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A Meta-Analysis of the Effectiveness of Health Belief Model Variables in Predicting Behavior

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The Health Belief Model (HBM; Rosenstock, 1966) was constructed to explain which beliefs should be targeted in communication campaigns to cause positive health behaviors. The model specifies that if individuals perceive a negative health outcome to be severe, perceive themselves to be susceptible to it, perceive the benefits to behaviors that reduce the likelihood of that outcome to be high, and perceive the barriers to adopting those behaviors to be low, then the behavior is likely for those individuals. A meta-analysis of 18 studies (2,702 subjects) was conducted to determine whether measures of these beliefs could longitudinally predict behavior. Benefits and barriers were consistently the strongest predictors. The length of time between measurement of the HBM beliefs and behavior, prevention versus treatment behaviors, and drug-taking regimens versus other behaviors were identified as moderators of the HBM variables' predictive power. Based on the weakness of two of the predictors, the continued use of the direct effects version of the HBM is not recommended.

According to Rosenstock's (1966) seminal work on the Health Belief Model (HBM), the original goal of the researchers who developed the model was to focus the efforts of those who sought to improve public health by understanding why people failed to adopt a preventative health measure. The model's ability to explain and predict a variety of behaviors associated with positive health outcomes has been successfully replicated countless times (Janz & Becker, 1984). The model has also been used to develop many successful health communication interventions by targeting messages at the HBM variables to change health behaviors (Sohl & Moyer, 2007). The individual elements of the model, however, have varied in their ability to predict health behaviors (Harrison, Mullen, & Green, 1992). In order to resolve the uncertainty concerning which elements of the model are most strongly related to health behaviors, this review presents the results of a meta-analysis of the HBM variables.

REVIEW OF THE MODEL

The HBM specifies that individuals' perceptions of four variables can predict their behavior. First, the model argues people will be more motivated to act in healthy ways if they believe they are susceptible to a particular negative health outcome (Rosenstock, 1966). The model states that people will not act to prevent a negative health outcome that is unlikely to afflict them. For example, women are unlikely to get a mammogram if they believe they are unlikely to develop breast cancer (Hyman, Baker, Ephraim, Moadel, & Philip, 1994).

Second, the model predicts that the stronger people's perception of the severity of the negative health outcome, the more they will be motivated to act to avoid that outcome (Rosenstock, 1966). Specifically, if the undesirable health outcome will not have a large impact on the individual's life, she or he will not be motivated to act to avoid it. Severe outcomes include death, physical or mental impairment, pain, etc. In the case of breast cancer, women are more likely to get a mammogram if they believe breast cancer has a high likelihood of mortality if it develops undetected (Hyman et al., 1994). Susceptibility and severity concern the individual's perception of the negative health outcome. The other two variables in the model concern the individual's perception of

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the target behavior that will supposedly reduce the likelihood of the negative health outcome.

The individual must perceive that the target behavior will provide strong positive benefits. Specifically, the target behavior must be likely to prevent the negative health outcome. If the individual perceives that mammograms are unlikely to detect cancer accurately, the individual will be unlikely to schedule an appointment to get one (Hyman et al., 1994).

Finally, the model argues that if people perceive there are strong barriers that prevent their adopting the preventative behavior, they will be unlikely to do so (Rosenstock, 1966). The behavior may be perceived as too expensive, painful, challenging, etc. Some women may not get mammograms because the process can be painful even if they believe it will accurately detect breast cancer (Hyman et al., 1994).

The model also includes a cue to action whereby the individual is spurred to adopt the preventative behavior by some additional element (Rosenstock, 1966). In Rosenstock's original formulation, cues to action could include external cues like a mass media campaign or internal cues like a negative change in bodily state. However, Rosenstock and every other reviewer of the literature since his initial work have noted that the cue to action is the most underdeveloped and rarely measured or researched element of the model (Janz & Becker, 1984; Rosenstock, 1974; Zimmerman & Vernberg, 1994). While the cue to action may be important, it is not examined in the current review, as there are not enough studies that measured it.

Several other variables have been proposed as potential additions to the HBM. Becker (1974) proposed that overall motivation to pursue healthy behavior should be included. Self-efficacy was also proposed as an HBM variable (Rosenstock, Strecher, & Becker, 1988). However, these variables are rarely included in HBM studies (Zimmerman & Vernberg, 1994), which precludes quantitative summary. Furthermore, Zimmerman and Vernberg questioned whether or not the HBM is still the same model when these other variables are added. Given the paucity of studies and theoretical uncertainty of these additional variables' place in the model, the current review focuses on the original four variables of susceptibility, severity, benefits, and barriers.

In addition to adding more variables, different ways of modeling the relationships among those variables and their relationship with behavior have been proposed. For example, Janz and Becker (1984) described a model where benefits and barriers were subtracted from each other and directly affect behavior as a difference score. Susceptibility and severity were proposed to be indirectly related to behavior because their relationship to behavior is mediated by perceived threat. Strecher, Champion, and Rosenstock (1997) lamented the frequency with which the HBM was only implemented as a four-variable model with only additive effects on behavior. They suggested future HBM research should begin looking at more complex causal

models and examining interactions amongst the variables. Unfortunately, such research is rarely done and this quantitative review is only able to summarize research testing the direct effects of each variable on behavior.

THE IMPORTANCE OF LONGITUDINAL STUDIES

In Rosenstock's (1966) original proposal of the HBM, he expressed strong misgivings about applying the HBM to the analysis of cross-sectional data. He argued that in order for relationships between behavior (current or recalled) and the HBM variables to have any meaning in a cross-sectional design, one must assume the subjects' perceptions of these variables have not changed since they first adopted the behavior. He argued that cognitive dissonance theory would predict that perceptions of the HBM variables would change after behavior. He explained that once one has adopted a behavior, one is likely to change one's beliefs to be consistent with that behavior. This hypothesis would predict that cross-sectional studies would produce inaccurately strong estimates of the relationships between the HBM variables and behavioral adoption of the target preventative behavior.

Janz and Becker (1984) argued the opposite pattern of results could occur where some cross-sectional relationships would be weaker than the relationships in longitudinal studies. They suggested that after one has adopted a prevention measure, one should logically perceive oneself as less susceptible to the negative health outcome. This process would cause a negative relationship between susceptibility and the likelihood of adopting the behavior. They note the same could be true for severity if the target behavior reduces the severity of the illness. Barriers may also seem to be lessened once one has adopted the behavior if it was easier than originally perceived. Alternatively, an individual could discover that barriers were stronger than originally perceived before the behavior was adopted. In short, there are several good reasons to suspect that unless the HBM variables are measured some time before the individuals in a study make their choice to adopt the behavior or not, the results could misrepresent the ability of the HBM to predict behavior.

Previous Meta-Analyses of the HBM

Several meta-analyses of the ability of the HBM to predict behavior across different health behaviors have been published (Harrison et al., 1992; Janz & Becker, 1984; Zimmerman & Vernberg, 1994). The Janz and Becker review found barriers, benefits, and susceptibility were good predictors of behavior whereas severity was not. The Janz and Becker review was not a meta-analysis in the traditional sense because it counted statistically significant relationships rather than estimating mean effect sizes. This style of quantitative review does not provide precise estimates of the strength of the relationships between the variables

of interest, overly relies on the statistical significance test when sample size variance can have a strong effect on the outcomes, and cannot correct for various artifacts that can obscure accurate understandings of the key relationships (Hunter & Schmidt, 2004).

The Zimmerman and Vernberg (1994) review found the HBM was predictive of behavior, but only weakly so in comparison to social cognitive theory and especially as compared to the theory of reasoned action. Their review examined the ability of the model as a whole to predict behavior but did not examine the effects of each variable on behavior. Their analysis included a few cases where the model included the two new variables and others where it did not. The variation in the included variables obscures the ability of the original and most often researched core HBM variables to predict behavior.

The most complete meta-analysis was conducted by Harrison et al. (1992). The Harrison et al. meta-analysis concluded that retrospective studies produced substantially larger effect sizes than prospective studies. This suggests that the HBM is not as good at predicting future behavior as its creators had hoped. The estimates of the effect of each variable on behavior were all fairly small in their meta-analysis.

The Harrison et al. (1992) review did examine the relationship between specific HBM variables and behavioral outcomes. Their meta-analysis did not correct their effect size estimates for the unequal split in many of the behavioral outcome measures and the unreliability of the measures of the HBM variables. Failure to correct for these artifacts attenuates estimates of the effect sizes (Hunter & Schmidt, 2004) and may have contributed to their small estimates. Also, 12 HBM studies have been conducted since the Harrison et al. article that were included in the current review.

The Current Meta-Analysis

Given the continued use of the HBM to explain and predict health behavior both by being implemented in health campaigns and by being taught in academic settings (Lapinski & Witte, 1998), it is surprising that there exist no reliable estimates of the model's ability to predict behavior. In order to evaluate the accuracy of the direct effects model of the HBM, a meta-analysis of longitudinal studies will be reported. In addition to estimating the effects of each variable, the effects of a variety of moderators will be examined as well.

The length of time between the measurement of the HBM variables and the measurement of behavior will be examined as a possible moderator because the impact of beliefs on time two behaviors may fade with time. During the period between belief measurement and behavior measurement, people may have conversations with friends, read a brochure, or even gain better access to health care via improved health insurance. Any of these experiences and many more could

change people's health beliefs after they were measured but before behavior was chosen. The longer this interval is, the greater is the likelihood that people's beliefs will have changed. Due to this possibility it is predicted that the length of time between belief measurement and behavior measurement will be negatively correlated with the effect size of each of the four predictors' ability to predict behavior.

Different types of outcome behaviors will also be examined as possible moderators in order to help determine whether the model can predict behaviors beyond its original focus on prevention behaviors (Rosenstock, 1966). The Janz and Becker (1984) review found that behaviors that were associated with treating a diagnosed disease or disorder were related to the four HBM variables differently than behaviors that attempted to prevent some negative health outcome. Specifically, susceptibility predicted behavior better for prevention than treatment, while the reverse was true for benefits and severity. Barriers were not affected by this moderator in their analysis. This pattern is predicted to be replicated in the studies that have been conducted since Janz and Becker's review. If any other groupings of the studies based on the target behavior appear reasonable, they too will be explored as possible moderators. The current meta-analysis will examine these possible moderators and estimate the effect of each variable on health behavior outcomes.

METHOD

Literature Search

The academic search engines "PsychInfo," "Medline," and "Communication and Mass Media Complete" were used to find articles for inclusion in the current review. All journal articles that included the phrase "health belief model" in the abstract or title were examined for possible inclusion.

Study Selection

First, the study had to measure the HBM variables. Studies that only measured two of the four variables were still included in order to maximize the sample of studies. Studies that used HBM variables to design an intervention but did not measure the variables were not included. Second, the studies had to be longitudinal in design. Specifically, the studies had to measure the HBM variables at time one and measure some sort of health-related behavior associated with those beliefs at time two. Several studies measured the HBM variables and then provided their sample with an intervention designed to change the target health behavior. If the intervention had an effect on the target health behavior, it seems probable that the subjects' perceptions of the HBM variables had also changed. This design renders the time one measurement invalid because the subjects' perceptions probably changed substantially before they chose to adopt or

not adopt the key behavior. These studies were also excluded from the meta-analysis in order to determine if the HBM variables could be used predict time two behavior. Also, some studies were excluded because they did not include sufficient statistical reporting to allow the calculation of estimates of the bivariate relationships between the HBM variables and the health behavior.

There were 94 articles discovered that measured the HBM variables at the beginning of the study and then measured the target behavior at a later date. Of these, 40 were excluded because they implemented some sort of intervention targeted at the HBM variables between the two measurement points. Another 36 were excluded because they did not provide enough information to estimate effect sizes. Many of these only reported standardized slopes from regression equations with a variety of different variables included in the regression equation or the results of discriminant analyses. This left a collection of 18 studies published between 1982 and 2007 with a total sample of 2,702. For severity there were 17 studies with a combined sample of 2,629. For susceptibility, there were 18 studies with a combined sample of 2,702. For benefits there were 15 studies and a combined sample of 1,949. Finally, for barriers, there were 17 studies with a combined sample of 2,669.

Coding

The coded study characteristics included the sample size, the length of time between the measurement of the HBM variables and the measurement of the health behavior, and aspects of the outcome behavior. The outcome behavior was coded in two ways. First, as per Janz and Becker's (1984) grouping,

the outcome behavior was coded as either a treatment or a prevention behavior. There were eight studies that studied treatment behavior and 10 that studied prevention behavior. Also, because many studies in this set examined prescribed drug-taking behaviors, the behavior was coded as either a drug-taking behavior or other, to explore the possibility that this type of behavior might be differentially predicted by the HBM variables. There were five studies that measured a drug-taking outcome and 13 that did not. The reliability of each of the measures, the percentage of the sample that changed their health behavior (only for the studies that only offered a dichotomous change/didn't change outcome), and the correlation between each HBM variable (susceptibility, severity, benefits, and barriers) and the outcome behavior were coded. The correlation between perceived barriers and time two behaviors was reverse coded so that a positive correlation indicates that the effect is in the direction hypothesized by the theory (e.g., lower perceived barriers is positively related to a greater likelihood of performing the target behavior). All of the studies and the elements of each that could be coded are presented in Table 1.

Data Analysis

Hunter and Schmidt's (2004) variance-centered meta-analysis method was used to calculate estimates of the correlations between each of the HBM variables and their associated health behavior change outcomes. In the cases where the outcome variable was dichotomous, the estimates were corrected for an uneven split using Hunter and Schmidt's corrections of both the effect size estimate and the estimate of sampling error. Given the inconsistent reporting

TABLE 1
Effect Sizes, Study Information, and Moderator Coding

<i>Study</i>	<i>Number of Days Between Measures</i>	<i>Behavior</i>	<i>Treat/ Prevent</i>	<i>n</i>	<i>Sev. r</i>	<i>Susc. r</i>	<i>Ben. r</i>	<i>Barr. r</i>
Wurtele et al., 1982	2	TB Test	1	553	0.04	-0.05		0.17
Kaufert et al., 1986	21	Quit smoking	1	33	0.26	0.03		
Smith et al., 1987	174	Drug taking	0	174	0.14	0.11	0.01	0.03
Reid & Christensen, 1988	10	Drug taking	0	113	0.09	0.03	0.17	0.32
Kuhner & Raetzke, 1989	41	Dental care	0	120	0.295	0	0.175	0
Oldridge & Streiner, 1990	180	Attend program	0	92	-0.14	0.00	-0.14	0.19
Hyman et al., 1994	90	Mammogram	1	73		0.04	0.41	-0.28
Hahn, 1995	49	Attend program	1	200	0.08	0.03	0.19	0.24
Abraham et al., 1996	365	Condom use	0	122	0	-0.09	0.01	0.18
DiFranceisco et al., 1998	49	Attend program	0	89	-0.2	0	0.03	0.037
Abraham et al., 1999	28	Drug taking	1	167	0.10	0.03		0.35
Sage et al., 2001	30	CPAP usage	0	40	0.13	0.12	0.28	0.14
Bish et al., 2002	90	Cervical smear test	1	142	-0.01	-0.02	0.15	0.12
Blue et al., 2002	—	Influenza vaccination	1	207	0.25	0.29	0.42	0.20
Peltzer et al., 2002	182	Drug taking	0	136	0.08	-0.014	0.13	0.03
Farquharson et al., 2004	28	Drug taking	1	80	0.36	0.34	0.47	0.00
Sullivan et al., 2004	—	Calcium and exercise	1	76	-0.15	0.03	0.19	0.39
Schmeige et al., 2007	180	Attend program	1	285	0.04	-0.04	0.05	0.26

Note. 0 = Outcome behavior is a treatment for illness and 1 = prevention of an illness.

of the reliabilities of the measures used in these studies, Hunter and Schmidt's artifact distribution method was used to correct the estimates for attenuation due to measurement error for the measures of the HBM variables.¹ Correcting for attenuation due to the unreliability of the measures of behavior was not possible because none of the articles reported an estimate of the reliability of their behavior measures. The correlation coefficient was not transformed to Fisher's z because recent simulation studies have shown that the transformation tends to reduce accuracy more than the small bias produced by the untransformed correlation coefficient (Schulze, 2007).

Moderator detection was conducted by applying Hunter and Schmidt's (2004) 75% rule. They stated that if 75% or more of the variance in an effect size can be attributed to sampling error and other artifacts, then the effect size estimate is probably homogeneous. Application of the 75% rule has been found to have a higher probability of accurately detecting heterogeneity of variance in small k meta-analyses than the Q-test or chi-square test (Sackett, Harris, & Orr, 1986). When the effects were not completely homogenous (i.e., when error accounted for less than 100% of the variance), 80% credibility intervals were reported in order to estimate how widely the population effect size is predicted to vary based on undetected moderators (Hunter & Schmidt, 2000).

RESULTS

The estimates of the effect sizes for each variable can be found in Table 2, both in the set of studies as a whole and under various groupings based on possible moderators. The

length of time between time one and time two measurement, whether the study focused on treatment or prevention of a negative health outcome, and whether or not the behavioral outcome was taking prescribed drugs were all found to be important moderators. Each predictor variable and the effects of the coded moderators is examined individually.

Severity

Overall, the estimates were low for the relationship between subjects' estimate of how severe a given negative health outcome would be and their likelihood of adopting the target behavior. The current estimate was slightly larger than the Harrison et al. (1992) estimate of $r = .08$. Also, these estimates were all heterogeneous as there were no moderators where the explained variance exceeded 75%. However, when only studies that measured taking a prescribed drug regimen were considered, the effect size estimate was at its largest and the credibility interval did not include zero. This finding suggests there is something about considering complying with a prescription to take drugs that causes people to consider the severity of the consequences for not taking the drugs more so than for other health behaviors. Unlike Janz and Becker's (1984) finding, treatment versus prevention did not moderate the relationship between severity beliefs and behavior.

The length of time between the time one measurement of the HBM variables and the time two assessment of behavior was tested as a possible moderator by correlating the effect sizes with the number of days between measurements. The correlation between severity and the length of time between measurements was $r = -.37$, which suggests that severity ratings are more likely to be positively related to time two behavior if that behavior is measured shortly after the HBM variables are measured.

TABLE 2
Correlations With Behavior, Percentage of Variance Explained by Error, and 80% Credibility Intervals for the Whole Sample of Studies and Various Moderators

Moderators	Severity	HBM Variables		
		Susceptibility	Benefits	Barriers
Whole sample	0.15 24.73% $-.04 < \rho < .35$	0.05 58.10% $-.04 < \rho < .14$	0.27 31.17% $.09 < \rho < .45$	0.30 33.08% $.13 < \rho < .47$
Prevention	0.16 17.74% $-.05 < \rho < .37$	-0.06 32.51% $-.08 < \rho < .20$	0.42 34.17% $.25 < \rho < .59$	0.33 12.87% $.09 < \rho < .57$
Treatment	0.14 37.70% $-.03 < \rho < .31$	0.03 100% —	0.11 55% $0 < \rho < .23$	0.22 93% $.19 < \rho < .26$
Drug outcome	0.25 46.70% $.1 < \rho < .40$	0.14 42.30% $0 < \rho < .28$	0.28 26.70% $.06 < \rho < .5$	0.37 100.00% —
Non-drug outcome	0.12 23.08% $-.07 < \rho < .31$	0.02 75.20% $-.04 < \rho < .08$	0.26 30.09% $.08 < \rho < .45$	0.30 30.68% $.12 < \rho < .48$

¹The reliability estimates that were used for these calculations are available from the author.

Susceptibility

The relationship between susceptibility beliefs and behavior was almost always near zero. This is a smaller estimate than the Harrison et al. (1992) estimate of $r = .15$. Only when the set of studies was narrowed to the set that tried to predict the likelihood of their subjects complying with a drug regimen was the effect consistently positive. For several subsets, the estimates were homogeneous. This suggests that there are unlikely to be other moderators. Despite Janz and Becker's (1984) finding that susceptibility predicted behavior better for prevention behavior than treatment, the effect of susceptibility beliefs was predicted to be near zero for both types of behavior. Janz and Becker also found severity was the weakest predictor of behavior, whereas the current meta-analysis found susceptibility to be the weakest predictor of behavior.

The correlation between the effect size for susceptibility and the number of days between measurements was $r = -.50$, which suggests that the longer the period between measurements, the weaker is the relationship between the time one measure of susceptibility and time two behavior.

Benefits

The estimates of the effect of subjects' perceptions of benefits on their likelihood of performing the outcome behavior were consistently positive. This is consistent with the model and stronger than the Harrison et al. (1992) estimate of $r = .13$. These estimates were also consistently heterogeneous. No moderator was able to produce a set of homogeneous effects for benefits. The importance of the heterogeneity is tempered by examination of the credibility intervals, which suggest there are unlikely to be any moderators that make the effect negative. When the health behavior in question is a treatment for a negative health outcome, benefits have the smallest effect, though it does remain positive. This contradicts Janz and Becker's (1984) findings, as they found that benefits are a stronger predictor of treatment behavior rather than prevention behavior.

The effect of perceived benefits and time two behavior and the length of time between measurements is estimated to be $r = -.59$. This finding suggests that the amount of time that passes between measurements is a strong moderator of the effect of the time one benefits variables on time two behavior estimates, such that longer periods of time are associated with weaker effects.

Barriers

The effects of subjects' perceptions of the barriers to performing the outcome behavior on their likelihood of performing that behavior were consistently the largest of the four HBM variables. It was again larger than the estimate of $r = .21$ produced by the Harrison et al. (1992) review. The subset of studies that were concerned with subjects

complying with recommended treatments for diseases and the subset that measured drug taking as outcomes were both homogeneous. Homogeneity indicates that these averages can be assumed to be accurate estimates of a single population effect sizes. Barriers were a weaker predictor of behavior when the behavioral outcome was treatment than when it was prevention.

The relationship between of the amount of time between measures and the estimate of the effect of barriers on behavior was $r = .02$. This is inconsistent with the prediction that they would be negatively correlated.

DISCUSSION

Summary

When all of the obtained studies were considered together, severity, barriers, and benefits were all related in the predicted direction to the likelihood of performing the target behavior. Examination of the percentage of variance explained by artifacts and other sources of error indicates that moderators of these effects are very likely. The estimate of the effect of perceived susceptibility on behavior was nearly homogeneous, but the estimate of the effect was also nearly zero.

As the amount of time that elapsed between measurement of the HBM variables and the measurement of behavior increased, the likelihood of finding effects in the predicted direction decreased for susceptibility, severity, and benefits. However, in the case of barriers, the relationship was nearly zero. When the type of outcome was considered (treatment or prevention behavior), the size of the effects for benefits and barriers varied, where both were stronger predictors when the outcome was preventing a negative health outcome than when it was treating an existing one. This moderator did not substantially affect the relationship between both severity and susceptibility and behavior. When the outcome behavior was to take prescribed drugs, the effect sizes for severity and susceptibility were both larger than studies that measured other behaviors, whereas this moderator did not substantially affect the estimates for benefits and barriers.

Strength of the Relationships

Benefits and barriers emerged as the strongest predictors of behavior. Severity was weak, but largely in the direction predicted. Harrison et al. (1992) suggested severity might not vary as much as some of the other variables because few people consider outcomes like breast cancer as anything other than extremely severe. Low variance leads to low estimates of effect size. Future research might try testing the model with several diseases with varying levels of severity to examine this possibility.

Susceptibility was almost always unrelated to behavior. One possible explanation is that people who have already been diagnosed with a disease do not vary in their perception of susceptibility. If they have the disease, clearly they are susceptible. This possibility is belied by the finding that susceptibility was just as weak a predictor of behavior in the studies that examined prevention as it was for the studies that examined treatment of already diagnosed subjects.

The extended parallel process model (EPPM; Witte, 1992) argued that the effects of susceptibility and severity on behavior are moderated by the subjects' self-efficacy. Unfortunately, the studies obtained for this meta-analysis did not allow for the testing of this explanation. Future applications of the HBM should take this possibility into account and report the interaction that the HBM variables have with self-efficacy.

Another possibility is that severity and susceptibility have indirect effects on behavior such that their effects are mediated by perceived threat as per Janz and Becker's (1984) description. If this is the case, it is unsurprising that their effects are consistently weaker. Their effects on behavior may also be moderated by each other, as suggested by Strecher et al. (1997). Future work should examine these possibilities instead of continuing to test these variables' direct effects on behavior.

Time Between Measures as a Moderator

For susceptibility, severity, and benefits a relationship was detected where the length of time between measuring the HBM variables and measuring behavior was associated with a decreasing likelihood of finding effects in the predicted direction. This pattern of results was expected because the beliefs measured may change over time, which renders the time one measurement invalid. As Rosenstock (1966) noted, a cue to action may occur after the time one measurement, a cue that, if strong enough, will cause someone who does not perceive the disease to be severe or themselves susceptible to adopt the prevention behavior despite their original perceptions. The longer the time between measurements, the more likely it is for a cue to action or messages targeted at the HBM variables to reach many of the subjects.

Barriers may not be affected by the length of time between measures as they are not based on perceptions of possible future outcomes of diseases or treatments but current problems that prevent adopting a behavior like low access to medical care. Many types of barriers like low access to medical care or the cost of a behavior are unlikely to change over time. If barriers change very little, measures of the subjects' beliefs about barriers would remain a good predictor of behavior regardless of how long the period of time between measures is extended. Future work should vary the amount of time between measures to determine the causes of these effects.

Treatment Versus Prevention

Benefits and barriers seem to predict behavior better when the goal is the prevention of a negative health outcome instead of attempting to determine if subjects will comply with a treatment program for an existing condition. This contradicts the Janz and Becker (1984) finding that this moderator does not affect barriers and that treatment studies would show a bigger effect for benefits. This is, however, consistent with Rosenstock's (1974) assertion that the model was designed to predict the adoption of preventative measures rather than treatment for existing diseases and disorders. This discrepancy may be explained by the current meta-analysis's focus on longitudinal designs and also by the current meta-analysis making precise estimates of effect size, rather than the vote-counting method of review employed by Janz and Becker.

Drug-Taking Regimen Compliance Versus Others

The subset of studies that examined the likelihood that subjects would comply with a prescription drug regimen produced larger effect sizes than studies that examined other behavioral outcomes. The subset of drug-taking studies included both prevention and treatment goals. The drug-taking studies were the only set such that susceptibility was positively related to behavior. The reason for this moderator having such a strong effect is unclear. Future research should attempt to determine what aspects of this particular behavior are related to HBM constructs. Given that this finding was based on a small number of studies and was not theoretically derived, this result should be interpreted with caution until more studies have been conducted.

Limitations

The most important limitation of this meta-analysis is the small number of studies. Unfortunately, many researchers are still not providing enough information for other researchers to make estimates about the effect sizes of the basic relationships among the variables. Future researchers should provide a full correlation matrix of all of the variables measured in their study to improve future meta-analytic estimates.

Another limitation of the current review is the variety and varying quality of the measures used. Many were one-item measures and very few of the multi-item measures used any kind of factor analysis to demonstrate construct validity or even reported the reliability of the measures. This casts doubt about whether the HBM constructs were accurately measured. Once more standardized methods of measuring these variables have been established, some of the heterogeneity in the effectiveness of the constructs may be reduced (Strecher et al., 1997).

Sixteen of the 18 articles relied on convenience samples, though very few were student samples. One study used a quota sample (Abraham, Sheeran, Abrams, & Spears, 1996) and another used a stratified random sample (Blue & Valley, 2002). The reliance on convenience samples may limit the generalizability of these estimates, but the large combined sample of the meta-analysis provides some check against the problems associated with any one study's weak sampling.

Finally, this review did not test the more complex models that are possible and that are ideal (Strecher et al., 1997). In order to test different causal models, the studies included in this meta-analysis needed to have all reported full correlation matrixes. Unfortunately, very few of them did, and more complex path models will have to await more studies to be tested meta-analytically. The variety of ways that the effects of each variable could moderate the effects of the others on behavior also awaits further research.

Conclusion

The HBM constructs vary in their effectiveness as predictors of behavior. This conclusion must remain tentative due to the small number of studies and the need to test some of the more complex versions of the model that may offer greater predictive power.

Zimmerman and Vernberg (1994) claimed that the HBM is "an anachronism, no longer applying well to an understanding of prevention of chronic illness" (p. 62). While their judgment may not apply to the more complex versions of the HBM that have been proposed, it certainly applies to the direct effects model that this review found to be the most commonly used model among the longitudinal studies of the HBM. What is clear from the inconsistent effects and the weakness of susceptibility and severity as predictors is that future work should abandon the simple four-variable additive model and instead examine possible mediation and moderation among the variables.

REFERENCES

- Abraham, C., Clift, S., & Grabowski, P. (1999). Cognitive predictors of adherence to malaria prophylaxis, regimens on return from a malaria region: A prospective study. *Social Science and Medicine*, 48, 1641-1654.
- Abraham, C. S., Sheeran, P., Abrams, D., & Spears, R. (1996). Health beliefs and teenage condom use: A prospective study. *Psychology and Health*, 11, 641-655.
- Becker, M. H. (1974). The health belief model and sick role behavior. In M. H. Becker (Ed.), *The health belief model and personal health behavior* (pp. 82-92). Thorofare, NJ: Charles S. Black, Inc.
- Bish, A., Sutton, S., & Golombok, S. (2000). Predicting uptake of a routine cervical smear test: A comparison of the health belief model and the theory of planned behavior. *Psychology and Health*, 15, 35-50.
- Blue, C. L., & Valley, J. M. (2002). Predictors of influenza vaccine: Acceptance among healthy adult workers. *AAOHN Journal*, 50, 227-233.
- Champion, V. L. (1990). Breast self-examination in women 35 and older: A prospective study. *Journal of Behavioral Medicine*, 13, 523-538.
- DiFranceisco, W., Kelly, J. A., Sikkema, K. J., Somlai, A. M., Murphy, D. A., & Stevenson, L. Y. (1998). Differences between completers and early dropouts from 2 HIV intervention trials: A health belief approach to understanding prevention program attrition. *American Journal of Public Health*, 88, 1068-1073.
- Farquharson, L., Noble, L., Barker, C., & Behrens, R. H. (2004). Health beliefs and communication in the travel clinic as predictors to adherence to malaria chemoprophylaxis. *British Journal of Health Psychology*, 9, 201-217.
- Hahn, E. J. (1995). Predicting head start parent involvement in an alcohol and other drug prevention program. *Nursing Research*, 44, 45-51.
- Harrison, J. A., Mullen, P. D., & Green, L. W. (1992). A meta-analysis of studies of the health belief model with adults. *Health Education Research*, 7, 107-116.
- Hunter, J. E., & Schmidt, F. L. (2000). Fixed effects vs. random effects meta-analysis models: Implications for cumulative research knowledge. *International Journal of Selection and Assessment*, 8, 275-292.
- Hunter, J. E., & Schmidt, F. L. (2004). *Methods of meta-analysis: Correcting for error and bias in research findings*. Thousand Oaks, CA: Sage.
- Hyman, R. B., Baker, S., Ephraim, R., Moadel, A., & Philip, J. (1994). Health belief model variables as predictors of screening mammography utilization. *Journal of Behavioral Medicine*, 17, 391-406.
- Janz, N. K., & Becker, M. H. (1984). The health belief model: A decade later. *Health Education Quarterly*, 11, 1-47.
- Kaufert, J. M., Rabkin, S. W., Syrotuik, J., Boyko, E., & Shane, F. (1986). Health beliefs as predictors of success of alternate modalities of smoking cessation: Results of a controlled trial. *Journal of Behavioral Medicine*, 9, 475-489.
- Kuhner, M. K., & Raetzke, P. B. (1989). The effect of health beliefs on the compliance of periodontal patients with oral hygiene instructions. *Journal of Periodontology*, 60, 51-56.
- Lapinski, M. K., & Witte, K. (1998). Health communication campaigns. In L. D. Jackson & B. K. Duffy (Eds.), *Health communication research: A guide to developments and directions*, (pp. 139-161). Westport, CT: Greenwood Press.
- Oldridge, N. B., & Streiner, D. L. (1990). The health belief model: Predicting compliance and dropout in cardiac rehabilitation. *Medicine and Science in Sports and Exercise*, 22, 678-683.
- Peltzer, K., Onya, H., Seoka, P., Tladi, F. M., & Malema, R. N. (2002). Factors at first diagnosis of tuberculosis associated with compliance with the directly observed therapy (DOT) in the Limpopo Province, South Africa. *Curationis*, 25, 55-67.
- Reid, L. D., & Christensen, D. B. (1988). A psychosocial perspective in explanation of patients' drug-taking behavior. *Social Science and Medicine*, 27, 277-285.
- Rosenstock, I. M. (1966). Why people use health services. *Milbank Memorial Fund Quarterly*, 44, 94-127.
- Rosenstock, I. M. (1974). Historical origins of the health belief model. *Health Education Monographs*, 2, 328-335.
- Rosenstock, I. M., Strecher, V. J., & Becker, M. H. (1988). Social learning theory and the health belief model. *Health Education Quarterly*, 15, 175-183.
- Sackett, P. R., Harris, M. M., & Orr, J. M. (1986). On seeking moderator variables in the meta-analysis of correlational data: A Monte Carlo investigation of statistical power and resistance to Type I error. *Journal of Applied Psychology*, 71, 302-310.
- Sage, C. E., Southcott, A. M., & Brown, S. L. (2001). The health belief model and compliance with CPAP treatment for obstructive sleep apnoea. *Behaviour Change*, 18, 177-185.
- Schmiege, S. J., Aiken, L. S., Sander, J. L., & Gerend, M. A. (2007). Osteoporosis prevention among young women: Psychological models of calcium consumption and weight bearing exercise. *Health Psychology*, 26, 577-587.

- Schulze, R. (2007). Current methods for meta-analysis: Approaches, issues, and developments. *Journal of Psychology*, 215, 90–103.
- Smith, N. A., Ley, P., Seale, J. P., & Shaw, J. (1987). Health beliefs, satisfaction, and compliance. *Patient Education and Counseling*, 10, 279–286.
- Sohl, S. J., & Moyer, A. (2007). Tailored interventions to promote mammography screening: A meta-analytic review. *Preventative Medicine*, 45, 252–261.
- Strecher, V. J., Champion, V. L., & Rosenstock, I. M. (1997). The health belief model and health behavior. In D. S. Gochman (Ed.) *Handbook of health behavior research I: Personal and social determinants* (pp. 71–91). New York: Plenum Press.
- Sullivan, K., Pasch, L. A., Cornelius, T., Cirigliano, E. (2004). Predicting participation in premarital prevention programs: The health belief model and social norms. *Family Process*, 43, 175–193.
- Witte, K. (1992). Putting the fear back into fear appeals: The extended parallel process model. *Communication Monographs*, 59, 329–349.
- Wurtelle, S. K., Roberts, M. C., & Leeper, J. D. (1982). Health beliefs and intentions: Predictors of return compliance in a tuberculosis detection drive. *Journal of Applied Social Psychology*, 12, 128–136.
- Zimmerman, R. S., & Vernberg, D. (1994). Models of preventative health behavior: Comparison, critique, and meta-analysis. *Advances in Medical Sociology*, 4, 45–67.