

### INTRODUCTION

- There is a need for research and policy development informed by both the sociodemographic and psychological characteristics of smokers.
- Self-reported daily cigarette amount (DCA) is an important factor used by many studies to assess the level of cigarette dependence. Some studies have used DCA as a predictor for successful smoking cessation or of attempting cessation.
- Previous studies also demonstrate the relationship between depression and failure to quit smoking. However, the impact of smokers’ depression status change (e.g. from depressed status to non-depressed status) on their DCA has not been adequately assesses. Thus, this study sought to examine the effect of smokers’ depression status changes on their DCA.

### MATERIALS AND METHODS

- Data source:** This study used a sample drawn from the Korea Welfare Panel Study (KoWePS) waves 3 (2008) to 13 (2018) for analysis.
- Study population:** The initial 2008 baseline data included 16,613 individuals from 6,314 households. To analyze the effect of smokers’ depression status change, we included currently smoking individuals who are 19 years old and older. After excluding individuals with missing data, the 2008 data included a total of 1,821 individuals: 1,645 males and 176 females.
- Outcome variables:** Daily cigarette smoking amounts, referring to the number of the cigarettes smoked per day at the time of the survey.
- Interesting variables:** The main independent variable is change in depression status, which was measured by the 11-item version of the Center for Epidemiologic Studies Depression Scale (CESD-11). It is a self-reported screening tool which is well validated. The total score of the CESD-11 was calculated by adding the scores for all 11 questions and multiplying these values by 20/11. Scores of 16 and higher were considered evidence of likely depressed status. A change in depression status over one year was classified into four categories: (1) “No→No”; (2) “No→Yes”; (3) “Yes→No”; (4) “Yes→Yes”.
- Covariates:** Demographic(gender, age, and region), socioeconomic(education level, marital status, and income level) and health-related factors(age at smoking commencement, alcohol consumption, and the absence or presence of chronic disease) were included.
- Statistical analysis:** An ANOVA and the generalized estimating equation (GEE) model were used. Statistical analyses were performed using the GENMOD procedure in SAS version 9.4 and considered statically significant if the p-value was less than 0.05.

# RESULTS

Variables	Daily cigarette smoking amount (DCA)											
	Male					P value	Female					P value
	N	%	MEANS	±	SD		N	%	MEANS	±	SD	
TOTAL	1,645	100	17.74	±	8.30		176	100	11.32	±	6.72	
Change of depression status (2008→2009)												
No→No	1,429	86.9	17.80	±	8.34	0.2428	113	64.2	10.54	±	6.15	0.0764
No→Yes	82	5.0	18.60	±	9.88		26	14.8	11.15	±	6.73	
Yes→No	90	5.5	16.40	±	6.29		19	10.8	13.95	±	8.48	
Yes→Yes	44	2.7	16.82	±	7.30		18	10.2	13.67	±	7.44	

Variables	Daily cigarette smoking amount (DCA)					
	Male			Female		
	β	S.E	P value	β	S.E	P value
Change of depression status						
No→No	Ref.			Ref.		
No→Yes	0.414	0.338	0.2202	-0.134	0.458	0.7702
Yes→No	-0.631	0.281	0.0248	-0.065	0.523	0.9006
Yes→Yes	-0.005	0.578	0.9933	-0.769	0.727	0.2904

Change of depression status	Daily cigarette smoking amount (DCA)					
	Male			Female		
	β	S.E	P value	β	S.E	P value
Among smokers with ≥ 10 daily amount						
No→No	Ref.			Ref.		
No→Yes	0.453	0.363	0.2119	0.005	0.491	0.9914
Yes→No	-0.556	0.300	0.0637	0.031	0.572	0.9570
Yes→Yes	0.768	0.619	0.2144	-0.712	0.681	0.2963
Among smokers with ≥ 15 daily amount						
No→No	Ref.			Ref.		
No→Yes	0.789	0.407	0.0526	-0.133	0.512	0.7953
Yes→No	-0.280	0.295	0.3427	0.869	0.578	0.1327
Yes→Yes	0.295	0.654	0.6520	0.854	0.669	0.2015
Among smokers with ≥ 20 daily amount						
No→No	Ref.			Ref.		
No→Yes	0.997	0.416	0.0164	-0.463	0.455	0.3090
Yes→No	-0.360	0.301	0.2314	0.237	0.591	0.6889
Yes→Yes	0.335	0.667	0.6158	0.876	0.654	0.1805

\* Age at smoking initiation, age, region, marital status, educational level, income level, chronic disease, alcohol consumption, and survey year were adjusted.

### RESULTS

**Table 4. Subgroup analysis of daily smoking amount stratified by covariates.**

Variables	Daily cigarette smoking amount (DCA)								
	No → No			No → Yes			Yes → No		
	β	S.E	P value	β	S.E	P value	β	S.E	P value
Male									
Age at the smoking initiation (years)									
Under than 19	Ref.			0.163	0.395	0.6799	-0.881	0.337	0.0089
19 or older	Ref.			0.166	0.702	0.8132	-0.111	0.519	0.8301
Marriage status									
Living w spouse	Ref.			-0.014	0.450	0.9758	-1.088	0.342	0.0015
Living w/o spouse	Ref.			0.825	0.519	0.1117	-0.250	0.455	0.5835
Female									
Age at the smoking initiation (years)									
Under than 19	Ref.			-0.245	0.508	0.6294	0.196	0.664	0.7677
19 or older	Ref.			0.756	0.810	0.3503	0.131	0.862	0.8795
Marriage status									
Living w spouse	Ref.			-0.637	1.029	0.5357	-0.427	0.734	0.5607
Living w/o spouse	Ref.			-0.098	0.506	0.8473	-0.016	0.609	0.9789

\* Age at the smoking initiation, age, region, marital status, educational level, income level, chronic disease, alcohol consumption, and survey year were adjusted.

### DISCUSSION

- Findings suggest that emerging from a depressed status is related to a decreased DCA among males.
- For males who smoke more than 15 cigarettes per day, depressed status appears to increase DCA.
- Among males who began smoking before age 19, and males living with spouses, Yes→No depression status groups had a lower DCA than the No→No groups.
- Smokers experiencing significant depression are more likely to begin smoking, due to the antidepressant effect of nicotine. In addition, nicotine boosts bioavailability of serotonin, whose mechanism is similar to some antidepressants. Thus, depression contributes to increased DCA.
- Moreover, depression encourages smokers, particularly those who smoke more than 15 cigarettes per a day, to persist in this behaviour despite the health risk. It is, therefore, necessary to help smokers seek alternative, healthier antidepressant resources, or to encourage smokers with depressive symptoms to consult mental problem professionals.
- Of significance in our study is the fact that smokers who began before 19 years of age and changed from depressed to non-depressed status had a much lower DCA than general smokers with the same change pattern. This may provide evidentiary support for the implementation of smoking cessation programs by detecting depression symptoms and encourage to participating in antidepressant programs in parallel with smoking cessation programs for smokers with early initiation age.
- This study demonstrated no statistically significant results among females. This is likely related to the low self-reporting rate among female smokers in Korea. Further study is needed, using data obtained from other smoking detection methods, e.g. urine cotinine examination.
- Limitations :
  - First, since the KoWePS largely represents low income households, study findings are somewhat limited when it comes to generalizing to the national population, and high income households in particular.
  - Second, because of data limitations, the analysis could not include clinical laboratory results (such as those from urinary cotinine level exams) that show the degree of smoking intensity.
  - Third, the use of self-reported responses means that measurement issues such as reporting bias and recall bias may have confounded the findings.
- Strengths :
  - First, we used data from a nationwide survey with randomly sampled longitudinal data and a 10-year follow up. As the KoWePS largely represents low income households, it can be generalized to South Korea’s low-income population.
  - Second, previous studies have examined the association between depression and smoking cessation success. However, this study used a lagged GEE model to determine the ability of depression status change (which may occur through treatment) to lessen daily smoking cigarettes among smokers.

### CONCLUSION

- We found that change from depressed to non-depressed and non-depressed to depressed status is associated with decreasing and increasing DCA, respectively.
- Among those who began smoking before age 19, the subgroup that changed from depressed to non-depressed status had a much lower DCA than general smokers with the same change pattern.
- These findings may support the incorporation of depressive symptom treatment into smoking cessation programs.