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Jolanta Życińska*

Cognitive and behavioral predictors in the process of smoking cessation during pregnancy: Testing for discontinuity patterns in the Transtheoretical Model

The aim of the study was to assess predictive power of cognitive variables and health-promoting behaviors for the process of smoking cessation described in terms of the Transtheoretical Model (TTM). Participants in the study were 150 women (mean age 26.93, SD = 4.56 years), in uncomplicated pregnancy. Cigarette smokers constituted 29.3% of the sample, while the rest had previously quit smoking (in that number 42.1% during pregnancy). Beliefs and expectations were measured by means of scales developed by the author, while health-related behaviors were assessed using the Health Behavior Inventory (HBI) by Z. Juczyński, supplemented with pregnancy-specific behaviors. TTM discontinuity patterns were tested in the study using polynomial-based orthogonal contrasts. Statistically significant linear trends were found for expectations concerning the infant's health state and the course of delivery, for beliefs about the effect of maternal smoking on infant health, as well as for pregnancy health behaviors. The obtained results were confirmed by hierarchical regression analysis, with smoking cessation explained to a larger extent by cognitive factors than by health-related behaviors. This may suggest that the TTM is a "pseudo-stage" model, and a general change of the variables under study is of greater importance for the process of smoking cessation than focusing on the TTM stages.

Keywords: health-related behaviors, health beliefs and expectations, stage models, discontinuity patterns, pregnancy smoking cessation

Introduction

Many epidemiological studies have confirmed negative consequences of cigarette smoking during pregnancy. Maternal cigarette smoking is related to pregnancy and delivery complications, as well as to morbidity and mortality of newborns (Kolas, Nakling & Salvesen, 2000; Radomiński, 2001). Among the toxic effects of tobacco on the infant's health the following are reported most frequently: low birth weight, lower chest and head circumferences, physical development retardation at birth and in subsequent developmental stages (Gilliland, Li & Peters, 2001; McArthur, Knox & Lancashire, 2001; Shankaran, Das, Bauer, Bada, Lester, Wright & Semergilio, 2004). Thus, cigarette smoking during pregnancy can be justifiably regarded as a risky maternal behavior (associated with the role), and not only individual (Wakschlag, Pickett, Middlecamp, Tenzer & Leventhal, 2003).

However, the evidence for the effect of tobacco on the maternal and fetal health does not seem to be a sufficient argument for smoking cessation, since only 20% of

smoking women decide to maintain nicotine abstinence all over the pregnancy period (Ockene, Ma, Zapka, Pbert, Goins & Stoddard, 2002). Moreover, pregnant smokers quit smoking most often not earlier than in the second trimester of pregnancy, and this change is associated with both their low level of dependence and nicotine abstinence among their close family and friends. These women are also better educated, married, and their economic status is higher (Ebrahim, Floyd, Merritt, Decoufle & Holtzman, 2000). In this context both the sociodemographic profile and dependence characteristics of pregnant smokers are unfavorable. Undoubtedly, these variables allow to identify a group at risk that should be provided with a special professional care. However, neither determinants of the smoking cessation process, nor principles of intervention aimed at change of this harmful behavior can be described that way.

Theoretical models proposed in health psychology explain behaviors and their change, with stage models distinguishing phases of this process and specific tasks to be performed at each stage. One of the most widely

* Warsaw School of Social Psychology, ul. Chodakowska 19/31, 03-815 Warszawa, email: jzycinska@swps.edu.pl

described models regarded as a general approach to change in the therapeutic process (e.g. Czabała, 2000), most valid for nicotine dependent persons (cf. Dijkstra & De Vries, 2000), is the Transtheoretical Model (TTM; Prochaska & DiClemente, 1992). In the TTM five stages of behavior change are distinguished, including the individual's own activity and professional interventions (Życińska, 2001). The first stage of precontemplation assumes that the individual is not aware of the negative effect of risky behavior on health, and therefore does not consider changing his/her behavior. In the next stage of contemplation such a change within six months is taken under consideration, and the decision is made on the grounds of the balance between benefits and losses. A positive balance implies transition to the next stage - of preparation. This stage is characterized by forming an intention to change a risky behavior and planning to implement the change in the nearest future (within about a month). The next stage, of action, consists in initiation of a purposeful behavior change. If the period of change consolidation is longer than six months, the stage of maintenance begins. The process of change is completed when the new behavior is consciously selected in difficult situations and so becomes a stable element of lifestyle.

Although this model is most frequently used in the research on smoking cessation, it is criticized for the lack of clear criteria for identification of particular stages. The main criticism refers to using a temporal criterion for the purpose (cf. Łuszczynska, 2004), instead of a set of variables determining a qualitative specificity of each stage (cf. Sutton, 2000). Therefore, variables borrowed from various theoretical models are used by researchers (e.g. intention regarded as a continuous variable in the Theory of Planned Behavior, TPB), which is probably the reason for discrepancies in the research findings testing the TTM discontinuity patterns (cf. Armitage & Arden, 2002; or Kraft, Sutton & McCreath-Reynolds, 1999).

Since there is no adequate model of health-related behavior change during pregnancy, variables responsible for this process were identified on the grounds of conclusions drawn from the hitherto conducted research. Firstly, specific variables (i.e. beliefs concerning specific behaviors) were found to have a greater predictive power than non-specific ones (i.e. generalized beliefs - cf. Armitage, 2003; Łuszczynska, 2004). On these grounds two cognitive variables not tested earlier were introduced in the present study. The variables pertained to expected consequences of health-related behaviors during pregnancy (cf. outcome expectations according to Bandura, 1977) – namely, expectations concerning the course of delivery, and expectations concerning the state of the infant's health at birth. The aim was to capture the maternal decision-making process characteristic of the initial TTM stages (i.e. normal, physiological, uncomplicated delivery and a very good health of the newborn vs. abnormal, difficult and

complicated delivery and a very poor health of the infant). Secondly, four cognitive variables were distinguished concerning relatively stable properties formed in the socialization process - beliefs about the possibility of influencing and controlling one's health. Research findings have confirmed the effect of these variables on change of health-compromising behaviors. The variables include: self-efficacy (Hinton, 2001; Woodby, Windsor, Snyder, Kohler & DiClemente, 1999), internal health locus of control and a sense of responsibility for the unborn infant's health, or internal fetal health locus of control (Bielawska-Batorowicz, 1993, Hasam & Lawrence, 2004, Walker, Cooney & Riggs, 1999), as well as beliefs concerning the effect of maternal smoking on the infant's health (cf. Haslam, 2000; Haslam & Draper, 2000). Finally, research findings concerning health-compromising behaviors of nicotine dependent persons (e.g.: Martinelli, 1999; Ockene, Emmons, Mermelstein, Perkins, Bonollo, Voorhees & Hollis, 2000), including pregnant women (Haslam & Lawrence, 2004), seem to deserve attention. The findings suggest that pursuing health-compromising behaviors may reduce the likelihood of smoking cessation (cf. Ward, Vander Weg, Klesges, Kovach, Elrod, DeBon, Haddock, Talcott & Lando, 2003), and besides, be the cause of failure in long-term abstinence maintenance (cf. Hamadem & Musaiger, 2000). The hypothesis may be corroborated by the results of a study evaluating the effectiveness of a cognitive-behavioral program aimed at smoking cessation among women (Perkins, Marcus, Levine, D'Amico, Miller & Broge, 2001). Change in the intensity of behaviors related to eating habits and physical activity with simultaneous planning to quit smoking was associated with an increase in smoking cessation attempts. On the other hand, such a change in these behaviors intensity in the period of abstinence maintenance was associated with more stable effects of intervention (see also Spring, Pagoto, Pingitore, Doran, Schneider & Hedeker, 2004). Therefore, the introduction of two behavioral variables explaining stages of behavior change seems justified – the variables include: health behaviors specific to the period of pregnancy and general health-related behaviors (occurring earlier, but modified by the new maternity role, e.g. nutritional habits, physical activity).

Hypotheses

The following hypotheses can be posed on the grounds of the preceding considerations:

Hypothesis 1: The role of cognitive and behavioral variables will be different in accordance with the TTM stage. In other words, the model meets the criteria for discontinuity patterns.

The hypothesis can be expanded by specifying of the role of particular variables in successive TTM stages. The

intensity of the participants' beliefs about their possibilities of influencing health - self-efficacy beliefs, internal health locus of control, and a sense of responsibility for the fetal's health - should be the lowest in the precontemplation stage. The contemplation stage associated with the decision-making process should be characterized by a high intensity of positive expectations concerning the course of delivery and the infant's health state (cf. Marlatt & George, 1990). In the preparation stage the level of these variables will be probably even higher since the intention to quit smoking is already present and its implementation is planned (cf. Prochaska, Norcross & DiClemente, 1994). Transition to the action stage should be associated with a high intensity of beliefs about the possibilities of influencing health, while maintenance of the behavior change will be probably characterized by a higher level of the variables in question (cf. Dijkstra & De Vries, 2000). As suggested by the research findings cited above, the perceived effect of smoking on the infant's health should increase from stage to stage (Haslam & Draper, 2000; Haslam, 2000), even though it is against the TTM model assumptions.

As regards behavioral variables, the intensity of health-related behaviors should be the highest in the preparation and maintenance stages, irrespective of behavior category (see cited earlier: Hamadeh & Musaiger, 2000; Perkins et al., 2001; Spring et al., 2004; Ward et al., 2003). This is due to the function served by health-promoting behaviors in these two stages - in the preparation stage they motivate the individual to change the risky behavior (facilitating the realization of intention), while in the maintenance stage - they consolidate the behavior change.

Hypothesis 2: It is difficult to univocally specify predictiveness of particular groups of variables for pregnancy smoking cessation. However, it seems that cognitive variables as compared to behavioral variables will affect this process to a larger extent. Taking into account the type of behavioral variables, pregnancy-specific behaviors consciously undertaken by women should be better predictors than general health-related behaviors requiring modification of old habits in pregnancy.

Method

Participants

Participants in the study were 150 women in uncomplicated pregnancy, aged 18-35 ($M = 26.93$; $SD = 4.56$) years. For the majority (69.3%) it was the first pregnancy, but only 25 (16.7%) of the participants had attended antenatal classes. In order to determine sociodemographic variables important for smoking cessation the participants were divided into two groups: of pregnant smokers (29.3%); and of those who had quit smoking within the past 36 months (70.7%, out of that

number 42.1% had quit smoking during pregnancy). The two groups were homogeneous in terms of age, having children (69.3% women were childless), marital status (66.0% were married, and only 7.3% single), employment (65.3% were employed) and self-rated economic status (assessed by 48.0% of the sample as good or very good). The groups significantly differed as regards pregnancy duration ($t = -2.27$; $df = 148$; $p < 0.05$); as could be expected, smokers were in an earlier week of pregnancy than non-smokers ($M = 27.39$; $SD = 5.05$, and $M = 30.72$; $SD = 9.87$, respectively). Moreover, pregnant smokers as compared to non-smokers had lower education level ($\chi^2 = 11.21$; $df = 3$; $p < 0.05$)¹. The mean length of smoking history in months was 91.60 ($SD = 61.17$), the mean number of cigarettes smoked - 13.63 ($SD = 9.62$), and the average severity of nicotine dependence assessed using the Fagerstrom Test² was 3.70 ($SD = 1.47$).

Tools

Measurement of beliefs and expectations during pregnancy

Since the aim of the study was to evaluate health-related behaviors during pregnancy, none of the available tools for the measurement of generalized health behaviors and expectations was applied. Instead, six items assessed on 7-point rating scales were used to measure the following variables: self-efficacy ("I am convinced that sticking to a healthy lifestyle during pregnancy: 1. requires a great effort and is difficult to attain; 7. does not require any great effort and is easy to attain"; $M = 4.91$; $SD = 1.65$); internal health locus of control ("I believe that my health during pregnancy: 1. does not depend on me and I have no influence on it; 7. depends to the greatest degree on myself"; $M = 5.54$; $SD = 1.32$); internal fetal health locus of control ("I believe that my baby's state of health: 1. does not depend on me and I have no influence on it; 7. depends to the greatest degree on myself"; $M = 5.66$; $SD = 1.26$); expected course of delivery ("I expect the course of my delivery will be: 1. abnormal, difficult and with complications; 7. normal, appropriate and without complications"; $M = 6.14$; $SD = 1.24$); the infant's health state expected at birth ("I am sure that my baby's health at birth will be: 1. very poor; 7. very good";

1 As regards the distribution of particular categories of this variable, the ratios were the following in the subgroups of smokers and non-smokers, respectively: elementary education - 50.0% and 50.0%; vocational education - 46.2% and 53.8%; secondary education - 30.4% and 69.6%, and higher education - 13.3% and 86.7%.

2 Nicotine dependence severity was assessed using the full version of the Fagerstrom Test of Nicotine Dependence (Heatherton, Kozlowski, Frecker & Fagerstrom, 1991). The test consists of six items assessing the number of cigarettes smoked and the ability to refrain from smoking on waking up, during the day, when being ill, and in places where smoking is forbidden. The higher the score, the more severe is nicotine dependence.

$M = 6.43$; $SD = 0.91$); and the perceived effect of smoking on the infant's health ("I believe that quitting smoking by pregnant women: 1. has no effect on their baby's health; 7. has a beneficial effect on the baby's health"; $M = 6.43$; $SD = 1.28$). Moreover, smoking women rated their self-efficacy in smoking cessation ($M = 3.15$; $SD = 2.01$). The higher the score, the higher was the level of a given indicator. Average ratings of self-efficacy for smoking cessation were significantly correlated with self-efficacy in pursuing health-promoting behaviors during pregnancy ($r = 0.49$; $p = 0.001$) and with the perceived effect of smoking on the infant's health ($r = 0.59$; $p < 0.001$), which may be interpreted as testifying to the validity of the items used. A high correlation was found between internal locus of the participants' own health and fetal health in the whole sample under study ($r = 0.69$; $p < 0.001$).

Measurement of health-related behaviors during pregnancy

The Health Behaviors Inventory (HBI) by Z. Juczyński (2001) was used, with instructions modified with the author's permission so that the respondents rated on a 5-point scale the intensity of their health-related behaviors during pregnancy. The Inventory includes 24 health-related behaviors in four categories: 1. Positive mental set, 2. Preventive behaviors, 3. Proper eating habits, 4. Health practices. In the study sample the HBI internal consistency as expressed by the Cronbach alpha coefficient was 0.90 for the full scale, and for particular behavioral categories 0.76; 0.61; 0.77 and 0.75, respectively.

Due to the lack of an adequate instrument for the measurement of health-related behaviors specific to pregnancy a special scale was developed by the present author for this purpose. A pilot study was conducted on a group of five women in order to eliminate ambiguous or incomprehensible items, while the items validity was assessed by an obstetrician. Finally, a 16-item scale was constructed including such behaviors as: taking folic acid, iron preparations and vitamins, regular medical check-ups, compliance with doctor's orders, and avoiding health risks. On the grounds of an analysis of representations of all possible responses 3 items were excluded from the questionnaire and from further analyses. The corrected coefficient of correlation between particular items and the global score was over 0.42, and the Cronbach alpha of 0.85 was satisfactory. The HBI was supplemented with the instrument for the measurement of pregnancy-specific health-related behaviors, and the respondents were asked to rate their answers to both tools on a 5-point scale. In both instruments higher scores denoted a higher intensity of health-promoting behaviors.

TTM stage measurement

The respondents who had declared cigarette smoking were asked about their intention to quit within six months. If their response was negative, they were allotted to the precontemplation stage, while those who confirmed such an intention - to the contemplation stage. The next question concerned the intention to quit smoking within the next month. The respondents who intended to change their smoking behavior within that period and had at least one attempt at smoking cessation lasting over 24 hours were allotted to the preparation stage. Women who declared they had quit smoking were regarded as representing the two remaining TTM stages - of action and maintenance. In accordance with the TTM assumptions, the period of a six-month abstinence was assumed as the point of transition between the two stages (i.e. women abstaining from smoking longer than six months were ascribed to the maintenance stage).

Statistical data analysis

To test TTM discontinuity patterns trend analysis was performed using polynomial-based orthogonal contrasts (cf. Armitage & Arden, 2002). Even if quadratic and cubic trends, but of smaller strength emerge, linear trends can be interpreted as confirming continuity patterns of the model tested (cf. Armitage & Arden, 2002; Lippke, Sniehotta & Luszczynska, 2005). Contrast analyses were introduced in order to demonstrate differences between successive stages.

In the regression analysis two models were applied: the first one included cognitive variables, pregnancy-specific behaviors, and general health-related behaviors. The second model differed from the first one by the introduction of general behaviors divided into categories. The reason for testing the two models was the indicator of general behaviors, being an aggregate of a number of behavioral categories: positive mental set, preventive behaviors, proper eating habits, and health practices. The change of F value turned out to be significant only in the first tested model, therefore the second model was not included in the analyses.

Results

Pregnant smokers were allotted to one of the following three TTM stages: 17 (11.3%) of them did not intend to quit smoking, 13 (8.7%) were considering such a decision, while 16 (10.7%) were in the preparation stage. The women who had previously quit smoking were qualified to either of the remaining two stages: 33 respondents (22.0%) to the action stage, since they abstained from smoking for less than six months, while 71 (47.3%) of the respondents - to the maintenance stage.

Table 1
Cross-sectional relations between TTM stages and maternal beliefs/expectations during pregnancy:
mean scores, standard deviations and contrast tests.

Maternal expectations and beliefs during pregnancy	PC <i>M(SD)</i>	C <i>M(SD)</i>	P <i>M(SD)</i>	A <i>M(SD)</i>	M <i>M(SD)</i>	Contrasts	<i>F/p</i>
<i>N</i>	17	13	16	33	71		
Self-efficacy	4.41 (2.18)	4.92 (1.80)	4.53 (2.10)	4.58 (1.52)	4.86 (1.69)		0.38/0.82
Health locus of control	5.29 (1.72)	5.69 (1.49)	4.69 (1.78)	5.28 (1.37)	5.63 (1.22)		1.73/0.15
Fetal health locus of control	5.41 (1.50)	5.77 (1.24)	4.88 (1.46)	5.55 (1.35)	5.79 (1.03)	C>P; A<M	2.00/0.10
Expected course of delivery	5.41 (1.84)	5.92 (1.38)	5.00 (1.90)	5.91 (1.36)	6.56 (0.73)	A<M	7.04/<0.001
Infant's health state expected at birth	5.65 (1.32)	6.23 (1.24)	5.94 (1.24)	6.21 (1.22)	6.73 (0.63)	A<M	5.59/<0.001
Perceived effect of smoking on the infant's health	4.12 (2.32)	5.54 (1.66)	5.13 (1.78)	6.33 (1.45)	6.92 (1.41)	P<A; A<M	13.06/<0.001

Note: PC – precontemplation stage; C – contemplation stage; P – preparation stage; A – action stage; M – maintenance stage.
 The following contrasts were analyzed: PC-C, C-P, P-A, A-M; differences between means significant at $p < 0.05$.

Table 2
Cross-sectional relations between TTM stages and maternal health-related behaviors:
mean scores, standard deviations and contrast tests.

Maternal expectations and beliefs during pregnancy	PC <i>M(SD)</i>	C <i>M(SD)</i>	P <i>M(SD)</i>	A <i>M(SD)</i>	M <i>M(SD)</i>	Contrasts	<i>F/p</i>
<i>N</i>	17	13	16	33	71		
Pregnancy-specific health behaviors	43.94 (14.79)	44.31 (13.56)	46.13 (9.77)	53.88 (5.84)	56.16 (5.46)	P<A	13.08/<0.001
Health behaviors (HBI global score)	77.63 (17.76)	74.23 (19.36)	79.44 (13.96)	87.67 (10.00)	92.00 (9.08)	P<A; A<M	10.50/<0.001
Positive mental set	19.69 (5.76)	19.00 (6.34)	20.00 (5.07)	22.48 (3.55)	23.80 (3.13)		7.21/<0.001
Preventive behaviors	20.06 (4.61)	19.46 (4.56)	20.81 (3.97)	23.00 (3.37)	23.70 (2.83)	P<A	7.68/<0.001
Proper eating habits	18.38 (4.60)	17.31 (4.84)	19.13 (3.50)	18.94 (4.09)	20.96 (3.48)	A<M	3.94/<0.01
Health practices	19.50 (5.44)	18.46 (4.93)	19.50 (4.12)	23.24 (3.41)	23.54 (3.65)	P<A	9.04/<0.001

Note: PC – precontemplation stage; C – contemplation stage; P – preparation stage; A – action stage; M – maintenance stage.
 The following contrasts were analyzed: PC-C, C-P, P-A, A-M; differences between means significant at $p < 0.05$.

Contrast analyses of cognitive and behavioral variables in successive TTM stages

In order to test hypothesis 1, i.e. to demonstrate differences between TTM stages, contrast analyses were used (see Tables 1 and 2). Out of the planned 20 contrasts concerning beliefs and expectations six (30%) were statistically significant. Between-stage differences in the mean scores turned out to be statistically significant ($p < 0.001$) for three variables: two directly related to expectations regarding the course of delivery ($F(1;149)=7.04$) and the newborn's state of health at birth ($F(1;149)=5.59$); while the third one pertained to the estimated effect of maternal smoking on the infant's health ($F(1;149)=13.06$). The respondents scored on these three variables significantly

lower in the action than in maintenance stages. Moreover, as regards the estimated effect of maternal smoking on the infant's health, their scores were significantly higher in the action stage than in the phase of preparation. The situation was different for the internal fetal health locus of control – the level of this variable was significantly higher in the contemplation than in preparation stages, being significantly lower in the action than maintenance stages (respective contrasts were significant at $p < 0.05$). Thus, the intensity of the internal fetal health locus of control did not increase across stages.

In the analyses of 20 planned contrasts for pregnancy-specific and general categorized health behaviors also six contrasts (30%) were found to be statistically significant.

Table 3
Testing the TTM model: trends.

Maternal beliefs and expectations during pregnancy	Trend – <i>F/p</i>		
	Linear	Quadratic	Cubic
Self-efficacy	0.24/0.63	0.00/0.99	0.83/0.36
Health locus of control	0.09/0.76	1.77/0.19	1.35/0.25
Fetal health locus of control	0.47/0.50	1.83/0.18	0.90/0.34
Expected course of delivery	8.38/<0.01	4.41/<0.05	1.77/0.19
Infant's health state expected at birth	11.65/<0.001	0.30/0.58	2.52/0.12
Perceived effect of smoking on the infant's health	39.74/<0.001	0.00/0.97	1.13/0.29

Table 4
Testing the TTM model: trends.

Maternal beliefs and expectations during pregnancy	Trend – <i>F/p</i>		
	Linear	Quadratic	Cubic
Pregnancy-specific health behaviors	39.66/<0.001	2.03/0.16	1.34/0.25
Health behaviors (HBI global score)	29.19/<0.001	3.49/0.06	2.10/0.15
Positive mental set	19.36/<0.001	2.65/0.11	0.94/0.33
Preventive behaviors	23.47/<0.001	1.48/0.23	1.95/0.17
Proper eating habits	7.40/<0.001	1.74/0.19	0.06/0.81
Health practices	25.05/<0.001	2.73/0.10	3.78/0.05

Between-stage differences in the mean scores turned out to be significant ($p < 0.01$) for all the behavioral variables under study (see Table 2). The intensity of pregnancy-specific behaviors, general health behaviors, preventive behaviors, and health practices was assessed by the respondents significantly higher in the action than preparation stages. Moreover, nutritional behaviors and general health-related behaviors were also rated higher in the maintenance than in action stages (the contrasts were significant at $p < 0.05$). In contradistinction to beliefs and expectations during pregnancy, the intensity of health-related behaviors in all the analyzed categories increased from stage to stage. Therefore, a linear trend can be expected for this group of variables.

Trend analyses of cognitive and behavioral variables in successive TTM stages (testing for discontinuity patterns)

The next step to confirm hypothesis 1 was to test for TTM discontinuity patterns. Linear trends concerning beliefs and expectations during pregnancy were statistically significant for the three variables that had revealed differences across stages in the contrast analyses, namely: the expected course of delivery, the infant's state of health expected at birth, and the effect of maternal cigarette smoking on the infant's health (see Table 3). The quadratic trend was statistically significant only for the expected course of delivery, while the results of the cubic trend analyses turned out to be insignificant for all the variables tested. However, it should be noted that quadratic trends for both types of locus of control (the respondents' own health and the fetal health)

were significant at a tendency level, being stronger than the linear trends where *F* test values were insignificant. This may suggest a qualitative dissimilarity of the TTM stages.

The results were more consistent as regards health-related behaviors, since linear trends were found for all the analyzed variables: pregnancy-specific behaviors, general behaviors, and all their categories: positive mental set, preventive behaviors, proper eating habits, and health practices (see Table 4). Moreover, as regards general health-related behaviors a quadratic trend significant at a tendency level emerged, and for health practices - a cubic trend. This means that the relationship between the stage of smoking cessation and the latter variables may be explained by both these types of trend.

However, since the linear trend for the cognitive and behavioral variables under study was stronger across the stages of TTM than either the quadratic or cubic trends, the obtained results should be interpreted as confirming continuity patterns of the tested model (cf. Armitage & Arden, 2002; Lippke, Sniehotta & Luszczynska, 2005).

Beliefs, expectations and health-related behaviors as predictors of TTM stages

In order to test hypothesis 2 and confirm the results of previous analyses, hierarchical regression analysis was used, where successive stages of the TTM³ were the explained variable, while explanatory variables included beliefs and expectations concerning pregnancy, as well

3 The analysis is based on the assumptions presented in the paper by Armitage and Arden (2002). Numerical values starting from 1 were ascribed in an increasing order to successive TTM stages.

Table 5
Hierarchical regression: maternal expectations, beliefs and health behaviors intensity regressed on TTM stages (N = 150).

Variables introduced in the model	R	R ²	ΔR ²	ΔF/p	β/p Step 3
Step 1: Expectations and beliefs	0.54	0.29	0.29	9.48/<0.001	
Self-efficacy					-0.18/<0.05
Health locus of control					-0.08/0.44
Fetal health locus of control					-0.07/0.45
Expected course of delivery					-0.09/0.40
Infant's health state expected at birth					0.24/<0.05
Perceived effect of smoking on the infant's health					0.31/<0.001
Step 2: Pregnancy-specific health behaviors	0.61	0.38	0.09	18.73/<0.001	0.22/<0.05
Step 3: Health behaviors (HBI global score)	0.64	0.41	0.03	7.01/0.01	0.25/<0.01

as health-related behaviors pursued in that period (see Table 5). Cognitive variables introduced in the first step of the analysis explained 29% of variance, while pregnancy-specific and general health-related behaviors introduced in the second and third steps only 12% of the global variance in TTM stages. Moreover, as expected, the contribution of pregnancy-specific behaviors was larger than that of general health-related behaviors (9% and 3% of explained variance, respectively).

It should be also emphasized that the regression analysis confirmed linear trends in two variables: the infant's state of health expected at birth ($\beta_{\text{step3}} = 0.24; p < 0.05$) and the perceived effect of maternal smoking on the infant's health ($\beta_{\text{step3}} = 0.31; p < 0.001$). On the other hand, the outcome for the expected course of delivery was statistically insignificant, which is reflected in the previous trend analyses – in the case of this variable also the quadratic trend was statistically significant.

Surprisingly, self-efficacy introduced in the model in step 3 turned out to significantly explain the TTM stage transition ($\beta_{\text{step1}} = -0.10; p = 0.26; \beta_{\text{step2}} = -0.14; p = 0.08; \beta_{\text{step3}} = -0.18; p < 0.05$), but the effect was opposite to the assumed one. In other words, transition to a next TTM stage is determined by a decrease, and not increase in the level of this variable.

Discussion

The following conclusions concerning cognitive and behavioral determinants of the TTM stage dissimilarity can be drawn from the obtained results (regarding the first hypothesis).

Contrary to expectations based on the hitherto reported research findings (cf. Marlatt & George, 1990), the contemplation-to-preparation stage transition was determined not by the mother's expectations concerning consequences of her behavior, but by a strong maternal belief about her responsibility for the infant's health. This is probably due to the mother's focusing on her current activities, striving to create the best possible conditions for her unborn child's development, while her evaluation

of consequences of such behaviors is located most likely in a distant future – and therefore absent from this stage. Another possible explanation is that in the case of pregnant smokers evaluation of their behavior consequences is blocked by their anxiety about the infant's health. However, this requires further empirical verification.

The transition from the preparation to action stage depends on: a cognitive variable – the perceived effect of smoking on the infant's health; pregnancy-specific behaviors; and out of a number of general health-related behaviors – preventive behaviors and health practices. The obtained findings are rather consistent, since it is only a strong belief about beneficial effects of maternal smoking cessation on the infant's health that can lead to this intention implementation in real life. This belief gets stronger in further stages, so it can be assumed to be of importance also for consolidation of the behavior change. As regards health-related behaviors, the first category of preventive behaviors includes compliance with health-related recommendations, and seeking information on determinants of health and illness, while the second, of health practices, comprises everyday life habits associated with sleep, recreation or physical activity. Change of such behaviors with simultaneous introduction of new, pregnancy-specific behaviors may be hypothesized to be easier than modification of the remaining behavioral categories (cf. Życińska, 2008). It should be stressed also that these groups of behaviors motivate to nicotine abstinence (cf. Perkins et al.; 2001; Ward et al., 2003).

Abstinence maintenance, or completion of the action stage, is determined by another group of behaviors, and namely – proper eating habits. This result may lead not only to a conclusion about different functions served by health-related behaviors in the process of behavior change (cf. Ward et al., 2003), but also to a supposition that various categories of these behaviors are mutually independent in particular stages. Abstinence maintenance is associated also with a high level of cognitive variables. Two of the latter pertain to perceived consequences of maternal behavior, namely – to the expected course of delivery and the expected

state of the infant's health at birth. In contradistinction to the contemplation stage, in the maintenance stage the variables in question may be manifested, since the mother had quit smoking and therefore positive consequences of her behavior can be expected. The role of these variables is probably determined by the phase of pregnancy, since the previously cited results of general population studies indicate that only beliefs about possibility of influencing one's own health are of importance at this stage (cf. Dijkstra & De Vries, 2000). Also the present author's research findings corroborate these reports, since maintenance of abstinence is determined - besides the already mentioned highly beneficial perceived effect of smoking cessation on the infant's health - also by the internal fetal health locus of control. However, both these variables pertain to the mother's beliefs about her possibilities of influencing her child's health, so it can be concluded that the maternal role is responsible for smoking cessation. Beliefs concerning the respondents' own health - their self-efficacy and health locus of control - did not differ in successive TTM stages in the sample of pregnant women.

Moreover, regression analysis confirmed that the effect of cognitive variables on smoking cessation was greater than that of behavioral variables, with pregnancy-specific behaviors having greater predictive power than other health-related behaviors (this conclusion refers to hypothesis 2). As regards cognitive variables, a surprising result was obtained for self-efficacy, but only when general health-related behaviors had been introduced in the analysis. The level of these variables was found to decrease across successive TTM stages, contrary to the expected increasing tendency from stage to stage. This is probably due to the fact that as intention to change emerges, the role of other kinds of self-efficacy increases (e.g. maintenance self-efficacy and recovery self-efficacy - cf. the Health Action Process Approach, HAPA, Łuszczynska, 2004) in all the categories of health-related behaviors under study.

Regression analysis was applied also to verify linear increases in the level of variables introduced in the TTM, as indicated by the earlier trend analyses. However, the obtained results are not clear-cut. As regards health practices, a statistically significant cubic trend emerged, and for the expected course of delivery - a quadratic trend. On the other hand, trend analyses of the following three variables: health locus of control, responsibility for the infant's health, and general health-related behaviors, indicated the presence of a quadratic trend significant at a tendency level. However, in both cases the linear trend was stronger. In accordance with the assumptions, the obtained results can be interpreted as a confirmation of continuity of the tested model (cf. Armitage & Arden, 2002; Lippke, Sniehotka & Luszczynska, 2005).

There seem to be several reasons for the lack of a clear confirmation of differences between the TTM stages. The

first reason, described earlier, consists probably in using the temporal criterion for allotting the study participants to particular TTM stages. For example, in an empirical verification of the MSM (Multi-Stage Model of Health Behavior Change; Fuchs, 1999, cited after: Lippke et al., 2005) a specific configuration of cognitive variables (perceived risk and intention) used as a criterion for defining stages of behavior change allowed to confirm discontinuity patterns (Lippke et al., 2005). It seems worth considering whether the cognitive and behavioral variables introduced in the model are continuous, i.e. whether their value increases with the transition from stage to stage, even if the research findings cited earlier do not suggest that. This might explain their linear change, and exclude them (at least when defined as in the present study) as variables characterizing the smoking cessation process. Finally, it should be said that even this argument highlights a weakness of the TTM.

Let us consider then consequences of assuming that the TTM is a "pseudo-stage" model. As far as interventions are concerned this means that there is no need to identify the stage of change among participants, and evaluation of intervention effectiveness should consist only in an estimation of change in health-related behaviors or cognitive variables intensity, e.g. in the perceived effect of smoking cessation on the infant's health. Any recorded change would be an evidence for the next TTM stage attainment (cf. Armitage & Arden, 2002). From this perspective both the development and implementation of behavior modification programs and interventions seem simpler, and besides, exemplify a clear application of theory to practice.

Conclusions from the study should be supplemented by a comment on its evident limitations. Firstly, a cross-sectional paradigm was used, while in the research into behavior change a longitudinal design with an introduced intervention is recommended (e.g. Sutton, 2000). However, a cost-effectiveness analysis of such interventions may show that they are unfeasible⁴. Therefore the cross-sectional paradigm without manipulation seems to be a justifiable, even if not quite correct method of testing stage models (cf. Quinlan & McCall, 2000).

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4 The estimated sample size should amount to about 1000 individuals, when taking into account the number of TTM stages, number of transitions between stages, and at least two measurements (cf. Armitage, Arden, 2002).

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