Lung cancer risk perception and distress: difference by smoking status, and role of physical activity and race among US population

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ABSTRACT

BACKGROUND: cigarette smoking is the greatest known risk factor for lung cancer, and people with different smoking status may process risk information differently. While psychological distress has been linked with smoking status, little is known about the impact of distress on lung cancer perception or the moderating role of physical activity and race. This study explores the association of lung cancer perception and distress and investigates the effects of physical activity and race on that association.
METHODS: the study uses a national, biennial survey (the Health Information National Trends Survey) that was designed to collect nationally representative data on the American public's need for, access to, and use of cancer-related information using a cross-sectional, complex sample survey design. Out of 5 586 participants, 1 015 were current smokers, 1 599 were former smokers, 2 877 were never smokers. Of the sample, 1 765 participants answered the lung cancer risk perception question and had no personal history of lung cancer. Statistical analysis contrasts smokers, former smokers, and never smokers to examine the association of lung cancer perception and distress and the moderating role of physical activity and race.
RESULTS: distress and lung cancer risk perception were significantly positively associated (p value < 0.001). Respondents who were current smokers and were distressed had very high odds of agreeing that they have a somewhat high chance (odds ratio=900.8, CI: 94.23, 8 611.75; p value < 0.001) or a very high chance (odds ratio=500.44 CI: 56.53, 4 430.02, p value < 0.001) of developing lung cancer in the future as compared to not distressed never smokers. However, race and physical activity status did not significantly affect perception of risk. Perceptions of risk are important precursors of health change.
CONCLUSIONS: elevated distress level and higher perceived risk, in addition to physical activity status and race, could potentially be used to develop targeted interventions, such as tailoring quitting support for smokers at elevated distress levels, which may enhance success rate of quitting smoking and staying quit.

Key words: Distress; Perception; Lung cancer; Smoking

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INTRODUCTION

Lung cancer is considered a leading death cause in the United States [1]. Lung cancer is the second most common cancer in both men and women [2], causing more deaths than colon, breast and prostate cancer combined. In 2007, the number of deaths due to lung cancer was reported as 158 683, while the combined number of deaths due to colon, breast and prostate cancer was reported as 114 309 [3]. The age-adjusted death rate was 65.2 per 100 000 for males and 40.0 per 100 000 for females for lung cancer [4]. The age-adjusted death rate of white males was 68.3 per 100 000, while black males had an age-adjusted death rate of 87.5 per 100 000 for lung cancer [3]. The survival rate for lung cancer is much lower than for other common cancers. The 5-year survival rate for all lung cancer patients was 15.2%, compared to 63.9% for colon cancer, 88.7% for breast cancer, and 98.9% percent for prostate cancer [5].

Psychological stress refers to the emotional and physiological reactions experienced when an individual confronts a situation in which the demands go beyond his/her coping resources [6]. Stress hormones, such as cortisol and adrenaline, are released from the body in response to a stress. These stress hormones in turn increase blood pressure, heart rate, and blood sugar levels [7]. A causal link between psychological stress and cancer has been widely debated in scientific literature, but a direct cause-and-effect relationship between stress and cancer risk has not been established [8]. Psychological stress is shown to have a positive association with the risk of breast cancer [9]. The pathway may be related to DNA damage, initiated by exposure to stress hormones such as cortisol [10]. The role of estrogen has been linked to cell proliferation, which could induce genetic damage [11]. More recently, it was found that chronic exposure to the stress hormone adrenaline creates DNA damage via a catecholamine-induced response [12].

Distress is an aversive state in which an animal is unable to adapt completely to stressors and the ensuing stress, and shows maladaptive behaviors [13]. The transition of stress to distress depends on several factors, which include stressor duration and intensity, either of which is likely to produce behavioral or physical signs of distress [13]. Among lung cancer patients, young age and specific physical and psychosocial symptoms are predictive of clinical distress [14].

In lung cancer patients, psychological distress is a predictor of cancer mortality [7]. Psychological distress also predicts poorer prognosis in subjects with prior cancer diagnoses [7]. A literature review [8] examining the evidence for an association between major life events, depression and cancer suggested that research was inconsistent to support the hypothesis that depression is a risk factor for cancer. In an investigation of 53 studies dealing with perceived risk of developing cancer in high risk populations, family history of cancer, previous prophylactic tests and treatments, and younger age were associated with cancer risk perception [9]. Smokers, in particular, have been subject to major depression [13-15]. Depression has been linked with higher smoking rates [16]. In a population-based prevalence study it was found that 59% of smokers (who smoked daily for one month or more) had a lifetime diagnosis of major depression, while only 17% of the general population suffered from major depression [17].

Several theoretical models, such as Theory of Reasoned Action [18] and the Health Belief Model [19], have shown that perceptions of risk are important precursors of health change. The underestimation of personal chance of developing lung cancer is common among smokers [20]. Therefore, it becomes important to study the association of distress and risk perception of lung cancer among people with different smoking status.

In addition to studying the association between distress and risk perception, it is also important to know the role played by physical activity and race on lung cancer perception among people who are current smokers, former smokers and never smokers to formulate targeted interventions for these groups.

Physical activity levels differ among people of various race/ethnicities. While 64.5 % of the U.S. population is physically active, 25.4% of the population engages in no leisure-time physical activity [21]. Approximately 31.9% of blacks are not physically active during leisure time, while 22.2% of whites engage in no leisure-time physical activity. Mortality gaps among different races/ethnic groups may be attributed to several factors such as access to surgical care, factors related to hospitalization, and biological differences [22]. Black patients

have shown different outlooks regarding the risk and fear of cancer diagnosis as compared to other races [23]. Men and women who smoke are 23 and 13 times, respectively, more likely to develop lung cancer [2]. African-American men have 2-4 times higher chance to develop lung cancer [24]. The risk of lung cancer among racial groups is modified by the number of cigarettes smoked per day [25].

Given that smoking status and physical activity are endogenously chosen behaviors, it has not been explored whether distress and cancer risk perceptions are associated and how this association is moderated by race and physical activity. Researchers have focused on finding the effect of race on lung cancer, but we are not aware of any research that attempted to investigate the effect of race and physical activity/exercise on the perception of lung cancer risk and distress among smokers, non-smokers and former smokers. The effect of race and physical activity is important in guiding efforts to reduce cancer mortality. More research is needed to identify factors related to smoking behavior that can be integrated into clinical and community practice. This research builds on earlier research by incorporating distress into risk perception and examining the role of race and physical activity.

The elevated distress level and higher perceived risk, in addition to physical activities and race, could potentially be used for formulating targeted intervention. For example, modification of quitting support for smokers at elevated distress levels may lead to better success rate of smoking cessation. Also, successful quitting may lead to lower psychological distress.

We hypothesized that (1) distress has a positive association with the lung cancer risk perception among people with different smoking status; (2) race has an effect on the association of stress and the lung cancer perception; and (3) physical activity has an effect on the association of stress and lung cancer perception.

METHODS

Sample

The data for this study are derived from the 2005 Health Information National Trends Survey (HINTS). The description of methodology of the survey and sampling procedure can be obtained from the National Cancer Institute (NCI) [26]. The HINTS is a national, biennial survey designed to collect nationally representative data on the American public's need for, access to, and use of cancer-related information. The response rates for the initial household screener and extended interview were 34% and 61%, respectively.

Participants

The HINTS consisted of 5 586 individuals. A current smoker is defined as a person who has smoked at least 100 cigarettes and currently smokes every day or some days. A former smoker is defined as a person who has smoked at least 100 cigarettes in his/her life but does not smoke at present. A never smoker is defined as a person who has never smoked or who has smoked fewer than 100 cigarettes in his/her lifetime [27]. There were 1 015 current smokers, 1 599 former smokers, and 2 877 never smokers.

Dependent variable

In the HINTS, under the mental portion of the survey, respondents were asked a total of 15 questions concerning risk perception. We used Chi-square tests to examine bivariate associations between respondents' races, and physical activity characteristics and responses to all questions related to risk perception. We selected the following question for our study: "How likely do you think it is that you will develop lung cancer in the future? Would you say your chance of getting lung cancer is…". The response categories were "Very low; somewhat low; moderate; somewhat high; or very high". Several questions were asked to ascertain the level of distress among respondents, such as: "(a) During the past 30 days, how often did you feel so sad that nothing could cheer you up? (b) During the past 30 days, how often did you feel nervous? (c) During the past 30 days, how often did you feel restless or fidgety? (d) During the past 30 days, how often did you feel hopeless? (e) During the past 30 days, how often did you feel that everything was an effort? (f) During the past 30 days, how often did you

feel worthless?". The answer categories were as follows: "All of the time; most of the time; some of the time; a little of all the time; none of the time; not certain; refused; don't know". These variables were recoded into a new variable. Respondents with scores of 1-12 were grouped as not having serious psychological distress, and respondents with scores of 13-24 were grouped as people with serious psychological distress. Out of 5 586 participants, 1 765 individuals who answered the lung cancer risk perception question had no personal history of lung cancer and met our criteria. Our study is based on this subset of the population.

Independent variables

Due to the scope of our study, we grouped the respondents into several categories following the classification [28]: non-Hispanic blacks; non-Hispanic whites; Hispanics; and others (American Indian or Alaska Native, Asian, Native Hawaiian or other Pacific Islander).

We defined a person to be physically active who engages in light to moderate physical activity for at least 30 minutes per day [29]. Based on the levels of physical activity, we formed two groups of respondents: physically active and non-physically active.

Covariates

The gender of a respondent was considered as a covariate.

Analysis

The preliminary selection of questions was based on bivariate association between respondents' race and physical activity characteristics, as well as responses to all questions related to the lung cancer perception and distress. Based on this analysis, we investigated the effects of race and physical activity on current smokers, former smokers, and never smokers using multivariate generalized regression model. We tested these effects by constructing two separate multivariate logistic regression models with each question as the dependent variable. The model used can be stated as follows:

Risk Perception = Distress + Smoking status + Race + Physical Activities + Distress* Smoking Status + Distress* Race + Distress*Physical Activities + Smoking Status*Race + Smoking Status *Physical Activities + Race*Physical Activities + Distress*Smoking

We excluded all the responses of "Refused" and "Don't know" to survey items, as well as all respondents with missing values of variables under study.

RESULTS

Socio-demographic characteristics of the population are presented in the Table 1. Among 1 765 participants who answered lung cancer risk perception question and had no personal history of lung cancer, 18.97% were current smokers; 28.70% were former smokers; and 52.32% were never smokers. Young respondents in the age group of 18-34 years were more likely (26.09%) to be current smokers. Respondents in the age group 65-74 years were more likely to be former smokers (42.31%). College graduates were more likely (59.99%) to be never smokers. Among black (non-Hispanic) respondents, 53.85% were never smokers. Among white (non-Hispanic) respondents, 51.27% were never smokers.

The never smokers constituted 53.57% of the respondents who had the health insurance. Among respondents who did not have insurance, 30.32% were current smokers. In all the groups pertaining to body mass index (BMI), the majority of respondents (37.33%) reported a healthy weight. The majority of respondents in the Obese I, II and III categories were never smokers. In the group of respondents with a family history of cancer, 48.08% were never smokers. Among the respondents, 42.73% enjoyed excellent health; the majority of them (55.14%) were never smokers. Among 68.57% of the physically active respondents, the majority (52.17%) were never smokers. Among all respondents, 93.24% were not distressed; and among this category of respondents, 52.32% were never smokers. Among distressed people, 44.68% were never smokers. Among the respondents who answered the question of chance of getting lung cancer in future, 52.01% were never smokers, and 18.30% were current smokers.

TABLE 1

SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE POPULATION			
RESPONDENT CHARACTERISTICS n=1 765	SMOKING STATUS		
	CURRENT SMOKERS (n=323) (18.97%)	FORMER SMOKERS (n=524)(28.70%)	NEVER SMOKERS (n=918) (52.32%)
GENDER (n=1 765)			
Male (n=579) (32.80%)	128 (22.10%)	213 (36.78%)	238 (41.10%)
Female (n=1 186) (67.19%)	195 (16.44%)	311 (26.22%)	680 (57.33%)
AGE (n=1 761)			
18-34 y (n=322) (20.87%)	84 (26.09%)	49 (15.22%)	189 (58.7%)
35-49 y (n=470) (29.08%)	108 (22.98%)	114 (24.26%)	248 (52.77%)
50-64 y (n=498) (29.01%)	86 (17.27%)	168 (33.73%)	244 (44.98%)
65-74 y (n=260) (12.10%)	41(15.77%)	110 (42.31%)	109 (41.92%)
≥75 y (n=211) (8.90%)	4 (1.90%)	82 (38.86%)	125 (59.24%)
EDUCATION (n=1 730)			
Less than high school (n=193) (11.16%)	54 (27.98%)	57 (29.53%)	82 (42.49%)
High school (n=452) (26.13%)	102 (22.57%)	122 (26.99%)	228 (50.44%)
Some college (n=508) (29.36%)	110 (21.65%)	149 (29.33%)	249 (49.02%)
College graduate (n=573) (33.12%)	51(8.9%)	184 (32.11%)	338 (59.99%)
MARITAL STATUS (n=1 721)			
Married or unmarried couple (n=997) (57.93%)	147 (14.74%)	306 (30.60%)	544 (54.56%)
Divorced/Separated/Widowed (n=498)(28.94%)	108 (21.69%)	170 (31.14%)	220 (44.18%)
Never Married (n=226) (13.13%)	63 (27.88%)	32 (14.16%)	131 57.96%)
RACE (n=1 730)			
Black, non-Hispanic (n=143) (8.27%)	32 (22.38%)	25 (17.28%)	77 (53.85%)
Whites, non-Hispanic (n=1 342) (77.57%)	234 (17.44%)	420 (31.3%)	688 (51.27%)
Others, non-Hispanic (n=101) (5.84%)	12 (11.88%)	20 (19.8%)	36 (35.64%)
ANNUAL INCOME (n=1 271)			
< $25K (n=291) (23.91%)	88 (30.24%)	66 (22.68%)	137 (47.08%)
$25K to < $50K (n=345) (28.35%)	74 (21.45%)	103 (29.86%)	168 (48.7%)
$50K to < $75K (n=322) (26.46%)	58 (18.01%)	96 (29.81%)	168 (52.17%)
≥ $75K (n=313) (25.72%)	35 (11.18%)	104 (33.22%)	174 (55.59%)

TABLE 1 (CONTINUED)

SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE POPULATION			
RESPONDENT CHARACTERISTICS	CURRENT SMOKERS	FORMER SMOKERS	NEVER SMOKERS
BODY MASS INDEX (n= 1 717)			
Underweight (n=28) (1.63%)	6 (21.43%)	7 (25%)	15 (53.57%)
Normal weight (n=641) (37.33%)	130 (20.28%)	181 (28.24%)	330 (51.48%)
Overweight (n=577) (33.61%)	106 (18.37%)	187 (32.41%)	284 (49.22%)
Obese I, II (n=379) (22.07%)	60 (15.83%)	114 (30.08%)	205 (54.09%)
Obese III (n=92) (5.36%)	13 (14.13%)	22 (23.91%)	57 (61.96%)
LUNG CANCER STATUS			
Family history of lung cancer (n=312)	72 (23.08%)	90 (28.85%)	150 (48.08%)
GENERAL HEALTH (n=1 732)			
Excellent – Very good (n=740) (42.73%)	92 (12.43%)	240 (32.43%)	408 (55.14%)
Good (n=589) (34.01%)	80 (13.58%)	90 (15.28%)	151 (25.64%)
Fair-Poor (n=402) (23.21%)	104 (25.87%)	111 (27.61%)	187 (46.52%)
PHYSICAL ACTIVITY STATUS (n=1 435)			
Physically active (n=984) (68.57%)	174 (17.69%)	298 (30.28%)	512 (52.03%)
Physically non-active (n=451) (31.43%)	76 (16.85%)	130 (28.82%)	245 (54.32%)
DISTRESSED (n=1 731)			
No (n=1 641) (93.24%)	285 (17.66%)	487 (30.17%)	842 (52.17%)
Yes (n=94) (5.43%)	30 (31.91%)	22 (23.40%)	42 (44.68%)
People who answered the question of chance of getting lung cancer in future (n= 1 765)	323 (18.30%)	524 (29.69%)	918 (52.011%)

Table 2 provides correlations along with p values. There is a significant correlation (p value < 0.001) between distress and the perception of developing lung cancer in future. Similarly, distress is related significantly (p value < 0.001) to the race of a person. The perception of developing lung cancer is significantly (p value < 0.001) related to smoking status.

Multivariate analysis

Logistic regression is used for comparing the likelihood of agreeing to the perception question by smoking status, and distress state. In Table 3, the odds ratio, 95% confidence interval, and the p value are presented for the cancer-related perception (smoking status and distress status). Compared to never-smokers-not distressed, current smokers who were distressed had 20.35 (CI: 2,43, 170.23; p value < 0.001) times higher odds of agreeing that they have a somewhat/low chance of developing lung cancer in future. Current smokers who were not-distressed had 3.289 (CI: 1.96, 5.51; p value < 0.001) times higher odds of agreeing that they have a somewhat low chance of developing lung cancer in future. Among former smokers and respondents who were not-distressed, there is 2.266 (CI: 1.73, 2.97; p value < 0.001) times higher odds of agreeing that they have a somewhat low chance of developing lung cancer in the future as compared to respondents who were never smokers and not distressed. A

TABLE 2

	HOW LIKELY DO YOU THINK IT IS THAT YOU WILL DEVELOP LUNG CANCER IN THE FUTURE?	DISTRESS STATUS	SMOKING STATUS	PHYSICAL ACTIVITY STATUS	RACE
CORRELATIONS (p VALUE)					
HOW LIKELY DO YOU THINK IT IS THAT YOU WILL DEVELOP LUNG CANCER IN THE FUTURE?	1.00	0.13* (0.00)	-0.34* (0.00)	0.00 (0.859)	0.04* (0.05)
DISTRESS STATUS	0.13* (0.00)	1.00	0.00 (0.67)	-0.01 (0.48)	0.06* (0.00)
SMOKING STATUS	-0.35* (0.00)	0.00 (0.67)	1.00	0.02 (0.15)	0.02 (0.14)
PHYSICAL ACTIVITY STATUS	0.00 (0.85)	-0.01 (0.48)	0.02 (0.15)	1.00	0.00 (0.74)
RACE	0.04* (0.05)	0.06* (0.00)	0.02 (0.14)	0.00 (0.74)	1.00

*Correlation is significant at the 0.05 level (2-tailed)

similar trend is seen in the category of current smokers who are distressed, and there is 39.81 (CI: 4.85, 327.09; p value < 0.001) times higher odds of agreeing that they have a moderate chance of developing lung cancer in future as compared to respondents who are never smokers and distressed. The highest odds ratio of 900.8 (CI: 94.23, 8611.75; p value < 0.001) was found for the current smokers who were distressed in the category of somewhat high chance of developing lung cancer. The odds ratio of 500.44 (CI: 56.53, 4430.02; p value < 0.001) was also in the same category. Thus, respondents who were current smokers and distressed had higher odds of agreeing that they have somewhat low, moderate, somewhat high or very high chance of developing lung cancer in future, as compared to other categories of respondents.

The overall model fit very well (p value < 0.001). The distress status had a significant effect on respondents with somewhat low perception (β=-41.98, p-value=0.04). The perception of somewhat low risk was affected by smoking status (current smokers and former smokers, β=0.91, p value=0.01; β=0.93 p value < 0.001, respectively). Race was not found to influence the perception of somewhat low risk (for non-Hispanic blacks: β=-0.71, p value=0.38; for non-Hispanic Whites: β=-0.81, p value=0.29). The physical activity status had no significant effect on the perception of somewhat low risk.

Similar results were noticed for other categories of risk perception (Moderate; Somewhat High; Very High).

DISCUSSION

Lung cancer is one of the leading causes of deaths due to cancer [30]. Among current smokers, 10.6% were distressed, while only 3.9% of the never smokers were distressed. The majority of current smokers tend to be young (26.09%) and male (22.10%), which is consistent with another study [31]. Moreover, the majority of current smokers tend to be physically active (69.6%), which is consistent with Deruiter et al. [29].

Respondent characteristics differed among categories of smoking status. The majority of blacks (54.33%) and whites (51.01%) were never smokers. The annual income of never smokers was higher than that for current smokers and former smokers. Most of the current smokers (82.01%) had health insurance. The majority of participants (48.08%) who had a family history of lung cancer were never smokers. Among current smokers, 33.65% were overweight; 19.04% were classified as obese I, II; and only 4.12% of the respondents were obese. Among current smokers, a small percentage of respondents reported having excellent health-good health (12.43%), compared to never

TABLE 3

LUNG CANCER-RELATED PERCEPTION (SMOKING STATUS AND DISTRESS STATUS)

PERCEPTION	CURRENT SMOKERS				FORMER SMOKERS				NEVER SMOKERS			
	DISTRESSED		NOT DISTRESSED		DISTRESSED		NOT DISTRESSED		DISTRESSED		NOT DISTRESSED	
Chance of getting lung cancer in future	n	Odds Ratio (95% CI)	n	Odds Ratio (95% CI)	n	Odds Ratio (95% CI)	n	Odds Ratio (95% CI)	n	Odds Ratio (95% CI)	n	Odds Ratio (95% CI)
Somewhat low	6	20.34 (2.43, 170.22) 0.00*	32	3.29 (1.96, 5.51) 0.00*	5	2.82 (0.85, 9.38) 0.09	147	2.26 (1.72, 2.97) 0.00*	11	1.77 (0.84, 3.76) 0.13	166	1 NA
Moderate	7	39.81 (4.85, 327.09) 0.00*	106	18.27 (11.7, 28.51) 0.00*	8	7.58 (2.58, 22.32) 0.00*	98	2.53 (1.84, 3.49) 0.00*	8	2.17 (0.93, 5.03) 0.07	99	1 NA
Somewhat High	8	900.80 (94.23, 8611.75) 0.00*	78	266.15 (100.98, 702.03) 0.00*	51	18.77 (1.90, 185.83) 0.01*	18	9.21 (3.38, 25.12) 0.00*	2	10.72 (1.96, 58.51) 0.00*	5	1 NA
Very high	8	500.44 (56.5, 4430.0) 0.000*	36	68.24 (30.35, 153.47) 0.00*	2	20.85 (3.70, 117.67) 0.00*	4	1.137 (0.35, 3.73) 0.83	0	0 (0,0) NA	9	1 NA
Very low	1		33		6		220		21		563	1 NA

* Odds ratio is significant at the 0.05 level (2-tailed)
** Model: Risk Perception = Distress + Smoking status + Race + Physical Activities + Distress* Smoking Status + Distress* Race + Physical Activities + Distress* Smoking Status + Distress* Race + Distress*Physical Activities + Smoking Status*Race + Smoking Status *Physical Activities + Race*Physical Activities + Distress*Smoking Status*Distress + Gender

smokers (32.43%) and former smokers (55.14%).

The distress status was significantly associated with the perception of getting lung cancer in the future. However, it may be noted that the relationship between distress and perceived risk for getting lung cancer are both based on self-report measures with limited items. Smoking status affects the perception of developing lung cancer in the future. Race and physical activity status do not significantly affect the perception of acquiring lung cancer in the future. However, distress does influence the prognosis of those who already have lung cancer. Our findings are consistent with a previous study [32] which found that for current smokers, a significant interaction between race and psychological distress exists. Also, it was found that psychological distress was related to smoking status for white but not for black or Hispanic respondents. Non-Hispanic African Americans believe that quitting smoking is particularly difficult for them because they live in highly stressful environments, view smoking as a way to cope with that stress, and do not find much needed social support or resources for quitting [33]. Black and Hispanic smokers continue to be less likely than whites to receive and use tobacco-cessation interventions, even after controlling for socioeconomic and healthcare factors [34]. Therefore, healthcare providers need to take action to reduce this disparity. Tobacco use screening and counseling in physician offices are recognized as best practices [35] and are noted among the effective intervention modalities encouraged by *Healthy People 2020* [36]. Interventions that provide coaching and social support via individual, group, or telephone counseling are documented as even more effective, especially when coupled with pharmacotherapy [37].

Moreover, smoking cessation activities should be delivered in a culturally appropriate manner [38, 39]. Further research and actions are needed in this direction.

We find that physical activity and race have no significant effect on the association of perception of current, former, and never smokers about the chance of developing lung cancer and distress. Our search to identify factors that influence smokers' perception of lung cancer risk and the influence of psychological distress, race, or physical activity, may indeed be important to develop more effective intervention strategies. Smoking cessation can be a difficult process, and several quit attempts are often needed [32]. However, individuals who perform physical activities and participate in a smoking cessation program may have a better success rate for quitting smoking. Physical activity could act as a potential tobacco risk reduction strategy for smokers [29]. Daily smokers who are physically active are shown to have a greater number of cessation attempts [40]. The elevated distress level, in addition to physical activity, could potentially be used to modify quitting support for smokers at elevated distress level. This may lead to an improved quit rate by reinforcing tobacco control measures that support quitting and staying quit. Also, successful quitting may lower psychological distress [41], and educational programs and further interventions can be used for stress management. Appropriate screening and lifestyle recommendations can be formulated for targeted groups.

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