decreasing the cons may be less important for dietary behavior change than is increasing the pros to the point at which they surpass the cons. This may explain why, on average, the maximum increase in the pros (.82 standard deviation units) was considerably larger than the maximum decrease in the cons (.55 standard deviation units) across stages.

Finally, results supported the strong and weak principles for progressing from precontemplation to action stages. Data from 14 studies of 6 behaviors revealed that across behaviors, the magnitude of the increase in the pros was greater than the magnitude of the decrease in the cons, a finding that is remarkably consistent with findings from TTM research on dietary and nondietary behaviors.[5,7] In previous research, the change in the pros has been twice as great as the change in the cons, whereas in this study, the average increase in the pros was approximately 150% as great as the average decrease in the cons. One explanation for this difference is that as has been discussed, for dietary behavior change, shifts in the pros are often accompanied by nonsignificant shifts in the cons. However, when significant changes in the cons occur, this is accompanied by a smaller change in the pros. One would expect this to be the case because a smaller degree of change would be re-

quired for the pros to surpass the cons. Alternatively, the difference may be an artifact of the small number of comparisons on which findings regarding the strong and weak principles were based. Analyses of larger samples of comparisons are needed to determine whether there is consistent support for the smaller ratio of change found. It is also possible that the findings are true findings, suggesting that for dietary behavior change, the ratio of pro-con changes is smaller than that required for modifying nondietary behaviors. For all but 2 of the behaviors (ie, weight management and diabetes diet adherence), the ratio was smaller than 2:1. This finding was replicated in studies of behaviors that were not included in previous reviews (ie, consumption of a plant-based diet and consumer use of food labels) enhancing our confidence that this was in fact the case.

Study Limitations and Strengths

Results are limited by the cross-sectional nature of the studies on which they were based. Longitudinal research is needed to confirm the patterns and magnitude of the shifts in the pros and cons across stages found. In most of the studies included in the review, raw pro and con scores were converted to standardized scores prior to data analyses; however, in some of the studies, this was not the case. Thus, measures of the pros and cons were not quantified in equal units. To overcome this limitation in future research, investigators are encouraged to use standardized pro and con scores in analyses of the stages of change-decisional balance relationship to facilitate comparisons with findings from other TTM research on similar dietary behaviors.

The comparison-based approach used made assessments of the similarities and differences between findings from this study and findings from previous reviews difficult. Although this approach was a limitation, it was also a strength because it allowed a more comprehensive and inclusive assessment of all analyses reported in each study. Eight different dietary behaviors were represented across studies; however, the number of studies of each behavior varied considerably. Thus, findings based on the total number of comparisons may be more representative of behaviors for which multiple studies were available (ie, fruit and vegetable consumption and dietary fat avoidance/reduction). Moreover, findings that were summarized by behavior should be interpreted with caution, in particular, those that were based on comparisons from small numbers of available studies. Ideally, an equal number of studies of each behavior would have been included to permit the synthesis of findings both within studies of the same behavior and across studies of different behaviors. Because the aim of the study was to examine the extent of evidence for properties of the stages of change-decisional balance relationship as applied to dietary behavior change, we did not exclude any study that examined one or more properties of this relationship. Notwithstanding differences in the number of studies of each behavior, noteworthy is that findings were remarkably consistent across behaviors.

Only published studies were included in the review, introducing the potential for publication bias to threaten the validity of study findings.[41] To minimize this bias, it is suggested that unpublished studies be included in subsequent meta-analytic reviews of TTM research and analyses performed with and without these data. If study conclusions differ, the results of either approach should be interpreted cautiously.[42] Finally, although an effort was made to include all of the relevant literature, it is possible that other studies of dietary behavior were inadvertently omitted from the review.

This is the first study to examine all of the properties of the stages of change-decisional balance relationship. It included more studies and used more sophisticated analytic techniques than previous studies. For dietary behavior change, there was consistent and moderate support for each of the properties studied.

As demonstrated previously and replicated in this study, Janis and Mann's decision-making model of 8 factors representing comparative gains and losses can be simplified to 2 basic categories of the pros and cons of dietary behavior change.[3] Consistent with the TTM, the cons of dietary behavior change exceeded the pros in precontemplation; in action and maintenance the reverse was true; a crossover between the pros and cons occurred between precontemplation and action stages; and the average increase in the pros was greater than the average

decrease in the cons from precontemplation to action stages. Together, these findings inform understanding of the decision-making process that occurs as individuals strive to modify dietary behaviors, information that can aid program developers in designing more effective dietary intervention programs. Because progression to later stages was more often associated with shifts in the pros than the cons, emphasis on increasing the pros is warranted. A .82 standard deviation increase is a large effect by conventional standards.[36] Achieving such an effect will likely require individual-level change strategies to promote healthful eating as well as policy interventions to reduce environmental barriers to the adoption of a healthful diet. ■

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