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Quitters Feel Less Anxiety than Smokers after Ceasing Smoking for One Year

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Complete List of Authors:	Chen, Pei-Ching; National Yang-Ming University, Institute of Health and Welfare Policy Kuo, Raymond; National Taiwan University, Institute of Health Policy and Management Lai, Chih-Kuan; Taipei Veterans General Hospital, Department of Family Medicine Tsai, Shih-Tzu; Buddhist Tzu Chi Medical Foundation, Center for Preventive Services Lee, Yue-Chune; National Yang-Ming University,
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Title page

*Research Articles***Quitters Feel Less Anxiety than Smokers after Ceasing Smoking for One Year**Pei-Ching Chen¹, Raymond Nien-Chen Kuo², Chih-Kuan Lai³, Shih-Tzu Tsai^{4,5},Yue-Chune Lee^{1*}

¹Institute of Health and Welfare Policy, College of Medicine, National Yang-Ming University, Taipei, Taiwan.

No.155, Sec. 2, Linong St., Beitou Dist., Taipei City 112, Taiwan (R.O.C.)

²Institute of Health Policy and Management, College of Public Health, National Taiwan University, Taipei, Taiwan, R.O.C.

No.17, Xuzhou Road, Taipei City 100, Taiwan (R.O.C.)

³Department of Family Medicine, Taipei Veterans General Hospital, Taipei, Taiwan.

No.201, Sec. 2, Shipai Rd., Beitou Dist., Taipei City 112, Taiwan (R.O.C.)

⁴Center for Preventive Services, Hualien Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation, Taiwan

No. 707, Sec. 3, Zhongyang Rd., Hualien 970, Taiwan (R. O. C.)

⁵College of Medicine, Tzu Chi University, Hualien, Taiwan.

No.701, Sec. 3, Zhongyang Rd., Hualien City, Hualien 970, Taiwan (R. O. C.)

*Corresponding author

E-mail: PCC: peiching@ntu.edu.tw

RNCK: nckuo@ntu.edu.tw

CKL: chihkuan.lai@gmail.com

STT: stt.tsai@msa.hinet.net

YCL: yclee@ym.edu.tw

Key Words: EQ-5D, Smoking Cessation, tobacco, health-related quality of life

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Abstract

Objectives: To assess the relationship between smoking status and EQ-5D one year after participant involvement in a program to quit smoking in Taiwan.

Design: A cohort study of smokers who voluntarily participated in a smoking cessation program with follow-up assessment of smoking status via telephone interviews.

Setting: Hospitals and clinics providing smoking cessation services.

Participants: 3,514 participants completed a second telephone interview. The participants were divided into four groups according to their smoking status: (1) long-term quitters: participants who had not used tobacco products for at least one year, (2) short-term quitters: smokers who continued smoking for less than six months after completion of the program before ceasing the use of all tobacco products for at least six months, (3) relapsed smokers: participants who relapsed into tobacco use after ceasing all use of tobacco products for at least six months following completion of the program, (4) smokers: participants who failed to quit smoking for at least one year, despite participation in the program.

Interventions: The Outpatient Smoking Cessation Service of Taiwan provided counseling and pharmacotherapy to individuals seeking to quit smoking.

Primary outcomes: An approved Chinese version of the EQ-5D-3L descriptive

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4 system was used.
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7 **Results:** After controlling for sex, age, education, marital status, job status, monthly
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9 income, and current disease status, our results revealed that long-term and short-term
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11 quitters experienced less anxiety and depression than did smokers.
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15 **Conclusions:** Our study provides evidence to support claims that all quitters,
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17 regardless of whether they stop smoking for six months or one year, have better
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19 quality of life with regard to mental health.
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24 25 26 27 **Key Words:**

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29 EQ-5D, Smoking Cessation, tobacco, health-related quality of life
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38 39 **Strengths and limitations of this study**

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41 Unlike previous studies that focused on quitters and smokers using health-related
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43 quality of life (HRQOL), this study assessed differences among quitters, relapsed
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45 smokers, and non-quitters with regard to health-related quality of care using the
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50 EQ-5D.
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56 This study was a longitudinal study based on two telephone surveys conducted six
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4 months and one year following completion of an outpatient smoking cessation
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7 program. The generalized estimation equation method was used for repeated
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15 The fact that smokers in this study volunteered to quit smoking means that
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18 self-selection bias was inevitable. In addition, smoking status was self-reported, such
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21 that the validity of the responses cannot be guaranteed.
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27 This study did not collect the EQ-5D data at baseline (prior to quitting smoking),
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30 which made it impossible to control for differences between groups.
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36 Only 64% of the participants completed both follow-up surveys; the effects from the
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39 loss of participants are unknown.
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Main text

Introduction

The adverse effects of smoking and the beneficial effects of smoking cessation have been well established [1 2]. However, the means by which smoking cessation affects health-related quality of life (HRQOL) over time remains unknown. A number of cross-sectional studies have focused on the differences in HRQOL among smokers, nonsmokers, and former smokers [3-6]. Such studies have shown that smokers tend to have poor physical and mental health, compared to nonsmokers and former smokers, particularly with regard to depressive symptoms.

Previous longitudinal studies have focused on the relationship between smoking cessation and changes in HRQOL [7-13]. However, two of these were limited with regard to follow-up duration (< 6 months) [10 13], others targeted specific groups such as females [11] or university graduates [12], and still others examined small samples [9 10 13]. Hays et al. [8] compared various forms of pharmacotherapy to aid in the cessation of smoking and their influence on HRQOL. Only two studies have compared changes in HRQOL in smokers and quitters [7 11]. Piper et al. [7] used data obtained from smokers enrolled in a long-term smoking cessation trial and tracked changes in HRQOL over a period of three years. They found that compared with smokers, quitters had improved global QOL and HRQOL at the end of the first and

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4 third years. Sarna et al. [11] evaluated the impact of quitting smoking on changes in
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7 HRQOL over an eight-year period among women in two cohorts. Continuing smokers
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10 and those who had quit smoking both presented a significant decline in SF-36
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13 physical component scores over time and significant improvements in SF-36 mental
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16 component scores at eight years. However, little is known about the changes in
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19 HRQOL that occur in relapsed smokers, compared with quitters and smokers.

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21 The Outpatient Smoking Cessation Service (OSCS) of Taiwan was launched in
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24 2002 to provide counseling and pharmacotherapy for individuals attempting to quit
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27 smoking. Doctors received an additional stipend for delivering cessation counseling
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30 and participants were subsidized for medication. Smokers who participated in the
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33 program received treatment over an eight-week period. Beginning in 2005, the
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36 government increased reimbursements and medication subsidies in order to promote
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39 participation; however, due to a budget shortage, funding was reduced in April 2006.
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42 Previous studies have explored the effects of the OSCS program with regard to
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45 provider participation and patient utilization [14], the number of patients receiving
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48 counseling after the cutback in reimbursements [15], abstinence rates [16], and
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51 cost-benefit analysis [17]. However, few researchers have compared the HRQOL
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54 among smokers, relapsed smokers, and quitters over a given duration. The aim of this
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57 study was to use EQ-5D as a means to assess differences in HRQOL among quitters,
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relapsed smokers, and non-quitters who had participated in the OSCS in Taiwan.

Materials and Methods

This study was a cohort study. The study population was smokers who participated in OSCS program between January and September 2007. Data related to individual cases was provided by hospitals or clinics in monthly reports to the Smoking Cessation Therapy Management Center of Health Promotion Administration. A total of 115,945 participants were enrolled in the OSCS between January and September 2007, approximately 14% of which (2000 cases per month) were selected by systematic sampling for follow-up observation of their smoking status via telephone interviews. The OSCS program was continuously open for enrollment with new recruits joining monthly throughout the study period; therefore, the telephone surveys were on-going. An initial telephone survey of 5,501 participants was conducted six months after completion of the OSCS program (between July 2007 and Mar. 2008). A second telephone survey of 3,514 participants from the first survey group was conducted one year after the completion of the OSCS program (between Jan. 2008 and Sep. 2008), representing a loss of 1,987 participants. We tried to contact each case three times by telephone for follow-up. The first interview dealt with demographic characteristics, current smoking status, and current EQ-5D. A second

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4 interview six months later dealt with their smoking status and current EQ-5D (one
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7 year post-program).

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10 The smoking status of participants was self-reported and determined by having
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12 them answer the following question in both of the follow up interviews: “In the last
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14 six months, how many days have you abstained from cigarettes? (1) Less than 1 day,
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16 (2) 1 to 6 days (less than one week), (3) 7 to 29 days (one week to less than a month),
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18 (4) 30 to 179 days (one month to less than six months), (5) 180 days (six months or
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20 more).” Respondents who answered that he/she had quit for 180 days were considered
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22 quitters, while the others were considered smokers. According to answers from two
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24 phone interviews, we have four conditions: (1) cases where both answers indicated
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26 180 days of abstinence were classified as long-term quitters; (2) cases where both
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28 answers indicated smoking for 180 days were classified as smokers (3) cases where
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30 the first answer was abstinence for 180 with a second answer of smoking were
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32 classified as relapsed smokers; (4) cases where the first answer indicated continued
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34 smoking for 180 days with a second answer of having quit were classified as
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36 short-term smokers. Thus, participants were divided into four groups according to
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38 their smoking status: (1) long-term quitters: participants who had quit tobacco for one
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40 year, (2) short-term quitters: participants who had been smoking for six months then
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42 had quit tobacco for six months after program, (3) relapsed smokers: participants who
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4 had relapsed into tobacco use after six months cessation, (4) smokers: participants
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7 who failed to quit smoking for at least one year, despite participating in the program.
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10 This study used a standardized instrument “EQ-5D” for the measurement of
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12 generic HRQOL, to obtain a simple descriptive profile based on five dimensions
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14 applicable to a wide range of health conditions and treatments [18]. EQ-5D has been
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16 widely used in numerous countries in a variety of research fields [19]. The EQ-5D
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18 comprises 5 dimensions: mobility, self-care, usual activities, pain/discomfort, and
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20 anxiety/depression as well as a visual analogue scale (VAS) for health status. We used
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22 an approved Chinese version of the EQ-5D-3L descriptive system. Each dimension
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24 included three levels, reflecting *no health problems*, *slight health problems*, and
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26 *extreme health problems*. If no problems were reported for a given dimension, it was
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28 marked as level 1, whereas extreme difficulty was marked as level 3.
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38 The background characteristics of participants included sex, age, education,
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40 marital status, job status, monthly income, and current disease status. The education
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42 of patients was categorized into three levels: junior high school or lower, senior high
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44 school, and university/college or above. Marital status was classified as married,
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46 single, and other (divorced, separated, and widowed). The monthly income was
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48 separated into three levels: low (< NTD 20 000 / month), medium (NTD 30 000 – 40
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50 000 / month), and high (\geq NTD 50 000 / month).
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Missing data imputation

Some of the covariates in the study were missing or unknown. In order to increase the number of samples, this study applied multiple regression imputation to fill in missing values related to monthly income, marital status, and job status, which were missing in 1.6%, 0.65%, and 0.51% of the cases, respectively. Imputation of monthly income was based on sex, education, and job variables. Imputation of marital status was based on sex, age, and education variables. Imputation of job status was based on sex, age, and education variables.

Analysis

The Chi-square test was used to compare the proportions of demographic characteristics among the four groups. We dichotomized the EQ-5D levels into *no problems* (i.e. level 1) and *problems* (i.e. levels 2 and 3) due to the small number of responses citing level 3. Based on the distribution of the dependent variables, we used logistic regression for binary and normal regression for VAS of the Generalized Estimation Equation (GEE) method for repeated measures. All statistical analysis was performed using SAS version 9.2 (SAS Institute, Cary, North Carolina) with a *p* value <0.05 considered significant.

Results

Following participation in OPCS for six months, a telephone survey of 5,501

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4 participants was conducted as a follow up to the program. Six months later, 3,514
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7 participants completed a second telephone interview, representing a loss of 1,987
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10 participants. Significant differences ($p < 0.05$) in age, marital status, and monthly
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12 income were observed among the smokers who completed both interviews and those
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14 who were lost in the second follow-up. Smokers who were lost in the follow-up were
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16 slightly younger (age < 30: 19.07% vs. 13.52%), more were single (24.97% vs. 20.51%),
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18 and more earned a medium monthly income (38.31% vs. 34.73%), compared to those
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20 who completed both interviews.
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27 With regard to smoking status: 262 participants were identified as long-term
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29 quitters, 383 as short-term quitters, 45 as relapsed smokers, and 2824 as smokers.
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31 Table 1 presents the characteristics of the four groups. Most of the participants were
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33 male, 30 to 44 years old, had high school education, were married, were currently
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35 employed, earned a medium monthly income, and were free from disease. The four
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37 groups differed with regard to gender, age, marital status, job status, and monthly
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39 income. Among the four groups, females made up a larger proportion of the
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41 short-term quitters (20.1%) and a higher number of smokers were younger (14.09%
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43 age < 30), single (21.82%), and currently employed (74.42%). A larger number of
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45 relapsed smokers had low monthly incomes (46.67%).
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56 Table 2 shows the EQ-5D among the four groups after ceasing smoking for six
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4 months and one year. Level 1 refers to situations involving *no problems*, Level 2
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6 refers to *slight problems*, and Level 3 refers to *extreme problems*. Very few of the four
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10 groups after ceasing smoking for six months or one year reported extreme health
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12 problems related to mobility, self-care, usual activities, or pain and anxiety. However,
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14 approximately 30% of the participants reported slight health problems related to pain
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16 and anxiety. Finally, the mean of VAS among the four groups was approximately 70
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19 with regard to mobility, self-care, usual activities, and pain and anxiety after ceasing
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22 smoking for six months and one year.
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27 Table 3 presents the GEE results for EQ-5D among the four groups. After
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29 controlling for confounders, short-term quitters appeared to have fewer problems with
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31 regard to usual activities and pain/discomfort, compared with smokers. After
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33 controlling for confounders, long-term quitters and short-term quitters reported fewer
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35 problems related to anxiety/depression. After controlling for confounders, long-term
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37 quitters, short-term quitters, and relapsed smokers had VAS scores higher than those
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43 of smokers.
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47 Among the smoking status groups, no significant differences were observed with
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49 regard to mobility or self-care. Relapsed smokers reported fewer problems related to
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51 mobility, pain/discomfort, and anxiety/depression; however, those results were not
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56 significant.
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4 Male participants reported less pain/discomfort and anxiety/depression than their
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6 female counterparts (OR: 0.78, 0.83 respectively). Older individuals reported a greater
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8 number of problems related to mobility, usual activities, and pain/discomfort (OR:
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10 2.16-2.98, 3.80-4.50, 1.44-1.63 respectively). Individuals with a higher education
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12 reported fewer problems related to mobility, usual activities, and pain/discomfort (OR:
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14 0.55, 0.61-0.70, 0.72-0.81 respectively). Separated/widowed individuals reported a
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16 greater number of problems related to mobility, self-care, usual activities,
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18 pain/discomfort, and anxiety/depression (OR: 1.50, 2.11, 1.45, 1.40, 1.28
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20 respectively). Employed individuals reported fewer problems related to mobility and
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22 usual activities (OR: 0.60, 0.57 respectively). Individuals earning medium and high
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24 monthly incomes reported fewer problems related to mobility (OR: 0.50, 0.27
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26 respectively), usual activities (OR: 0.39, 0.23 respectively), pain/discomfort (OR:
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28 0.73, 0.65 respectively), and anxiety/depression (OR: 0.66, 0.60 respectively).
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30 Individuals undergoing treatment for a disease reported a greater number of problems
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32 related to mobility, self-care, usual activities, pain/discomfort, and anxiety/depression
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34 (OR: 3.19, 3.23, 3.63, 3.01, 1.81 respectively).
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50 Males reported higher VAS scores than did their female counterparts (B: 2.04,
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52 $p < 0.001$) and individuals older than 60 years reported higher VAS scores compared to
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54 those below 30 years of age (B: 2.40, $p < 0.05$). Individuals with a higher education
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4 reported higher VAS scores (B: 2.11-3.65, $p<0.001$). Single individuals reported lower
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7 VAS scores than did married people (B: -1.42, $p<0.05$). Employed individuals
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10 reported higher VAS scores than did the unemployed (B: 1.87-3.39, $p<0.01$).
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13 Individuals with disease reported lower VAS scores than did those who were free
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16 from disease (B: -6.27, $p<0.001$).
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21 Discussion

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24 This study provides evidence that quitting smoking can benefit one's subjective
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27 assessment of mental health. In our results, this effect is evident among those who
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30 quit for extended periods (>12 months) as well as those who quit for short durations
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33 (6 months), following participation in OCS for one year.
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36 Our results revealed that quitting, whether for a short or long period of time, had a
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39 significant effect on anxiety/depression. This is the first study to use EQ-5D to
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42 explore the relationship between smoking status and changes in HRQOL. Our
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45 findings are similar to those obtained in previous long-term studies using different
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48 HRQOL instruments; however, our interpretations may differ. For example,
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51 Guitierrez-Bedmar et al. [12] used the Short-term Form-36 (SF-36) and found that
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54 continuing smokers had worse scores than non-smokers with regard to general health
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57 and mental health, whereas recent quitters showed improvements in mental health
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4 over those who had continued smoking and those who became smokers. Using the
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6 SF-36, Sarna et al. [11] found that continuing smokers as well as quitters showed
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8 significant improvements in mental component scores at eight years. Also using the
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10 SF-36, Sales et al. [9] found that the mental and physical component summary scores
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12 were higher among quitters than among non-quitters after ceasing smoking for twelve
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14 months.
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21 Our results show that those who quit smoking for six months are less likely than
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23 smokers to have problems related to usual activities, pain or discomfort, and anxiety
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25 and depression. These results are similar to those obtained in previous cross-sectional
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27 studies [3-5]. Mody and Smith [3] found that current smokers were more likely to
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29 report poor mental health status and limitations in their activities, compared with
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31 nonsmokers and ex-smokers. Using the Center for Disease Control Prevention
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33 HRQOL-4 (general health, mental distress, physical distress, and activity limitations)
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35 and the Healthy Days Symptoms Module (anxiety symptoms, depressive symptoms,
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37 pain, vitality, and sleep impairment), McClave et al. [4] found that former smokers
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39 and never smokers were less likely to report frequent depressive symptoms than
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41 non-quitters. Mulder et al. [5], using the SF-36, obtained lower mental component
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43 summary scores among current smokers compared to never smokers and ex-smokers.
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56 In contrast, our results showed that smoking cessation had no significant effect
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4 on EQ-5D with regard to mobility or self-care. Our results differed from those
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6 obtained in previous studies [9 11], wherein quitters had higher SF-36 physical
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8 component scores than did smokers. These findings can be explained by differences
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10 in the smoking cessation programs and the characteristics of participants. Our subjects
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12 participated in a free smoking cessation service in which counseling and
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14 pharmacotherapy were provided. In the study by Sarna et al.[11], the study subjects
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16 were registered nurses and were undecided as to whether they had been affected by
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18 smoking cessation programs over an eight year period. In the study by Sales et al. [9],
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20 the cohort included only sixty patients who were self-referred to a smoking cessation
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22 program at a public hospital.
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33 This study had a number of limitations. First, smoking status was self-reported;
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35 therefore, the validity cannot be guaranteed. Second, this study did not collect the
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37 EQ-5D data at baseline (before quitting smoking), which made it impossible to
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39 control for differences between groups; however, we attempted to control the
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41 confounders and performed two measurements. Third, this study was able to follow
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43 participants for only one year due to a lack of funding, which may be too short-term
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45 to observe a difference in the quality of life among smokers, quitters, and relapsed
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47 smokers. Future studies should conduct a long-term cohort study to obtain
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49 information regarding the quality of health among smokers, quitters, and relapsed
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4 smokers. Fourth, the smokers in this study volunteered to quit smoking; therefore,
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6 self-selection bias was inevitable. Finally, only 64% of the participants underwent
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8 both follow-up surveys and the effect from a loss of participants is unknown.
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12 Our study provides evidence to support claims that all quitters, regardless of
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14 whether they stop smoking for six months or one year, have better quality of life with
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16 regard to mental health. These findings are important for governmental organizations
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18 such as the Health Promotion Administration. The findings provide more evidence to
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20 encourage smokers to quit smoking. Future researchers could extend the follow-up to
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22 better understand the long-term effects of smoking cessation on quality of life.
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Footnotes

Contributors PCC contributed to the study design, statistical analysis, interpretation, and writing of the manuscript. RK contributed to the interpretation and writing of the manuscript. YCL contributed through coordination of the study, interpretation and writing of the manuscript, and acting as corresponding author. STT and CKL contributed to data acquisition and interpretation as well as the writing of the manuscript. All authors have read and approved the content of the manuscript.

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Table 1 Demographic characteristics (N=3514)

Demographics	long-term quitters N=262	short-term quitters N=383	relapsed smokers N=45	Smokers N=2824	
Sex	%	%	%	%	*
Male	87.79	79.90	84.44	85.73	
Female	12.21	20.10	15.56	14.27	
Age					‡
<30	8.78	13.05	8.89	14.09	
30-44	37.79	31.07	17.78	38.49	
45-59	28.63	29.24	44.44	30.95	
≥60	24.81	26.63	28.89	16.47	
Education					
under junior school	34.10	34.46	40.00	34.64	
high school	35.63	33.94	31.11	37.41	
university/college above	30.27	31.59	28.89	27.95	
Marital status					‡
single	11.45	16.45	15.56	21.82	
married	81.68	74.67	73.33	68.79	
separated, widowed	6.87	8.88	11.11	9.39	
Have job					‡
Yes	63.98	62.14	60.00	74.42	
No	36.02	37.86	40.00	25.58	
Monthly income(NT\$)					†
Low (≤20,000)	29.01	34.73	46.67	28.61	
Medium (30,000-40,000)	31.68	35.77	24.44	35.98	
High (≥50,000)	39.31	29.50	28.89	35.41	
Any disease at baseline					
Yes	31.30	36.81	40.00	33.55	
no	68.70	63.19	60.00	66.45	

Using Chi-square test for four groups, *P<0.05, †P<0.01, ‡P<0.001

Table 2 Comparison of EQ-5D among the four groups after ceasing smoking for six months and one year

	Long-term quitters		Short-term quitters		Relapsed smokers		Smokers	
	Six months	One year	Six months	One year	Six months	One year	Six months	One year
Mobility (%)								
level 1	96.18	94.27	95.29	94.78	93.33	95.56	95.57	95.01
level 2	3.82	5.73	4.45	5.22	6.67	4.44	4.36	4.85
level 3	0.00	0.00	0.26	0.00	0.00	0.00	0.07	0.14
Self-Care (%)								
level 1	98.09	98.47	98.96	98.96	97.78	97.78	99.19	99.15
level 2	1.53	1.15	0.52	1.04	2.22	2.22	0.71	0.74
level 3	0.38	0.38	0.52	0.00	0.00	0.00	0.11	0.11
Usual Activities (%)								
level 1	94.66	94.64	95.04	96.34	88.89	91.11	94.58	95.04
level 2	3.82	4.60	4.70	3.14	11.11	8.89	4.89	4.25
level 3	1.53	0.77	0.26	0.52	0.00	0.00	0.53	0.71
Pain/Discomfort (%)								
level 1	75.95	73.28	79.00	74.41	71.11	73.33	71.33	69.59
level 2	22.52	25.95	19.16	23.76	28.89	24.44	25.94	28.50
level 3	1.53	0.76	1.84	1.83	0.00	2.22	2.73	1.92
Anxiety/Depression (%)								
level 1	76.25	72.41	71.54	72.51	66.67	64.44	63.20	63.52
level 2	22.22	25.29	26.11	26.18	28.89	28.89	32.54	32.65
level 3	1.53	2.30	2.35	1.31	4.44	6.67	4.26	3.83
VAS (mean)	79.20	75.87	76.38	75.85	76.98	71.49	69.37	70.26

Level 1=no problems, level 2=slight problems, level 3= extreme problems

Table 3 Generalized estimation equation results for EQ-5D among the four groups

Variable (reference)	EQ-5D ^a					
	Mobility	Self-care	Usual activities	Pain/discomfort	Anxiety/depression	VAS
	OR	OR	OR	OR	OR	B
Intercept ^b						64.02***
Smoking status						
Relapsed smokers (smokers)	0.78	2.02	1.39	0.72	0.83	5.41**
Short-term quitters	0.83	1.02	0.63*	0.62***	0.65***	6.73***
Long-term quitters	0.92	2.01	0.95	0.79	0.61***	7.16***
Time						
After one year (six months)	1.16	1.00	0.89	1.12*	1.00	0.27
Gender						
Male (female)	1.22	0.84	1.21	0.78**	0.83*	2.04**
Age						
30-44 (Age<30)	1.58	1.07	4.02***	1.44**	1.23	0.74
45-59	2.16*	0.78	3.80**	1.53**	1.18	1.01
≥60	2.98**	0.98	4.50***	1.63**	0.81	2.40*
Education						
High school (under junior)	0.74	0.53	0.70*	0.81*	1.09	2.11***
University/college above	0.50*	0.55	0.61*	0.72***	1.02	3.65***
Marital status						
Single (married)	1.40	0.37	1.22	1.04	0.98	-1.42*
Separated/widowed	1.50*	2.11*	1.45*	1.40**	1.28*	-0.67
Currently employed						
Yes (no)	0.60**	0.60	0.57***	0.87	0.96	1.91**
Monthly income						
Medium (low)	0.50***	0.59	0.39***	0.73***	0.66***	1.87**
High	0.27***	0.56	0.23***	0.65***	0.60***	3.39***
Currently undergoing treatment for disease						
Yes (no)	3.19***	3.23***	3.63***	3.01***	1.81***	-6.27***

^aFor all EQ-5D level 2 and 3 were merged (Y=1) and each was analyzed using binary logistic generalized estimation equation. ^bY=VAS had an intercept.

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*P<0.05, **P<0.01, ***P<0.001

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1-4
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3-4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	6-7
Objectives	3	State specific objectives, including any prespecified hypotheses	6-7
Methods			
Study design	4	Present key elements of study design early in the paper	8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	8-10
		(b) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	10
Bias	9	Describe any efforts to address potential sources of bias	9
Study size	10	Explain how the study size was arrived at	11-12
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	10
		(b) Describe any methods used to examine subgroups and interactions	
		(c) Explain how missing data were addressed	11
		(d) If applicable, explain how loss to follow-up was addressed	8
		(e) Describe any sensitivity analyses	
Results			11-15

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	11-12
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	12
Outcome data	15*	Report numbers of outcome events or summary measures over time	12-13
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	13-15
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			15-18
Key results	18	Summarise key results with reference to study objectives	15
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17
Generalisability	21	Discuss the generalisability (external validity) of the study results	17
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	19

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

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The relationship between smoking status and health-related quality of life among smokers who participated in a one-year smoking cessation program in Taiwan: A cohort study using the EQ-5D

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Title page

Research Articles

The relationship between smoking status and health-related quality of life among smokers who participated in a one-year smoking cessation program in Taiwan: A cohort study using the EQ-5D

Pei-Ching Chen¹, Raymond Nien-Chen Kuo², Chih-Kuan Lai³, Shih-Tzu Tsai^{4,5},
Yue-Chune Lee^{1*}

¹Institute of Health and Welfare Policy, College of Medicine, National Yang-Ming University, Taipei, Taiwan.

No.155, Sec. 2, Linong St., Beitou Dist., Taipei City 112, Taiwan (R.O.C.)

²Institute of Health Policy and Management, College of Public Health, National Taiwan University, Taipei, Taiwan, R.O.C.

No.17, Xuzhou Road, Taipei City 100, Taiwan (R.O.C.)

³Department of Family Medicine, Taipei Veterans General Hospital, Taipei, Taiwan.

No.201, Sec. 2, Shipai Rd., Beitou Dist., Taipei City 112, Taiwan (R.O.C.)

⁴Center for Preventive Services, Hualien Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation, Taiwan

No. 707, Sec. 3, Zhongyang Rd., Hualien 970, Taiwan (R. O. C.)

⁵College of Medicine, Tzu Chi University, Hualien, Taiwan.

No.701, Sec. 3, Jhongyang Rd., Hualien City, Hualien 970, Taiwan (R. O. C.)

*Corresponding author

E-mail: PCC: peiching@ntu.edu.tw

RNCK: nckuo@ntu.edu.tw

CKL: chihkuan.lai@gmail.com

STT: stt.tsai@msa.hinet.net

YCL: ycllee@ym.edu.tw

Key Words: EQ-5D, Smoking Cessation, tobacco, health-related quality of life

Word count for the text: 4086

Word count for the abstract: 253

Abstract

Objective: To assess the relationship between smoking status and health-related quality of life one year after participation in a smoking cessation program in Taiwan.

Design: A cohort study of smokers who voluntarily participated in a smoking cessation program with two follow-up assessments of smoking status via telephone interview, conducted six months and one year after finishing the smoking cessation program.

Setting: Hospitals and clinics providing smoking cessation services.

Participants: A total of 3,514 participants completed both telephone interviews, which represents a response rate of 67.32%. After the interviews, participants were divided into four groups according to their smoking status: (1) long-term quitters: participants who had quit tobacco use for one year, (2) short-term quitters: participants who had been smoking for at least six months and then quit tobacco for six months after participating in the program, (3) relapsed smokers: participants who relapsed into tobacco use after ceasing tobacco use for six months, (4) continuing smokers: participants who failed to quit smoking for at least one year, despite participating in the program.

Interventions: The Outpatient Smoking Cessation Service of Taiwan provides

counseling and pharmacotherapy to individuals seeking to quit smoking.

Primary outcomes: The health-related quality of life of the participants was measured using an approved Chinese version of the EQ-5D-3L descriptive system.

Results: After controlling for sex, age, education, marital status, job status, monthly income, and disease status at baseline, our results revealed that long-term (OR=0.61) and short-term (OR=0.65) quitters experienced less anxiety and depression than did continuing smokers.

Conclusions: Our study provides evidence to support claims that all quitters, regardless of whether they stop smoking for six months or one year, have better quality of life with regard to anxiety or depression.

Key Words:

EQ-5D, Smoking Cessation, tobacco, health-related quality of life

Word count for the abstract: 282

Strengths and limitations of this study

Unlike previous studies that used health-related quality of life (HRQOL) to study quitters and smokers, this study assessed differences among quitters, relapsed smokers, and continuing smokers with regard to health-related quality of care using the EQ-5D.

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7 This was a longitudinal study based on two telephone surveys conducted six months
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10 and one year after the completion of an outpatient smoking cessation program. The
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13 generalized estimation equation method was used for repeated measures.
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18 The fact that smokers in this study volunteered to quit smoking means that
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21 self-selection bias was inevitable. In addition, smoking status was self-reported, such
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24 that the validity of the responses cannot be guaranteed.
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30 This study did not collect EQ-5D data at baseline (prior to quitting smoking), which
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33 made it impossible to control for differences between groups.
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38 The response rate of this study was 67.32%, as this was the percentage of participants
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41 who were able to complete both follow-up surveys. Effects from the loss of
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44 participants are unknown.
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Main text

Introduction

The adverse effects of smoking and the beneficial effects of smoking cessation have been well established [1 2]. The harmful effects of smoking on health are well known; however, the influence of smoking cessation on health-related quality of life (HRQOL) over time has yet to be fully elucidated. HRQOL is broadly defined through the examination of several components of day-to-day functioning and well-being, such as physical functioning; functioning in daily activities, such as work and social activities; and psychological distress and well-being [3]. A number of cross-sectional studies have focused on the differences in HRQOL among smokers, nonsmokers, and former smokers [4-7]. These studies have shown that smokers tend to have poor physical and mental health, compared to nonsmokers and former smokers, particularly with regard to depressive symptoms.

Previous longitudinal studies have focused on the relationship between smoking cessation and changes in HRQOL [8-14]. However, two of these studies were limited with regard to follow-up duration (< 6 months) [11 14], while others targeted specific groups such as females [11] or university graduates [13], and still others included small samples [10 11 14]. Hays et al. [9] compared various forms of pharmacotherapy used to assist in the cessation of smoking and the influence of these

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4 pharmacotherapies on HRQOL. Only two studies have compared the changes in
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7 HRQOL that occur among smokers and quitters [8 12]. Piper et al. [7] used data
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10 obtained from smokers enrolled in a long-term smoking cessation trial and tracked
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13 changes in HRQOL over a period of three years. They found that compared with
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16 smokers, quitters had improved global QOL and HRQOL at the end of the first and
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19 third years. Sarna et al. [11] evaluated the impact of quitting smoking on changes in
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22 HRQOL over an eight-year period among women in two cohorts. Continuing smokers
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25 and those who had quit smoking both presented a significant decline in SF-36
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28 physical component scores over time and significant improvements in SF-36 mental
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31 component scores at eight years.

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33 Various hypotheses have been proposed to explain the relationship between
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36 smoking and mental health: 1) smoking and poor mental health may share common
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39 causes (genetic factors or environmental mechanisms); 2) among individuals with
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42 poor mental health, smoking may be a coping strategy used to regulate psychiatric
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45 symptoms; and 3) smoking worsens mental health [15]. Taylor et al. [16] reviewed 26
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48 longitudinal studies and found that smoking cessation is associated with reduced
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51 depression, anxiety, and stress as well as improved mood and quality of life,
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54 compared with individuals who continue smoking. However, little is known about the
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57 changes in HRQOL that occur in relapsed smokers, compared with quitters and
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4 smokers.

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7 The Outpatient Smoking Cessation Service (OSCS) of Taiwan was launched in
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10 2002 to provide counseling and pharmacotherapy for individuals attempting to quit
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12 smoking. Doctors received an additional stipend for the delivery of cessation
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14 counseling and medications were subsidized for participants. Smokers who
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16 participated in the program received treatment over an eight-week period. Beginning
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18 in 2005, the government increased reimbursements and medication subsidies in order
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20 to promote participation; however, due to a budget shortage, funding was reduced in
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22 April 2006. Previous studies have explored the effects of the OSCS program with
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24 regard to provider participation and patient utilization [17], the number of patients
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26 receiving counseling after the cutback in reimbursements [18], abstinence rates [19],
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28 and cost-benefit analysis [20]. However, few researchers have compared the HRQOL
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30 among smokers, relapsed smokers, and quitters over a given duration. The aim of this
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32 study was to use EQ-5D as a means to assess differences in HRQOL among quitters,
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34 relapsed smokers, and non-quitters who had participated in the OSCS in Taiwan.
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50 **Materials and Methods**

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53 This cohort study had a study population of smokers who participated in the
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55 OSCS program between January and September 2007. Data related to individual cases
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4 was provided by hospitals or clinics in monthly reports to the Smoking Cessation
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7 Therapy Management Center of Health Promotion Administration. A total of 115,945
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10 participants were enrolled in the OSCS between January and September 2007,
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13 approximately 14% of whom (2000 cases per month) were selected using systematic
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16 sampling for follow-up observation of their smoking status via telephone interviews.
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19 The OSCS program was continuously open for enrollment, with new recruits joining
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22 each month throughout the study period. As a result, the telephone surveys were
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25 conducted on an on-going basis. A total 16,274 individuals participated in the OSCS
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28 program. Excluding ineligible cases left 12,116 cases to be contacted. Among these
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31 cases, 5965 could not be contacted and 650 refused to be interviewed. A total of 5,501
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34 participants successfully completed the first interview. For more detailed information,
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37 refer to the previous study [20].

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40 The initial telephone survey of 5,501 participants was conducted six months after
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43 the subjects participated in the OSCS program (between July 2007 and Mar. 2008). A
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46 second telephone survey of 3,514 participants from the first survey group was
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49 conducted six months after the first interview (between Jan. 2008 and Sep. 2008).
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52 This represents a response rate of 67.32%. Researchers attempted to contact each of
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55 the subjects three times by telephone for follow-up. From the 5,501 cases in the initial
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58 survey, 281 were deemed ineligible due to having an invalid phone number or had
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4 moved away; 1,544 cases were not at home, did not answer the phone, or the line was
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7 busy; and 162 cases refused to participate in the interview. A total of 3,514
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10 participants completed both interviews. The first interview was used to collect
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12 information related to demographic characteristics, current smoking status, and
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14 current EQ-5D. A second interview six months later was used to collect information
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17 related to smoking status and current EQ-5D (one year post-program).
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21 The smoking status of participants was self-reported and determined by having
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23 the subjects answer the following question in both of the follow up interviews: “In the
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25 last six months, how many days have you abstained from cigarette use? (1) Less than
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27 1 day, (2) 1 to 6 days (less than one week), (3) 7 to 29 days (one week to less than a
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29 month), (4) 30 to 179 days (one month to less than six months), (5) 180 days (six
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31 months or more).” Respondents who reported having quit for 180 days were
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33 considered quitters, while the others were considered smokers. According to answers
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35 from the two phone interviews, we have four conditions: (1) cases in which both
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37 answers indicated 180 days of abstinence were classified as long-term quitters; (2)
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39 cases where both answers indicated smoking for 180 days were classified as
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41 continuing smokers (3) cases where the first answer was abstinence for 180 with a
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43 second answer of smoking were classified as relapsed smokers; (4) cases where the
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45 first answer indicated continued smoking for 180 days with a second answer of
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4 having quit were classified as short-term smokers. Thus, participants were divided
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7 into four groups according to their smoking status: (1) long-term quitters: participants
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10 who had quit tobacco use for one year, (2) short-term quitters: participants who had
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13 been smoking for six months and then quit tobacco for six months after participating
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16 in the program, (3) relapsed smokers: participants who had relapsed into tobacco use
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19 after six months cessation, (4) continuing smokers: participants who failed to quit
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22 smoking for at least one year, despite participating in the program.
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24 This study used a standardized instrument “EQ-5D” for the measurement of
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27 generic HRQOL, in order to obtain a simple descriptive profile based on five
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30 dimensions applicable to a wide range of health conditions and treatments [21]. The
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33 EQ-5D has been widely used in numerous countries in a variety of research fields [22].
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36 The EQ-5D comprises 5 dimensions: mobility, self-care, usual activities,
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39 pain/discomfort, and anxiety/depression as well as a visual analogue scale (VAS) for
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42 health status. The EQ VAS records the respondent’s self-rated health on a vertical,
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45 visual analogue scale where the endpoints are labelled ‘100’ (best imaginable health
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48 state) and ‘0’ (worst imaginable health state). We used an approved Chinese version
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51 of the EQ-5D-3L with three levels of severity for each dimension: *no health problems*,
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54 *slight health problems*, and *extreme health problems*. If no problems were reported for
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57 a given dimension, it was marked as level 1, whereas extreme difficulty was marked
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4 as level 3. Because the EQ-5D is simple and short, it is ideal for telephone surveys.
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7 The background characteristics of participants included sex, age, education,
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9 marital status, job status, monthly income, and disease status at baseline. The
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11 education of patients was categorized into three levels: junior high school or lower,
12
13 senior high school, and university/college or above. Marital status was classified as
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15 married, single, and other (divorced, separated, or widowed). Monthly income was
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17 separated into three levels: low (< NTD 20 000 / month), medium (NTD 30 000 – 40
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19 000 / month), and high (\geq NTD 50 000 / month). Disease status was determined by
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21 asking people about the diseases they have, such as cancers, cardiovascular diseases,
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23 heart cerebrovascular disease, asthma, diabetes, chronic obstructive pulmonary
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25 disease, gastritis, nephritis, and hepatitis. It should be noted that disease status did not
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27 include consideration of mental health condition.
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43 **Missing data imputation**

44 A number of the covariates in the study were missing or unknown. In order to
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46 increase the number of samples, this study applied multiple regression imputation to
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48 fill in missing values related to monthly income, marital status, and job status, which
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50 were missing in 1.6%, 0.65%, and 0.51% of the cases, respectively. Imputation of
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52 monthly income was based on sex, education, and job variables. Imputation of marital
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4 status was based on sex, age, and education variables. Imputation of job status was
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6 based on sex, age, and education variables.
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10 11 12 **Analysis**

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15 The Chi-square test and multinomial logistic regression were used to compare
16
17 the proportions of demographic characteristics among the four groups. We
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19 dichotomized the EQ-5D levels into *no problems* (i.e. level 1 as Y=0) and *problems*
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21 (i.e. levels 2 and 3 as Y=1) due to the small number of responses citing level 3. Based
22
23 on the distribution of the dependent variables, logistic regression was used for binary
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25 and normal regression for VAS of the Generalized Estimation Equation (GEE) method
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27 for repeated measures. All statistical analysis was performed using SAS version 9.2
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29 (SAS Institute, Cary, North Carolina) with a *p* value <0.05 considered significant.
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42 **Results**

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44 Following six months of participation in OSCS, a telephone survey of 5,501
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46 participants was conducted as a follow up to the program. Six months later, 3,514
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48 participants completed a second telephone interview, which represents a response rate
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50 of 67.32%. Significant differences (*p*<0.05) in age, marital status, and monthly
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52 income were observed among the smokers who completed both interviews and those
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4 who did not participate in the second follow-up. Smokers who did not participate in
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6 the follow-up were slightly younger (age<30: 19.07% vs.13.52%), a greater number
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8 were single (24.97% vs. 20.51%), and a greater number earned a medium monthly
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10 income (38.31% vs. 34.73%), compared to those who completed both interviews.
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15 A total of 307 participants reported 180 days of abstinence in the first interview,
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17 which represents a 6-month quit rate of 5.58%. Among those quitters, 262 cases
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19 reported 180 days of abstinence in the second interview, such that the 12-month quit
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21 rate was 4.76%. With regard to smoking status: 262 participants were identified as
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23 long-term quitters, 383 as short-term quitters, 45 as relapsed smokers, and 2824 as
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25 continuing smokers.
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33 As is shown in Table 1, the four groups differed with regard to gender, age,
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35 marital status, job status and monthly income. However, a majority of the participants
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37 were male, 30 to 44 years old, had a high school education, were married, were
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39 currently employed, earned a medium monthly income, and were free from disease.
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45 Multinomial logistic regression was used to test for differences among the four
46
47 groups with regard to sex, age, marital status, employment status, and income status,
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49 using continuing smokers as a reference group. Compared with continuing smokers,
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51 males were significant less likely to be the short-term quitters (OR=0.66,
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53 95%CI=0.50-0.87). Individuals above the age of 60 were significantly more likely to
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4 be short-term quitters or long-term quitters (Short-term quitters OR=1.75,
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6 95%CI=1.21-2.51; Long-term quitters OR=2.42, 95%CI=1.48-3.96). Married
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8 individuals were significantly more likely to be short-term quitters or long-term
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10 quitters (Short-term quitters OR=1.44, 95%CI=1.08-1.92; Long-term quitters
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12 OR=2.26, 95%CI=1.53-3.35). Individuals with a job were significantly less likely to
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14 be relapsed smokers, short-term quitters, or long-term quitters (Relapsed smokers
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16 OR=0.52, 95%CI=0.28-0.94; Short-term quitters OR=0.56, 95%CI=0.45-0.71;
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18 Long-term quitters OR=0.61, 95%CI=0.47-0.80). Individuals with a medium monthly
19
20 income were significantly less likely to be relapsed smokers (Relapsed smokers
21
22 OR=0.42, 95%CI=0.20-0.87), however, individuals with high monthly income were
23
24 significantly more likely to be short-term quitters (Short-term quitters OR=0.69,
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26 95%CI=0.53-0.90).

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39 Table 2 presents the EQ-5D among the four groups after ceasing smoking for six
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41 months and one year. Level 1 refers to situations involving *no problems*, Level 2
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43 refers to *slight problems*, and Level 3 refers to *extreme problems*. Very few of the four
44
45 groups reported extreme health problems related to mobility, self-care, usual activities,
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47 or pain and anxiety after ceasing smoking for six months or one year. However,
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49 approximately 30% of the participants reported slight health problems related to pain
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51 and anxiety. Finally, the mean VAS among the four groups was approximately 70 with
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4 regard to mobility, self-care, usual activities, and pain and anxiety after ceasing
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7 smoking for six months and one year.

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10 Table 3 presents the GEE results for EQ-5D among the four groups. After
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12 controlling for confounders, short-term quitters appeared to have fewer problems with
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14 regard to usual activities and pain/discomfort, compared with continuing smokers.
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16 After controlling for confounders, long-term quitters and short-term quitters reported
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18 fewer problems related to anxiety/depression. After controlling for confounders,
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20 long-term quitters, short-term quitters, and relapsed smokers had VAS scores higher
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22 than those of continuing smokers.
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30 Among the smoking status groups, no significant differences were observed with
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32 regard to mobility or self-care. Relapsed smokers reported fewer problems related to
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34 mobility, pain/discomfort, and anxiety/depression; however, those results were not
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36 significant.
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41 Male participants reported less pain/discomfort and anxiety/depression than their
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43 female counterparts (OR: 0.78, 0.83 respectively). Older individuals reported a greater
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45 number of problems related to mobility, usual activities, and pain/discomfort (OR:
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47 2.16-2.98, 3.80-4.50, 1.44-1.63 respectively). Individuals with a higher education
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49 reported fewer problems related to mobility, usual activities, and pain/discomfort (OR:
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51 0.55, 0.61-0.70, 0.72-0.81 respectively). Separated/widowed individuals reported a
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4 greater number of problems related to mobility, self-care, usual activities,
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6 pain/discomfort, and anxiety/depression (OR: 1.50, 2.11, 1.45, 1.40, 1.28
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10 respectively). Employed individuals reported fewer problems related to mobility and
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12 usual activities (OR: 0.60, 0.57 respectively). Individuals with medium or high
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14 monthly incomes reported fewer problems related to mobility (OR: 0.50, 0.27
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16 respectively), usual activities (OR: 0.39, 0.23 respectively), pain/discomfort (OR:
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18 0.73, 0.65 respectively), and anxiety/depression (OR: 0.66, 0.60 respectively).
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Individuals who noted a disease at baseline reported a greater number of problems related to mobility, self-care, usual activities, pain/discomfort, and anxiety/depression (OR: 3.19, 3.23, 3.63, 3.01, 1.81 respectively).

Males reported higher VAS scores than did their female counterparts (B: 2.04, $p < 0.001$) and individuals older than 60 years reported higher VAS scores compared to those below 30 years of age (B: 2.40, $p < 0.05$). Individuals with a higher education reported higher VAS scores (B: 2.11-3.65, $p < 0.001$). Single individuals reported lower VAS scores than did married people (B: -1.42, $p < 0.05$). Employed individuals reported higher VAS scores than did the unemployed (B: 1.87-3.39, $p < 0.01$). Individuals with disease reported lower VAS scores than did those who were free from disease (B: -6.27, $p < 0.001$).

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4 Considering the fact that “continuing smokers” included smokers who quit for
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6 less than 1 day as well as those who quit for 1-179 days, this group cannot be
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8 considered homogenous. We therefore differentiated smokers who quit for less than 1
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10 day from smokers who quit for 1-179 days in order to provide a stricter
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12 re-classification of the smoking group. Thus, the newly defined groups were as
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14 follows: (1) cases where both answers indicated 180 days of abstinence were
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16 classified as long-term quitters (n=262); (2) cases where both answers indicated
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18 abstinence for less than 1 day were classified as continuing smokers (n=2271); (3)
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20 relapsed smokers: cases where the first answer was abstinence for 180 days and the
21
22 second was abstinence for less than 1 day (n=26); (4) short-term smokers: cases
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24 where the first answer was abstinence for less than 1 day and the second answer
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26 indicated abstinence for 180 days (n=96). This new classification resulted in a loss of
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28 859 subjects, which represents 24% of the cases in this study. (See Supplementary
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30 Table 1)
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The new classification of generalized estimation equation results for EQ-5D among the four groups was shown in Table 4 (or Supplementary Table 2). After controlling for confounders, short-term quitters appeared to have fewer problems with regard to usual activities and pain/discomfort, compared with continuing smokers. After controlling for confounders, long-term quitters and short-term quitters reported

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4 fewer problems related to anxiety/depression. After controlling for confounders,
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7 long-term quitters and short-term quitters had VAS scores higher than those of
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10 continuing smokers. We found the results were similar to our original results in Table
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13 3.

14 15 16 17 18 **Discussion** 19

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21 This study provides evidence that quitting smoking can benefit one's subjective
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23 assessment of anxiety or depression. In this study, this effect is particularly evident
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25 among individuals who quit for extended periods (>12 months) as well as those who
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27 quit for short durations (6 months), following participation in OCS for one year. Our
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29 results revealed that quitting smoking, whether for a short or long period of time, had
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31 a significant effect on anxiety or depression.
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39 This is the first study to use EQ-5D to explore the relationship between smoking
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41 status and changes in HRQOL. We found both long-term and short-term quitters had
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43 problems related to anxiety or depression. Our findings are similar to those obtained
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45 in previous long-term studies; however, we used different instruments, therefore, we
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47 cannot make a direct comparison with their results. In a review of previous studies,
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49 Taylor et al. [16] discovered that smoking cessation is associated with reduced
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51 depression, anxiety, and stress and improved mood and quality of life, compared with
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4 individuals who continue smoking. Using the short-term Form-36 (SF-36),
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7 Guterrez-Bedmar et al. [13] found that continuing smokers had worse scores than did
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10 non-smokers with regard to general health and mental health, whereas recent quitters
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13 showed improvements in mental health over those who continued smoking and those
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16 who took up smoking. Using the SF-36, Sarna et al. [12] found that continuing
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19 smokers as well as quitters showed significant improvements in mental component
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22 scores at eight years. Sales et al. [10] also used the SF-36 and found that summary
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25 scores of mental and physical components were higher among quitters than among
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28 non-quitters after ceasing smoking for twelve months.

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30 Our results show that those who quit smoking for six months were less likely
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33 than smokers to have problems related to usual activities, pain or discomfort, or
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36 anxiety or depression. These results are similar to those obtained in previous
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39 cross-sectional studies [4-6]. Mody and Smith [4] found that current smokers were
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42 more likely to report poor mental health status and limitations in their usual activities,
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45 compared with nonsmokers and ex-smokers. McClave et al. [5] found that former
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48 smokers and never smokers were less likely to report depressive symptoms than were
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51 non-quitters. Mulder et al. [6] obtained lower summary scores for the mental
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54 component among current smokers compared to never smokers and ex-smokers.

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56 In this study, long-term quitters, short-term quitters, and relapsed smokers
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4 presented EQ VAS scores higher than those of continuing smokers. These findings are
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7 similar to those in previous studies using different HRQOL instruments, such as the
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10 SF-36, which includes eight dimensions. The discussion related to general health in
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12 the SF-36 is similar to our study; therefore, we opted to limit the comparison to this.
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15 Guterrez-Bedmar et al. [13] reported that continuing smokers had worse scores than
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17 recent quitters with regard to general health. Sarna et al. [12] found that continuing
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19 smokers as well as quitters present a significant decline in general health scores,
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21 whereas continuing smokers presented a decline in a wider range of scores than did
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23 quitters at eight years. Sales et al. [10] found that the general health component scores
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25 were higher among quitters than among non-quitters after ceasing smoking for twelve
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27 months.
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36 In contrast, our results show that smoking cessation had no significant effect on
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38 EQ-5D with regard to mobility or self-care. Our results differ from those obtained in
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40 previous studies [10 12], wherein quitters had higher SF-36 scores for the physical
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42 component than did smokers. These findings can be explained by differences in the
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44 smoking cessation programs and the background characteristics of participants. The
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46 subjects in this study participated in a free smoking cessation service in which
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48 counseling and pharmacotherapy were provided. In the study by Sarna et al. [12],
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50 participants were registered nurses and were undecided as to whether they had been
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4 affected by smoking cessation programs over an eight year period. In the study by
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7 Sales et al. [10], the cohort included only sixty patients who were self-referred to a
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10 smoking cessation program at a public hospital.

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13 In this study, the 6-month quit rate was 5.58% and the 12-month quit rate was
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15 4.76%. Naranjo et al [23] respectively reported smoking cessation rates of 14.4% and
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17 15.7% at 6 months and 12 months among patients with arthritis in a rheumatology
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19 clinic. Our results could not be compared directly with previous studies due to
20
21 fundamental differences in the design of the smoking cessation program and study
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23 population. Chang et al. [17] reported on smoking cessation outpatient services with
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25 quit rates of 25.2% and 21.3% in a six-month follow-up in 2004 and 2005 in Taiwan.
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27 These differences could be explained by the fact that the quit rate was not strictly
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29 defined; i.e., quitting for either 7-days or six-month were both included in the
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31 quit-rate.
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41 VAS scores represent a subjective self-evaluation of one's health and individuals
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43 over the age of 60 reported higher VAS scores than did those below the age of 30.
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47 Whynes [24] examined the correspondence between EQ-VAS scores and EQ-5D
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49 health states, and found that VAS scores are influenced by EQ-5D health state
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51 classification, the subject's perceived locus of control, and by his/her age, educational
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53 attainment, ethnic origin, and smoking behaviour. Whynes [25] also examined how
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4 the relationship between health state classification and VAS score varied with medical
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7 condition. They found that a given change between two EQ-5D-defined health states
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10 could produce different changes in VAS scores for different medical conditions and
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13 interventions. The difference between EQ-VAS scores and EQ-5D health status may
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16 be due to other factors, such as disease status or socio-demographic factors.

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18 This study faced a number of limitations. First, smoking status was self-reported;
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21 therefore, validity cannot be guaranteed. Second, we were unable to collect EQ-5D
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24 data at baseline (before quitting smoking), which made it impossible to control for
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27 differences between groups; however, we attempted to control for confounders and
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30 obtained two measurements, at six months and one year after participation in OSCS.
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33 Third, due to a lack of funding, we were able to follow participants for only one year,
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36 which may be too short-term to observe differences in the quality of life among
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39 smokers, quitters, and relapsed smokers. In the future, researchers should conduct a
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42 long-term cohort study to obtain information related to the quality of life among
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45 smokers, quitters, and relapsed smokers. Fourth, the smokers in this study volunteered
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48 to quit smoking; therefore, self-selection bias was inevitable. Finally, only 64% of the
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51 participants participated in both follow-up surveys, and the effect from a loss of
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54 participants is unknown.

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56 Our findings provide evidence to support the claims that all quitters, regardless
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4 of whether they stop smoking for six months or one year, have better quality of life
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7 with regard to mental health. These findings are important for governmental
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10 organizations such as the Health Promotion Administration. These findings provide
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12 additional evidence to encourage smokers to quit smoking. Future researchers could
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14 extend the follow-up to better understand the long-term effects of smoking cessation
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16 on quality of life.
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Footnotes

Contributors

PCC contributed to the study design, statistical analysis, interpretation, and writing of the manuscript. RK contributed to the interpretation and writing of the manuscript. YCL contributed through coordination of the study, interpretation and writing of the manuscript, and acting as corresponding author. STT and CKL contributed to data acquisition and interpretation as well as the writing of the manuscript. All authors have read and approved the content of the manuscript.

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Table 1 Demographic characteristics (N=3514)

Demographics	Long-term Quitters N=262	Short-term Quitters N=383	Relapsed Smokers N=45	Smokers N=2824	
Sex	%	%	%	%	*
Male	87.79	79.90	84.44	85.73	
Female	12.21	20.10	15.56	14.27	
Age					‡
<30	8.78	13.05	8.89	14.09	
30-44	37.79	31.07	17.78	38.49	
45-59	28.63	29.24	44.44	30.95	
≥60	24.81	26.63	28.89	16.47	
Education					
below junior school	34.10	34.46	40.00	34.64	
high school	35.63	33.94	31.11	37.41	
university/college above	30.27	31.59	28.89	27.95	
Marital status					‡
single	11.45	16.45	15.56	21.82	
married	81.68	74.67	73.33	68.79	
separated, widowed	6.87	8.88	11.11	9.39	
Employed					‡
Yes	63.98	62.14	60.00	74.42	
No	36.02	37.86	40.00	25.58	
Monthly income(NT\$)					†
Low (≤20,000)	29.01	34.73	46.67	28.61	
Medium (30,000-40,000)	31.68	35.77	24.44	35.98	
High (≥50,000)	39.31	29.50	28.89	35.41	
Any disease at baseline					
Yes	31.30	36.81	40.00	33.55	
no	68.70	63.19	60.00	66.45	

Using Chi-square test for four groups, *P<0.05, †P<0.01, ‡P<0.001

Table 2 Comparison of EQ-5D among the four groups after ceasing smoking for six months and one year

	Long-term quitters		Short-term quitters		Relapsed smokers		Smokers	
	Six months	One year	Six months	One year	Six months	One year	Six months	One year
Mobility (%)								
level 1	96.18	94.27	95.29	94.78	93.33	95.56	95.57	95.01
level 2	3.82	5.73	4.45	5.22	6.67	4.44	4.36	4.85
level 3	0.00	0.00	0.26	0.00	0.00	0.00	0.07	0.14
Self-Care (%)								
level 1	98.09	98.47	98.96	98.96	97.78	97.78	99.19	99.15
level 2	1.53	1.15	0.52	1.04	2.22	2.22	0.71	0.74
level 3	0.38	0.38	0.52	0.00	0.00	0.00	0.11	0.11
Usual Activities (%)								
level 1	94.66	94.64	95.04	96.34	88.89	91.11	94.58	95.04
level 2	3.82	4.60	4.70	3.14	11.11	8.89	4.89	4.25
level 3	1.53	0.77	0.26	0.52	0.00	0.00	0.53	0.71
Pain/Discomfort (%)								
level 1	75.95	73.28	79.00	74.41	71.11	73.33	71.33	69.59
level 2	22.52	25.95	19.16	23.76	28.89	24.44	25.94	28.50
level 3	1.53	0.76	1.84	1.83	0.00	2.22	2.73	1.92
Anxiety/Depression (%)								
level 1	76.25	72.41	71.54	72.51	66.67	64.44	63.20	63.52
level 2	22.22	25.29	26.11	26.18	28.89	28.89	32.54	32.65
level 3	1.53	2.30	2.35	1.31	4.44	6.67	4.26	3.83
VAS (mean)	79.20	75.87	76.38	75.85	76.98	71.49	69.37	70.26

Level 1=no problems, level 2=slight problems, level 3= extreme problems

Table 3 Generalized estimation equation results for EQ-5D among the four groups

Variable (reference group)	EQ-5D ^a					EQ
	Mobility	Self-care	Usual	Pain/ activities	Anxiety/ depression	VAS ^b
	OR	OR	OR	OR	OR	B
Intercept						64.02***
Smoking status						
(Smokers)	1.00	1.00	1.00	1.00	1.00	-
Relapsed smokers	0.78	2.02	1.39	0.72	0.83	5.41**
Short-term quitters	0.83	1.02	0.63*	0.62***	0.65***	6.73***
Long-term quitters	0.92	2.01	0.95	0.79	0.61***	7.16***
Time						
After one year	1.16	1.00	0.89	1.12*	1.00	0.27
(Six months)	1.00	1.00	1.00	1.00	1.00	-
Gender						
Male	1.22	0.84	1.21	0.78**	0.83*	2.04**
(female)	1.00	1.00	1.00	1.00	1.00	-
Age						
(<30)	1.00	1.00	1.00	1.00	1.00	-
30-44	1.58	1.07	4.02***	1.44**	1.23	0.74
45-59	2.16*	0.78	3.80**	1.53**	1.18	1.01
≥60	2.98**	0.98	4.50***	1.63**	0.81	2.40*
Education						
(under junior)	1.00	1.00	1.00	1.00	1.00	-
High school	0.74	0.53	0.70*	0.81*	1.09	2.11***
University/college	0.50*	0.55	0.61*	0.72***	1.02	3.65***
above						
Marital status						
(married)	1.00	1.00	1.00	1.00	1.00	-
Single	1.40	0.37	1.22	1.04	0.98	-1.42*
Separated/widowed	1.50*	2.11*	1.45*	1.40**	1.28*	-0.67
Currently employed						
Yes	0.60**	0.60	0.57***	0.87	0.96	1.91**
(no)	1.00	1.00	1.00	1.00	1.00	-
Monthly income						
(low)	1.00	1.00	1.00	1.00	1.00	-
Medium	0.50***	0.59	0.39***	0.73***	0.66***	1.87**
High	0.27***	0.56	0.23***	0.65***	0.60***	3.39***

Any disease at baseline

Yes	3.19***	3.23***	3.63***	3.01***	1.81***	-6.27***
(no)	1.00	1.00	1.00	1.00	1.00	-

^aThe level of each dimension of EQ-5D was dichotomized into no problems (i.e. level 1 as Y=0) and problems (i.e. levels 2 and 3 as Y=1) and each was analyzed using the binary logistic generalized estimation equation. ^b VAS had an intercept.

*P<0.05, **P<0.01, ***P<0.001

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Table 4 New classifications of generalized estimation equation results for EQ-5D among the four groups

Variable (reference group)	EQ-5D ^a					EQ
	Mobility	Self-care	Usual activities	Pain/ discomfort	Anxiety/ depression	VAS ^b
	OR	OR	OR	OR	OR	B
Intercept						61.93***
Smoking status						
(Smokers)	1.00	1.00	1.00	1.00	1.00	-
Relapsed smokers	0.76	3.42	0.99	0.99	0.87	3.49
Short-term quitters	1.09	1.04	0.53**	0.53**	0.62**	3.86**
Long-term quitters	1.02	2.69*	0.79	0.79	0.60***	7.78***
Time						
After one year	1.12	1.10	1.14*	1.14*	1.00	0.41
(Six months)	1.00	1.00	1.00	1.00	1.00	-
Gender						
Male	1.16	0.91	0.70**	0.70**	0.81*	2.45**
(female)	1.00	1.00	1.00	1.00	1.00	-
Age						
(<30)	1.00	1.00	1.00	1.00	1.00	-
30-44	1.31	0.59	1.52**	1.52**	1.17	1.44
45-59	2.01	0.47	1.57**	1.57**	1.13	2.03*
≥60	2.31	0.32	1.67**	1.67**	0.78	4.44***
Education						
(under junior)	1.00	1.00	1.00	1.00	1.00	-
High school	0.77	0.49	0.84	0.84	1.08	2.87***
University/college above	0.58*	0.77	0.69***	0.69***	0.99	3.50***
Marital status						
(married)	1.00	1.00	1.00	1.00	1.00	-
Single	1.36	0.13	1.09	1.09	0.98	-0.59
Separated/widowed	1.74**	3.00**	1.55***	1.55***	1.31*	-0.98
Currently employed						
Yes	0.65*	0.62	0.92	0.92	1.03	1.91*
(no)	1.00	1.00	1.00	1.00	1.00	-
Monthly income						
(low)	1.00	1.00	1.00	1.00	1.00	-

Medium	0.48***	0.39	0.79*	0.79*	0.64***	1.52
High	0.23***	0.34	0.68**	0.68**	0.62***	3.12***
Any disease at baseline						
Yes	3.11***	2.58*	3.06***	3.06***	1.85***	-6.51***
(no)	1.00	1.00	1.00	1.00	1.00	-

^aEach level of each dimension of EQ-5D was dichotomized into no problems (i.e. level 1 as Y=0) and problems (i.e. levels 2 and 3 as Y=1) and each was analyzed using the binary logistic generalized estimation equation. ^b VAS had an intercept.

*P<0.05, **P<0.01, ***P<0.001

Supplementary

Table 1 New classification of smoking groups

		Number of days of abstinence from smoking during the first 6-month period		
		Did not quit at all (< 1 day)	Quit 1-179 days	Quit completely (\geq 180 days)
Number of days of abstinence from smoking during the second 6-month period	Did not quit at all (< 1 day)	Continuing smokers(C) n=2271	X1 n=164	Relapsed Quitters(R) n=26
	Quit 1-179 days	X2 n=269	X3 n=120	X4 n=19
	Quit completely (\geq 180 days)	Short-term quitters(S) n=96	X5 n=287	Long-term Quitter(L) n=262

Table 2 New classification of generalized estimation equation results for EQ-5D among the four groups

Variable (reference group)	EQ-5D ^a					EQ VAS ^b B
	Mobility	Self-care	Usual activities	Pain/ discomfort	Anxiety/ depression	
	OR	OR	OR	OR	OR	
Intercept						61.93***
Smoking status						
(Smokers)	1.00	1.00	1.00	1.00	1.00	-
Relapsed smokers	0.76	3.42	0.99	0.99	0.87	3.49
Short-term quitters	1.09	1.04	0.53**	0.53**	0.62**	3.86**
Long-term quitters	1.02	2.69*	0.79	0.79	0.60***	7.78***
Time						
After one year	1.12	1.10	1.14*	1.14*	1.00	0.41
(Six months)	1.00	1.00	1.00	1.00	1.00	-
Gender						
Male	1.16	0.91	0.70**	0.70**	0.81*	2.45**
(female)	1.00	1.00	1.00	1.00	1.00	-
Age						
(<30)	1.00	1.00	1.00	1.00	1.00	-
30-44	1.31	0.59	1.52**	1.52**	1.17	1.44
45-59	2.01	0.47	1.57**	1.57**	1.13	2.03*
≥60	2.31	0.32	1.67**	1.67**	0.78	4.44***
Education						
(under junior)	1.00	1.00	1.00	1.00	1.00	-
High school	0.77	0.49	0.84	0.84	1.08	2.87***
University/college above	0.58*	0.77	0.69***	0.69***	0.99	3.50***
Marital status						
(married)	1.00	1.00	1.00	1.00	1.00	-
Single	1.36	0.13	1.09	1.09	0.98	-0.59
Separated/widowed	1.74**	3.00**	1.55***	1.55***	1.31*	-0.98
Currently employed						
Yes	0.65*	0.62	0.92	0.92	1.03	1.91*
(no)	1.00	1.00	1.00	1.00	1.00	-
Monthly income						
(low)	1.00	1.00	1.00	1.00	1.00	-

Medium	0.48***	0.39	0.79*	0.79*	0.64***	1.52
High	0.23***	0.34	0.68**	0.68**	0.62***	3.12***
Any disease at baseline						
Yes	3.11***	2.58*	3.06***	3.06***	1.85***	-6.51***
(no)	1.00	1.00	1.00	1.00	1.00	-

^aEach level of each dimension of the EQ-5D was dichotomized into no problems (i.e. level 1 as Y=0) and problems (i.e. levels 2 and 3 as Y=1) and each was analyzed using the binary logistic generalized estimation equation. ^b VAS had an intercept.

*P<0.05, **P<0.01, ***P<0.001

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Title page

Research Articles

The relationship between smoking status and health-related quality of life among smokers who participated in a one-year smoking cessation program in Taiwan: A cohort study using the EQ-5D

Pei-Ching Chen¹², Raymond Nien-Chen Kuo³, Chih-Kuan Lai⁴, Shih-Tzu Tsai⁵⁶,
Yue-Chune Lee^{1*}

¹Institute of Health and Welfare Policy, College of Medicine, National Yang-Ming University, Taipei, Taiwan.

No.155, Sec. 2, Linong St., Beitou Dist., Taipei City 112, Taiwan (R.O.C.)

²Department of Health and Welfare, University of Taipei, Taipei, Taiwan.

No.101, Sec. 2, Zhongcheng Rd., Shilin Dist., Taipei City 111, Taiwan (R.O.C.)

³Institute of Health Policy and Management, College of Public Health, National Taiwan University, Taipei, Taiwan, R.O.C.

No.17, Xuzhou Road, Taipei City 100, Taiwan (R.O.C.)

⁴Department of Family Medicine, Taipei Veterans General Hospital, Taipei, Taiwan.

No.201, Sec. 2, Shipai Rd., Beitou Dist., Taipei City 112, Taiwan (R.O.C.)

⁵Center for Preventive Services, Hualien Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation, Taiwan

No. 707, Sec. 3, Jhongyang Rd., Hualien 970, Taiwan (R. O. C.)

⁶College of Medicine, Tzu Chi University, Hualien, Taiwan.

No.701, Sec. 3, Jhongyang Rd., Hualien City, Hualien 970, Taiwan (R. O. C.)

*Corresponding author

E-mail: PCC: peiching@ntu.edu.tw

RNCK: nckuo@ntu.edu.tw

CKL: chihkuan.lai@gmail.com

STT: stt.tsai@msa.hinet.net

YCL: ycllee@ym.edu.tw

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Abstract

Objective: To assess the relationship between smoking status and health-related quality of life one year after participation in a smoking cessation program in Taiwan.

Design: A cohort study of smokers who voluntarily participated in a smoking cessation program with two follow-up assessments of smoking status via telephone interview, conducted six months and one year after finishing the smoking cessation program.

Setting: Hospitals and clinics providing smoking cessation services.

Participants: A total of 3,514 participants completed both telephone interviews, which represents a response rate of 64%. After the interviews, participants were divided into four groups according to their smoking status: (1) long-term quitters: participants who had quit tobacco use for one year, (2) short-term quitters: participants who had been smoking for at least six months and then quit tobacco for six months after participating in the program, (3) relapsed smokers: participants who relapsed into tobacco use after ceasing tobacco use for six months, (4) continuing smokers: participants who failed to quit smoking for at least one year, despite participating in the program.

Interventions: The Outpatient Smoking Cessation Service of Taiwan provides counseling and pharmacotherapy to individuals seeking to quit smoking.

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4 **Primary outcomes:** The health-related quality of life of the participants was
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6 measured using an approved Chinese version of the EQ-5D-3L descriptive system.
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10 **Results:** After controlling for sex, age, education, marital status, job status, monthly
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12 income, and disease status at baseline, our results revealed that long-term (OR=0.61,
13 [0.48-0.77]) and short-term (OR=0.65 [0.54-0.79]) quitters experienced less anxiety
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15 and depression than did continuing smokers.
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21 **Conclusions:** Our study provides evidence to support claims that all quitters,
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23 regardless of whether they stop smoking for six months or one year, have better
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25 quality of life with regard to anxiety or depression.
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30 31 32 **Key Words:**

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34 EQ-5D, Smoking Cessation, tobacco, health-related quality of life
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38 **Word count for the abstract:** 284
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41 42 43 **Strengths and limitations of this study**

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45 Unlike previous studies that used health-related quality of life (HRQOL) to study
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47 quitters and smokers, this study assessed differences among quitters, relapsed smokers,
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49 and continuing smokers with regard to health-related quality of care using the EQ-5D.
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4 This was a longitudinal study based on two telephone surveys conducted six months
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7 and one year after the completion of an outpatient smoking cessation program. The
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10 generalized estimation equation method was used for repeated measures.
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15 The fact that smokers in this study volunteered to quit smoking means that
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18 self-selection bias was inevitable. In addition, smoking status was self-reported, such
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21 that the validity of the responses cannot be guaranteed.
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27 This study did not collect EQ-5D data at baseline (prior to quitting smoking), which
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30 made it impossible to control for differences between groups.
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36 The response rate of this study was 64%, as this was the percentage of participants
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39 who were able to complete both follow-up surveys. Effects from the loss of
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42 participants are unknown.
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Main text

Introduction

The adverse effects of smoking and the beneficial effects of smoking cessation have been well established [1 2]. The harmful effects of smoking on health are well known; however, the influence of smoking cessation on health-related quality of life (HRQOL) over time has yet to be fully elucidated. HRQOL is broadly defined through the examination of several components of day-to-day functioning and well-being, such as physical functioning; functioning in daily activities, such as work and social activities; and psychological distress and well-being [3]. A number of cross-sectional studies have focused on the differences in HRQOL among smokers, nonsmokers, and former smokers [4-7]. These studies have shown that smokers tend to have poorer physical and mental health, compared to nonsmokers and former smokers, particularly with regard to depressive symptoms.

Previous longitudinal studies have focused on the relationship between smoking cessation and changes in HRQOL [8-14]. However, two of these studies were limited with regard to follow-up duration (< 6 months) [11 14], while others targeted specific groups such as females [12] or university graduates [13], and still others included small samples [10 11 14]. Hays et al. [9] compared various forms of pharmacotherapy used to assist in the cessation of smoking and the influence of these

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4 pharmacotherapies on HRQOL. Only two studies have compared the changes in
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7 HRQOL that occur among smokers and quitters [8 12]. Piper et al. [8] used data
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10 obtained from smokers enrolled in a long-term smoking cessation trial and tracked
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13 changes in HRQOL over a period of three years. They found that compared with
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16 smokers, quitters had improved global QOL and HRQOL at the end of the first and
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19 third years. Sarna et al.[12] evaluated the impact of quitting smoking on changes in
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22 HRQOL over an eight-year period among women in two cohorts. Continuing smokers
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25 and those who had quit smoking both presented a significant decline in SF-36
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28 physical component scores over time and significant improvements in SF-36 mental
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31 component scores at eight years.

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33 Various hypotheses have been proposed to explain the relationship between
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36 smoking and mental health: 1) smoking and poor mental health may share common
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39 causes (genetic factors or environmental mechanisms); 2) among individuals with
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42 poor mental health, smoking may be a coping strategy used to regulate psychiatric
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45 symptoms; and 3) smoking worsens mental health [15]. Taylor et al. [16] reviewed 26
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48 longitudinal studies and found that smoking cessation is associated with reduced
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51 depression, anxiety, and stress as well as improved mood and quality of life,
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54 compared with individuals who continue smoking. However, little is known about the
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57 changes in HRQOL that occur in relapsed smokers, compared with quitters and
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4 smokers.

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7 The Outpatient Smoking Cessation Service (OSCS) of Taiwan was launched in
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10 2002 to provide counseling and pharmacotherapy for individuals attempting to quit
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12 smoking. Doctors received an additional stipend for the delivery of cessation
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14 counseling and medications were subsidized for participants. Smokers who
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16 participated in the program received treatment over an eight-week period. Beginning
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18 in 2005, the government increased reimbursements and medication subsidies in order
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20 to promote participation; however, due to a budget shortage, funding was reduced in
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22 April 2006. Previous studies have explored the effects of the OSCS program with
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24 regard to provider participation and patient utilization [17], the number of patients
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26 receiving counseling after the cutback in reimbursements [18], abstinence rates [19],
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28 and cost-benefit analysis [20]. However, few researchers have compared the HRQOL
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30 among smokers, relapsed smokers, and quitters over a given duration. The aim of this
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32 study was to use EQ-5D as a means to assess differences in HRQOL among quitters,
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34 relapsed smokers, and non-quitters who had participated in the OSCS in Taiwan.
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50 **Materials and Methods**

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53 This cohort study had a study population of smokers who participated in the
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55 OSCS program between January and September 2007. Data related to individual cases
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4 was provided by hospitals or clinics in monthly reports to the Smoking Cessation
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7 Therapy Management Center of Health Promotion Administration. A total of 115,945
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10 participants were enrolled in the OSCS between January and September 2007,
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12
13 approximately 14% of whom (2000 cases per month) were selected using systematic
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15
16 sampling for follow-up observation of their smoking status via telephone interviews.
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19 The OSCS program was continuously open for enrollment, with new recruits joining
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21
22 each month throughout the study period. As a result, the telephone surveys were
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24
25 conducted on an on-going basis. A total 16,274 individuals participated in the OSCS
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27
28 program. Excluding ineligible cases left 12,116 cases to be contacted. Among these
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30
31 cases, 5965 could not be contacted and 650 refused to be interviewed. A total of 5,501
32
33
34 participants successfully completed the first interview. For more detailed information,
35
36
37 refer to the previous study [20].

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40 The initial telephone survey of 5,501 participants was conducted six months after
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42
43 the subjects participated in the OSCS program (between July 2007 and Mar. 2008). A
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45
46 second telephone survey of 3,514 participants from the first survey group was
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49 conducted six months after the first interview (between Jan. 2008 and Sep. 2008).
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52 This represents a response rate of 64%. Researchers attempted to contact each of the
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55 subjects three times by telephone for follow-up. From the 5,501 cases in the initial
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58 survey, 281 were deemed lost due to having an invalid phone number or had moved
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4 away; 1,544 cases were not at home, did not answer the phone, or the line was busy;
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6
7 and 162 cases refused to participate in the interview. A total of 3,514 participants
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10 completed both interviews. The first interview was used to collect information related
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12 to demographic characteristics, current smoking status, and current EQ-5D. A second
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14 interview six months later was used to collect information related to smoking status
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16 and current EQ-5D (one year post-program).
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21 The smoking status of participants was self-reported and determined by having
22
23 the subjects answer the following question in both of the follow up interviews: “In the
24
25 last six months, how many days have you abstained from cigarette use? (1) Less than
26
27 1 day, (2) 1 to 6 days (less than one week), (3) 7 to 29 days (one week to less than a
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29 month), (4) 30 to 179 days (one month to less than six months), (5) 180 days (six
30
31 months or more).” Respondents who reported having quit for 180 days were
32
33 considered quitters, while the others were considered smokers. According to answers
34
35 from the two phone interviews, we have four conditions: (1) cases in which both
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37 answers indicated 180 days of abstinence were classified as long-term quitters; (2)
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39 cases where both answers indicated smoking for 180 days were classified as
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41 continuing smokers (3) cases where the first answer was abstinence for 180 with a
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43 second answer of smoking were classified as relapsed smokers; (4) cases where the
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45 first answer indicated continued smoking for 180 days with a second answer of
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4 having quit were classified as short-term smokers. Thus, participants were divided
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6
7 into four groups according to their smoking status: (1) long-term quitters: participants
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10 who had quit tobacco use for one year, (2) short-term quitters: participants who had
11
12 been smoking for six months and then quit tobacco for six months after participating
13
14 in the program, (3) relapsed smokers: participants who had relapsed into tobacco use
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16 after six months cessation, (4) continuing smokers: participants who failed to quit
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18 smoking for at least one year, despite participating in the program.
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24 This study used a standardized instrument “EQ-5D” for the measurement of
25
26 generic HRQOL, in order to obtain a simple descriptive profile based on five
27
28 dimensions applicable to a wide range of health conditions and treatments [21]. The
29
30 EQ-5D has been widely used in numerous countries in a variety of research fields [22].
31
32 The EQ-5D comprises 5 dimensions: mobility, self-care, usual activities,
33
34 pain/discomfort, and anxiety/depression as well as a visual analogue scale (VAS) for
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36 health status. The EQ VAS records the respondent’s self-rated health on a vertical,
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38 visual analogue scale where the endpoints are labelled ‘100’ (best imaginable health
39
40 state) and ‘0’ (worst imaginable health state). We used an approved Chinese version
41
42 of the EQ-5D-3L with three levels of severity for each dimension: *no health problems*,
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44 *slight health problems*, and *extreme health problems*. If no problems were reported for
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46 a given dimension, it was marked as level 1, whereas extreme difficulty was marked
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4 as level 3. Because the EQ-5D is simple and short, it is ideal for telephone surveys.
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7 The background characteristics of participants included sex, age, education,
8
9 marital status, job status, monthly income, and disease status at the first follow-up
10
11 interview. The education of patients was categorized into three levels: junior high
12
13 school or lower, senior high school, and university/college or above. Marital status
14
15 was classified as married, single, and other (divorced, separated, or widowed).
16
17 Monthly income was separated into three levels: low (< NTD 20 000 / month),
18
19 medium (NTD 20 001 – 49 999 / month), and high (\geq NTD 50 000 / month). Disease
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21 status was determined by asking people about the diseases they have, such as cancers,
22
23 cardiovascular diseases, heart cerebrovascular disease, asthma, diabetes, chronic
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25 obstructive pulmonary disease, gastritis, nephritis, and hepatitis. It should be noted
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27 that disease status did not include consideration of mental health condition.
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42 **Missing data imputation**

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44 A number of the covariates in the study were missing or unknown. In order to
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46 increase the number of samples, this study applied multiple regression imputation to
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48 fill in missing values related to monthly income, marital status, and job status, which
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50 were missing in 1.6%, 0.65%, and 0.51% of the cases, respectively. Imputation of
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52 monthly income was based on sex, education, and job variables. Imputation of marital
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4 status was based on sex, age, and education variables. Imputation of job status was
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7 based on sex, age, and education variables.
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9 10 **Sensitivity Analysis**

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12 Considering the fact that “continuing smokers” included smokers who quit for
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14 less than 1 day as well as those who quit for 1-179 days, this group cannot be
15
16 considered homogenous. We therefore conducted sensitivity sub-analysis to
17
18 differentiate between smokers who quit for less than 1 day and those who quit for
19
20 1-179 days in order to provide a stricter re-classification of the smoking group. Thus,
21
22 the newly defined groups were as follows: (1) cases where both answers indicated 180
23
24 days of abstinence were classified as long-term quitters (n=262); (2) cases where both
25
26 answers indicated abstinence for less than 1 day were classified as continuing smokers
27
28 (n=2271); (3) relapsed smokers: cases where the first answer was abstinence for 180
29
30 days and the second was abstinence for less than 1 day (n=26); (4) short-term smokers:
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32 cases where the first answer was abstinence for less than 1 day and the second answer
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34 indicated abstinence for 180 days (n=96). The new classification system (as shown in
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36 Table 1) resulted in a loss of 859 subjects, which represents 24% of the cases in this
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38 study.
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53 **Analysis**

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56 The Chi-square test and multinomial logistic regression were used to compare
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4 the proportions of demographic characteristics among the four groups. We
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6 dichotomized the EQ-5D levels into *no problems* (i.e. level 1 as Y=0) and *problems*
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8 (i.e. levels 2 and 3 as Y=1) due to the small number of responses citing level 3. Based
9
10 on the distribution of the dependent variables, logistic regression was used for binary
11
12 outcome variables and normal regression was used for VAS with the Generalized
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14 Estimation Equation (GEE) method used for repeated measures. All statistical
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16 analysis was performed using SAS version 9.2 (SAS Institute, Cary, North Carolina)
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18 with a *p* value <0.05 considered significant.
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30 **Results**

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33 Following six months of participation in OSCS, a telephone survey of 5,501
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35 participants was conducted as a follow up to the program. Six months later, 3,514
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37 participants completed a second telephone interview, which represents a response rate
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39 of 64%. Significant differences ($p < 0.05$) in age, marital status, and monthly income
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41 were observed among the smokers who completed both interviews and those who did
42
43 not participate in the second follow-up. Smokers who did not participate in the
44
45 follow-up were slightly younger (age < 30: 19.07% vs. 13.52%), a greater number were
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47 single (24.97% vs. 20.51%), and a greater number earned a medium monthly income
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49 (38.31% vs. 34.73%), compared to those who completed both interviews.
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4 A total of 307 participants reported 180 days of abstinence in the first interview,
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6 which represents a 6-month quit rate of 5.58%. Among those quitters, 262 cases
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8 reported 180 days of abstinence in the second interview, such that the 12-month quit
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10 rate was 4.76%. With regard to smoking status: 262 participants were identified as
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12 long-term quitters, 383 as short-term quitters, 45 as relapsed smokers, and 2824 as
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14 continuing smokers.
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21 As is shown in Table 2, the four groups differed with regard to gender, age,
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23 marital status, job status and monthly income. However, a majority of the participants
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25 were male, 30 to 44 years old, had a high school education or above, were married,
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27 were currently employed, earned an above average monthly income, and were free
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29 from disease.
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36 Multinomial logistic regression was used to test for differences among the four
37
38 groups with regard to sex, age, marital status, employment status, and income status,
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40 using continuing smokers as a reference group. Compared with continuing smokers,
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42 males were significant less likely to be the short-term quitters (OR=0.66,
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44 95%CI=0.50-0.87). Individuals above the age of 60 were significantly more likely to
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46 be short-term quitters or long-term quitters (Short-term quitters OR=1.75,
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48 95%CI=1.21-2.51; Long-term quitters OR=2.42, 95%CI=1.48-3.96). Married
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50 individuals were significantly more likely to be short-term quitters or long-term
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4 quitters (Short-term quitters OR=1.44, 95%CI=1.08-1.92; Long-term quitters
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7 OR=2.26, 95%CI=1.53-3.35). Individuals with a job were significantly less likely to
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10 be relapsed smokers, short-term quitters, or long-term quitters (Relapsed smokers
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12 OR=0.52, 95%CI=0.28-0.94; Short-term quitters OR=0.56, 95%CI=0.45-0.71;
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14 Long-term quitters OR=0.61, 95%CI=0.47-0.80). Individuals with a medium monthly
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16 income were significantly less likely to be relapsed smokers (Relapsed smokers
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18 OR=0.42, 95%CI=0.20-0.87), however, individuals with high monthly income were
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20 significantly less likely to be short-term quitters (Short-term quitters OR=0.69,
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22 95%CI=0.53-0.90).
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30 Table 3 presents the EQ-5D among the four groups after participating in OCS
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32 for six months and one year. Level 1 refers to situations involving *no problems*, Level
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34 2 refers to *slight problems*, and Level 3 refers to *extreme problems*. Very few of the
35
36 four groups reported extreme health problems related to mobility, self-care, usual
37
38 activities, or pain and anxiety after participating in OCS for six months and one year.
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40 However, approximately 30% of the participants reported slight health problems
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42 related to pain and anxiety. Finally, the mean VAS among the four groups was
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44 approximately 70.
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53 Table 4 presents the GEE results for EQ-5D among the four groups. After
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55 controlling for confounders, short-term quitters appeared to have fewer problems with
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4 regard to usual activities and pain/discomfort, compared with continuing smokers. In
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7 addition, long-term quitters and short-term quitters reported fewer problems related to
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10 anxiety/depression. Moreover, long-term quitters, short-term quitters, and relapsed
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12 smokers had VAS scores higher than those of continuing smokers.
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15 Among the smoking status groups, no significant differences were observed with
16
17 regard to mobility or self-care. Relapsed smokers reported fewer problems related to
18
19 mobility, pain/discomfort, and anxiety/depression; however, those results were not
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21 significant.
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27 Male participants reported less pain/discomfort and anxiety/depression than their
28
29 female counterparts (OR: 0.78, 0.83 respectively). Older individuals reported a greater
30
31 number of problems related to mobility, usual activities, and pain/discomfort (OR:
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33 2.16-2.98, 3.80-4.50, 1.44-1.63 respectively). Individuals with a higher education
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35 reported fewer problems related to mobility, usual activities, and pain/discomfort (OR:
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37 0.55, 0.61-0.70, 0.72-0.81 respectively). Separated/widowed individuals reported a
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39 greater number of problems related to mobility, self-care, usual activities,
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41 pain/discomfort, and anxiety/depression (OR: 1.50, 2.11, 1.45, 1.40, 1.28
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43 respectively). Employed individuals reported fewer problems related to mobility and
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45 usual activities (OR: 0.60, 0.57 respectively). Individuals with medium or high
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47 monthly incomes reported fewer problems related to mobility (OR: 0.50, 0.27
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4 respectively), usual activities (OR: 0.39, 0.23 respectively), pain/discomfort (OR:
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7 0.73, 0.65 respectively), and anxiety/depression (OR: 0.66, 0.60 respectively).
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10 Individuals who noted a disease at baseline reported a greater number of problems
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12 related to mobility, self-care, usual activities, pain/discomfort, and anxiety/depression
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14 (OR: 3.19, 3.23, 3.63, 3.01, 1.81 respectively).
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18 Males reported higher VAS scores than did their female counterparts (B: 2.04,
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20 $p<0.001$) and individuals older than 60 years reported higher VAS scores compared to
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22 those below 30 years of age (B: 2.40, $p<0.05$). Individuals with a higher education
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24 reported higher VAS scores (B: 2.11-3.65, $p<0.001$). Single individuals reported lower
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26 VAS scores than did married people (B: -1.42, $p<0.05$). Employed individuals
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28 reported higher VAS scores than did the unemployed (B: 1.91, $p<0.01$). Individuals
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30 with a higher monthly income reported higher VAS scores (B: 1.87-3.39, $p<0.01$).
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33 Individuals with disease reported lower VAS scores than did those who were free
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35 from disease (B: -6.27, $p<0.001$).
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43 44 *Sensitivity Analysis Results*

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47 The new classification of generalized estimation equation results for EQ-5D
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49 among the four groups was shown in Table 5. After controlling for confounders,
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51 short-term quitters appeared to have fewer problems with regard to usual activities
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53 and pain/discomfort, compared with continuing smokers. After controlling for
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4 confounders, long-term quitters and short-term quitters reported fewer problems
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6 related to anxiety/depression. After controlling for confounders, long-term quitters
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8 and short-term quitters had VAS scores higher than those of continuing smokers. We
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10 found the results were similar to our original results in Table 4.
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15 16 17 18 **Discussion** 19

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21 This study provides evidence that quitting smoking can benefit one's subjective
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23 assessment of anxiety or depression. In this study, this effect is particularly evident
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25 among individuals who quit for extended periods (>12 months) as well as those who
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27 quit for short durations (6 months), following participation in OCS for one year. Our
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29 results revealed that quitting smoking, whether for a short or long period of time, had
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31 a significant effect on reducing anxiety or depression.
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39 This is the first study to use EQ-5D to explore the relationship between smoking
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41 status and changes in HRQOL. We found both long-term and short-term quitters had
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43 fewer problems related to anxiety or depression. Our findings are similar to those
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45 obtained in previous longitudinal studies; however, we used different instruments,
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47 therefore, we cannot make a direct comparison with their results. In a review of
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49 previous studies, Taylor et al. [16] discovered that smoking cessation is associated
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51 with reduced depression, anxiety, and stress and improved mood and quality of life,
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4 compared with individuals who continue smoking. Using the short-term Form-36
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6 (SF-36), Guiterrez-Bedmar et al. [13] found that continuing smokers had worse scores
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8 than did non-smokers with regard to general health and mental health, whereas recent
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10 quitters showed improvements in mental health over those who continued smoking
11
12 and those who took up smoking. Using the SF-36, Sarna et al. [12] found that
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14 continuing smokers as well as quitters showed significant improvements in mental
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16 component scores at eight years. Sales et al. [10] also used the SF-36 and found that
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18 summary scores of mental and physical components were higher among quitters than
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20 among non-quitters after ceasing smoking for twelve months.
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30 Our results show that those who quit smoking for six months were less likely
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32 than smokers to have problems related to usual activities, pain or discomfort, or
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34 anxiety or depression. These results are similar to those obtained in previous
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36 cross-sectional studies [4-6]. Mody and Smith [4] found that current smokers were
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38 more likely to report poor mental health status and limitations in their usual activities,
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40 compared with nonsmokers and ex-smokers. McClave et al. [5] found that former
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42 smokers and never smokers were less likely to report depressive symptoms than were
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44 non-quitters. Mulder et al. [6] obtained lower summary scores for the mental
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46 component among current smokers compared to never smokers and ex-smokers.
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56 In this study, long-term quitters, short-term quitters, and relapsed smokers
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4 presented EQ VAS scores higher than those of continuing smokers. These findings are
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7 similar to those in previous studies using different HRQOL instruments, such as the
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10 SF-36, which includes eight dimensions. The discussion related to general health in
11
12 the SF-36 is similar to our study; therefore, we opted to limit the comparison to this.
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14
15 Guterrez-Bedmar et al. [13] reported that continuing smokers had worse scores than
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17 recent quitters with regard to general health. Sarna et al. [12] found that continuing
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19 smokers as well as quitters present a significant decline in general health scores,
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21 whereas continuing smokers presented a decline in a wider range of scores than did
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23 quitters at eight years. Sales et al. [10] found that the general health component scores
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25 were higher among quitters than among non-quitters after ceasing smoking for twelve
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27 months.
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36 In contrast, our results show that smoking cessation had no significant effect on
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38 EQ-5D with regard to mobility or self-care. Our results differ from those obtained in
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40 previous studies [10 12], wherein quitters had higher SF-36 scores for the physical
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42 component than did smokers. These findings can be explained by differences in the
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44 smoking cessation programs and the background characteristics of participants. The
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46 subjects in this study participated in a free smoking cessation service in which
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48 counseling and pharmacotherapy were provided. In the study by Sarna et al. [12],
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50 participants were registered nurses and were undecided as to whether they had been
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4 affected by smoking cessation programs over an eight year period. In the study by
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7 Sales et al. [10], the cohort included only sixty patients who were self-referred to a
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10 smoking cessation program at a public hospital.

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13 In this study, the 6-month quit rate was 5.58% and the 12-month quit rate was
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15 4.76%. Naranjo et al [23] respectively reported smoking cessation rates of 14.4% and
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17 15.7% at 6 months and 12 months among patients with arthritis in a rheumatology
18
19 clinic. Our results could not be compared directly with previous studies due to
20
21 fundamental differences in the design of the smoking cessation program and study
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23 population. Chang et al. [17] reported on smoking cessation outpatient services with
24
25 quit rates of 25.2% and 21.3% in a six-month follow-up in 2004 and 2005 in Taiwan.
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27 These differences could be explained by the fact that the quit rate was not strictly
28
29 defined; i.e., quitting for either 7-days or six-month were both included in the
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31 quit-rate.
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41 VAS scores represent a subjective self-evaluation of one's health and individuals
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43 over the age of 60 reported higher VAS scores than did those below the age of 30.
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47 Whynes [24] examined the correspondence between EQ-VAS scores and EQ-5D
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49 health states, and found that VAS scores are influenced by EQ-5D health state
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51 classification, the subject's perceived locus of control, and by his/her age, educational
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53 attainment, ethnic origin, and smoking behavior. Whynes [25] also examined how the
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4 relationship between health state classification and VAS score varied with medical
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7 condition. They found that a given change between two EQ-5D-defined health states
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10 could produce different changes in VAS scores for different medical conditions and
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12 interventions. The difference between EQ-VAS scores and EQ-5D health status may
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14 be due to other factors, such as disease status or socio-demographic factors.
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18 This study faced a number of limitations. First, smoking status was self-reported;
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20 therefore, validity cannot be guaranteed. Second, we were unable to collect EQ-5D
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22 data at baseline (before quitting smoking), which made it impossible to control for
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24 differences between groups; however, we attempted to control for confounders and
25
26 obtained two measurements, at six months and one year after participation in OSCS.
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28 Third, due to a lack of funding, we were able to follow participants for only one year,
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30 which may be too short-term to observe differences in the quality of life among
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32 smokers, quitters, and relapsed smokers. In the future, researchers should conduct a
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34 long-term cohort study to obtain information related to the quality of life among
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36 smokers, quitters, and relapsed smokers. Fourth, the smokers in this study volunteered
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38 to quit smoking; therefore, self-selection bias was inevitable. Finally, only 64% of the
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40 5,501 participants successfully completed both follow-up surveys, and the effect from
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42 a loss of participants is unknown.
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56 Our findings provide evidence to support the claims that all quitters, regardless
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4 of whether they stop smoking for six months or one year, have better quality of life
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7 with regard to mental health. These findings are important for governmental
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10 organizations such as the Health Promotion Administration. These findings provide
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12 additional evidence to encourage smokers to quit smoking. Future researchers could
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14 extend the follow-up to better understand the long-term effects of smoking cessation
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16 on quality of life.
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20 21 22 23 24 **Acknowledgments**

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Footnotes

Contributors

PCC contributed to the study design, statistical analysis, interpretation, and writing of the manuscript. RK contributed to the interpretation and writing of the manuscript. YCL contributed through coordination of the study, interpretation and writing of the manuscript, and acting as corresponding author. STT and CKL contributed to data acquisition and interpretation as well as the writing of the manuscript. All authors have read and approved the content of the manuscript.

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Table 1 New classification of smoking groups for sensitivity analysis

		Number of days of abstinence from smoking during the first 6-month period		
		Did not quit at all (< 1 day)	Quit 1-179 days	Quit completely (≥ 180 days)
Number of days of abstinence from smoking during the second 6-month period	Did not quit at all (< 1 day)	Continuing smokers(C) n=2271	X1 n=164	Relapsed Quitters(R) n=26
	Quit 1-179 days	X2 n=269	X3 n=120	X4 n=19
	Quit completely (≥ 180 days)	Short-term quitters(S) n=96	X5 n=287	Long-term Quitter(L) n=262

Table 2 Demographic characteristics (N=3514)

Demographics	Long-term Quitters N=262	Short-term Quitters N=383	Relapsed Smokers N=45	Smokers N=2824	
Sex	%	%	%	%	*
Male	87.79	79.90	84.44	85.73	
Female	12.21	20.10	15.56	14.27	
Age					‡
<30	8.78	13.05	8.89	14.09	
30-44	37.79	31.07	17.78	38.49	
45-59	28.63	29.24	44.44	30.95	
≥60	24.81	26.63	28.89	16.47	
Education					
below junior school	34.10	34.46	40.00	34.64	
high school	35.63	33.94	31.11	37.41	
university/college above	30.27	31.59	28.89	27.95	
Marital status					‡
single	11.45	16.45	15.56	21.82	
married	81.68	74.67	73.33	68.79	
separated, widowed	6.87	8.88	11.11	9.39	
Employed					‡
Yes	63.98	62.14	60.00	74.42	
No	36.02	37.86	40.00	25.58	
Monthly income(NT\$)					†
Low (≤20,000)	29.01	34.73	46.67	28.61	
Medium (20,001-49,999)	31.68	35.77	24.44	35.98	
High (≥50,000)	39.31	29.50	28.89	35.41	
Any disease at baseline					
Yes	31.30	36.81	40.00	33.55	
no	68.70	63.19	60.00	66.45	

Using Chi-square test for four groups, *P<0.05, †P<0.01, ‡P<0.001

Table 3 Comparison of EQ-5D among the four groups after participating in OSCS_for six months and one year

	Long-term quitters		Short-term quitters		Relapsed smokers		Smokers	
	Six months	One year	Six months	One year	Six months	One year	Six months	One year
Mobility (%)								
level 1	96.18	94.27	95.29	94.78	93.33	95.56	95.57	95.01
level 2	3.82	5.73	4.45	5.22	6.67	4.44	4.36	4.85
level 3	0.00	0.00	0.26	0.00	0.00	0.00	0.07	0.14
Self-Care (%)								
level 1	98.09	98.47	98.96	98.96	97.78	97.78	99.19	99.15
level 2	1.53	1.15	0.52	1.04	2.22	2.22	0.71	0.74
level 3	0.38	0.38	0.52	0.00	0.00	0.00	0.11	0.11
Usual Activities (%)								
level 1	94.66	94.64	95.04	96.34	88.89	91.11	94.58	95.04
level 2	3.82	4.60	4.70	3.14	11.11	8.89	4.89	4.25
level 3	1.53	0.77	0.26	0.52	0.00	0.00	0.53	0.71
Pain/Discomfort (%)								
level 1	75.95	73.28	79.00	74.41	71.11	73.33	71.33	69.59
level 2	22.52	25.95	19.16	23.76	28.89	24.44	25.94	28.50
level 3	1.53	0.76	1.84	1.83	0.00	2.22	2.73	1.92
Anxiety/Depression (%)								
level 1	76.25	72.41	71.54	72.51	66.67	64.44	63.20	63.52
level 2	22.22	25.29	26.11	26.18	28.89	28.89	32.54	32.65
level 3	1.53	2.30	2.35	1.31	4.44	6.67	4.26	3.83
VAS (mean)	79.20	75.87	76.38	75.85	76.98	71.49	69.37	70.26

Level 1=no problems, level 2=slight problems, level 3= extreme problems

Table 4 Generalized estimation equation results for EQ-5D among the four groups

Variable (reference group)	EQ-5D ^a					EQ
	Mobility	Self-care	Usual activities	Pain/ discomfort	Anxiety/ depression	VAS ^b
	OR	OR	OR	OR	OR	B
Intercept						64.02***
Smoking status						
(Smokers)	1.00	1.00	1.00	1.00	1.00	-
Relapsed smokers	0.78	2.02	1.39	0.72	0.83	5.41**
Short-term quitters	0.83	1.02	0.63*	0.62***	0.65***	6.73***
Long-term quitters	0.92	2.01	0.95	0.79	0.61***	7.16***
Time						
After one year	1.16	1.00	0.89	1.12*	1.00	0.27
(Six months)	1.00	1.00	1.00	1.00	1.00	-
Gender						
Male	1.22	0.84	1.21	0.78**	0.83*	2.04**
(female)	1.00	1.00	1.00	1.00	1.00	-
Age						
(<30)	1.00	1.00	1.00	1.00	1.00	-
30-44	1.58	1.07	4.02***	1.44**	1.23	0.74
45-59	2.16*	0.78	3.80**	1.53**	1.18	1.01
≥60	2.98**	0.98	4.50***	1.63**	0.81	2.40*
Education						
(under junior)	1.00	1.00	1.00	1.00	1.00	-
High school	0.74	0.53	0.70*	0.81*	1.09	2.11***
University/college above	0.50*	0.55	0.61*	0.72***	1.02	3.65***
Marital status						
(married)	1.00	1.00	1.00	1.00	1.00	-
Single	1.40	0.37	1.22	1.04	0.98	-1.42*
Separated/widowed	1.50*	2.11*	1.45*	1.40**	1.28*	-0.67
Currently employed						
Yes	0.60**	0.60	0.57***	0.87	0.96	1.91**
(no)	1.00	1.00	1.00	1.00	1.00	-
Monthly income						
(low)	1.00	1.00	1.00	1.00	1.00	-
Medium	0.50***	0.59	0.39***	0.73***	0.66***	1.87**
High	0.27***	0.56	0.23***	0.65***	0.60***	3.39***

Any disease at baseline

Yes	3.19***	3.23***	3.63***	3.01***	1.81***	-6.27***
(no)	1.00	1.00	1.00	1.00	1.00	-

^aThe level of each dimension of EQ-5D was dichotomized into no problems (i.e. level 1 as Y=0) and problems (i.e. levels 2 and 3 as Y=1) and each was analyzed using the binary logistic generalized estimation equation. ^b VAS had an intercept.

*P<0.05, **P<0.01, ***P<0.001

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Table 5 New classifications of generalized estimation equation results for EQ-5D among the four groups

Variable (reference group)	EQ-5D ^a					EQ
	Mobility	Self-care	Usual activities	Pain/ discomfort	Anxiety/ depression	VAS ^b
	OR	OR	OR	OR	OR	B
Intercept						61.93***
Smoking status						
(Smokers)	1.00	1.00	1.00	1.00	1.00	-
Relapsed smokers	0.76	3.42	0.99	0.99	0.87	3.49
Short-term quitters	1.09	1.04	0.53**	0.53**	0.62**	3.86**
Long-term quitters	1.02	2.69*	0.79	0.79	0.60***	7.78***
Time						
After one year	1.12	1.10	1.14*	1.14*	1.00	0.41
(Six months)	1.00	1.00	1.00	1.00	1.00	-
Gender						
Male	1.16	0.91	0.70**	0.70**	0.81*	2.45**
(female)	1.00	1.00	1.00	1.00	1.00	-
Age						
(<30)	1.00	1.00	1.00	1.00	1.00	-
30-44	1.31	0.59	1.52**	1.52**	1.17	1.44
45-59	2.01	0.47	1.57**	1.57**	1.13	2.03*
≥60	2.31	0.32	1.67**	1.67**	0.78	4.44***
Education						
(under junior)	1.00	1.00	1.00	1.00	1.00	-
High school	0.77	0.49	0.84	0.84	1.08	2.87***
University/college above	0.58*	0.77	0.69***	0.69***	0.99	3.50***
Marital status						
(married)	1.00	1.00	1.00	1.00	1.00	-
Single	1.36	0.13	1.09	1.09	0.98	-0.59
Separated/widowed	1.74**	3.00**	1.55***	1.55***	1.31*	-0.98
Currently employed						
Yes	0.65*	0.62	0.92	0.92	1.03	1.91*
(no)	1.00	1.00	1.00	1.00	1.00	-
Monthly income						
(low)	1.00	1.00	1.00	1.00	1.00	-

Medium	0.48***	0.39	0.79*	0.79*	0.64***	1.52
High	0.23***	0.34	0.68**	0.68**	0.62***	3.12***
Any disease at baseline						
Yes	3.11***	2.58*	3.06***	3.06***	1.85***	-6.51***
(no)	1.00	1.00	1.00	1.00	1.00	-

^aEach level of each dimension of EQ-5D was dichotomized into no problems (i.e. level 1 as Y=0) and problems (i.e. levels 2 and 3 as Y=1) and each was analyzed using the binary logistic generalized estimation equation. ^b VAS had an intercept. *P<0.05, **P<0.01, ***P<0.001

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1-5
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3-5
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	6-8
Objectives	3	State specific objectives, including any prespecified hypotheses	8
Methods			
Study design	4	Present key elements of study design early in the paper	9
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8-11
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	9-10
		(b) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	11-12
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	10-11
Bias	9	Describe any efforts to address potential sources of bias	9
Study size	10	Explain how the study size was arrived at	9-10
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	13-14
		(b) Describe any methods used to examine subgroups and interactions	13
		(c) Explain how missing data were addressed	12-13
		(d) If applicable, explain how loss to follow-up was addressed	
		(e) Describe any sensitivity analyses	13
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	14
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	14-15
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	Report numbers of outcome events or summary measures over time	15

1	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	16-18
2			(b) Report category boundaries when continuous variables were categorized	
3			(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
4	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	18-19
5	Discussion			
6	Key results	18	Summarise key results with reference to study objectives	19
7	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	23
8	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	19-23
9	Generalisability	21	Discuss the generalisability (external validity) of the study results	23-24
10	Other information			
11	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	25

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.